Part – II

Chapter- 5

Research Methodology

Based on the literature survey for secondary data on adolescence education and services marketing, research methodology was designed. The objectives of the research were planned to materialize through research instruments like questionnaires for target groups: Adolescents, parents, teachers as well as interviews of doctors, school administrators, and education related authorities. The administration of the questionnaires was the main time consuming process. Data analysis after validation and findings from the same for final recommendations were carried out.

The objectives of this research can be summarized as under:

1. To study the onset of different physical changes with respect to transition from child to adult, among girls and boys.
2. To study the existing sources of information as well as preferred additional sources of information on reproductive healthcare and personality development.
3. To study the awareness about teenage products and reproductive healthcare issues.
4. To study the importance of life skills development among the target groups.

The research was planned accordingly to get the primary data that can be compiled and analyzed for conclusions and recommendations.

5.1 Data Sources

The first primary source of information is adolescents who are going through the changes of adolescence. Their level of awareness about physical changes and its effects on adolescents' emotional and social behavior are important. Their attitude towards reproductive health is a difficult and sensitive topic to ponder with.

The next primary source of information is the parents of these adolescents. Their role in the personality development outside the school environment plays a very vital role. Parents many time become role models for their son/daughter.

The third potential source of primary data is the teachers dealing with these adolescents in the school environment. They groom this generation for future competition. Their contribution in personality development through intellectual development is crucial. Their relationship with the early adolescent boys and girls can play real role in reproductive healthcare.

The fourth source of primary data is the doctors dealing with adolescent issues. The gynecologists, the psychiatrists, the ophthalmologists and others guide on preventive healthcare.

5.2 Data types

Demographics and behavioral aspects of primary data are relevant. Demographics of various data lead to the objectives of the research. The demographics will direct the suitable agewise and genderwise education plan. It will also help in deciding on the various topics to be

included standardwise in the textbooks of school curriculum. The opinions and attitudes of adolescents will direct in searching the marketing channels and communications to reach them. The opinions and attitudes of parents of these adolescents will lead us to see if any communication gap exists as well as ways to meet it. The opinions of teachers will lead us to review the school curriculum to meet the requirements of adolescence education. The opinions of doctors will lead us to prepare the communication action plan for preventive measures for reproductive healthcare issues.

5.3 Data instruments and communication approach

Structured questionnaire method was mainly used for the research. Open-ended as well as closed ended questions were asked for responses. Telephone interview or mail based administering of questionnaires were not used at all. Separate questionnaires were planned for adolescents, parents and teachers.

The focused group research used to arrive at quantitative information about the group in longer period of study (Apte, 2004). Our study considered a cross section of adolescents of different ages at one time. It is speedy and economic compared to longitudinal study (Papalia, 2004). The focused group communication approach was adopted as suggested by school authorities.

The researcher and the guide, to support and allow conducting the research with their adolescent students, addressed an appeal letter to the school authorities. The confidentiality of

data exclusively for this research was confirmed. Another appeal letter to adolescents and their parents was also addressed.

Time series analysis by secondary research can be tried by building the historic data and trends for future research. Currently such data are not available to study the physical changes among boys and girls over a period of four to seven years, from standard IV to Standard XII in Gujarat. The longitudinal approach is especially valuable for research, in which there is an attempt to discover whether characteristics such as intelligence, dependency, and behavior problems are stable over a long period of time or subject to fluctuations. (Mussen, 1969).

5.4 Design of Structured Questionnaires

Close ended dichotomous questions as well as multiple choice questions were used for ease of tabulation and analysis as well as to lower bias (Debashis, 2002). Questions were framed based on knowledge, attitudinal, demographic as well as behavioral aspects. Few open-ended questions were used to probe the respondent's mind as well as to get important key words for presentation. A separate questionnaire was designed for students who were adolescents, their parents and the teachers. 'QS' is used for 'Questionnaire for Students', 'QP' is used for 'Questionnaire for Parents and 'QT' is used for questionnaire for Teachers as abbreviation in the data analysis and findings.

5.4.1 Questionnaire for Students (Q-S)

The following key indicators and information were asked by using appropriate scales wherever applicable:

Demographics details: Name, Surname, Grade, Weight, Height, Birth date, Blood group, Teeth-braces and Eyes-spectacles.

a). Importance of various skills, activities, nature etc., with respect to the personality development on 6 points scale.

b). Extra efforts, for body and mind development being carried out on 4-point scale.

c). Interaction in terms of hour/day with mother.

d). Interaction in terms of hour/day with father.

e). Sources of information about physical changes were asked with multiple choices.

f). Level of awareness about teenage products on 3-points scale.

g). Sharing of personal problems with multiple choices for relationship.

h). Sharing of personal interests with multiple choices for relationship.

i). Hours/day spent on extra curricular activities; category wise, along with the level of competence.

j). Adolescents were asked to write the three factors to increase their height.

k). Occurrence of physical changes standard wise specifically for boys and girls. Also, initial shaving and trimming of under arm as well as pubic hair during specific standard.

l). The awareness level on some topics of reproductive healthcare, function of reproductive organs, physical changes, teenage products etc.

m). Change in behaviors with keen relationships during adolescence.

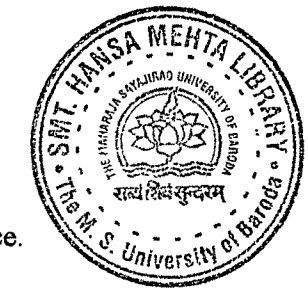
n). Three preferred sources for further information on adolescence issues.

o). Experience of few feelings during adolescence.

p). Importance of good personality on few occasions.

q). Adolescents comfort zone with all these puberty changes.

r). The suitable age range to develop personality skills was asked with multiple choices.



s). Descriptive answer was requested on major change affecting adolescence.

t). Open ended Feedback/suggestion/question about the questionnaire and the subject was asked.

Table 5.4.1 Data type and scales : Student Questionnaire

Question	Data Type	Basic Scaling Type	Scaling Technique
a	Ordinal	Non-comparative	6 Point Scale
b	Ordinal	Non-comparative	4 Point Scale
c	Continuous		
d	Continuous		
e	Nominal		
f	Ordinal	Non-comparative	3 Point Likert Scale
g	Nominal		
h	Nominal		
i	Ordinal	Non-comparative	3 Point Likert Scale
j	Text		
k	Discrete		
l	Ordinal	Non-comparative	3 Point Likert Scale
m	Text		
n	Text		
o	Ordinal	Non-comparative	4 Point Scale
p	Ordinal	Non-comparative	6 Point Scale
q	Nominal		
r	Nominal		
s	Text		
t	Text		

5.4.2 Questionnaire for Parents (Q-P)

The following key indicators and information were asked to parents by using appropriate scales wherever applicable:

a). Demographics details included were: name, surname and student's gender

b). Nos. of brothers/sister and their education

c & d). Profession and education of father and mother,

e). Total family members if it is a joint family and

f). Gross combined income of father and mother

g). Importance of skills, activities, nature etc., with respect to personality development of their son/daughter.

h). Interaction in hours/day with the son/daughter by father and mother.

i). The suitable age of adolescents to develop personality skills.

j). Any behavior change during adolescence with description of the behavior.

k). Discussion about adolescence changes as well as personality development.

l). Two preferred sources for further information on changes of adolescence.

m). Multiple-choice question on who should initiate first, on reproductive health care.

n). Information on telephone nos. and email Id were kept optional

o). Open-ended feedback and suggestion at the end was asked.

Table 5.4.2 Data type and scales: Parents Questionnaire:

Question	Data Types	Basic Scaling Type	Scaling Technique
a	Nominal		
b	Discrete		
c	Nominal		
d	Nominal		
e	Discrete		
f	Nominal		
g	Ordinal	Non-comparative	3 Point Likert Scale
h	Continuous		
i	Nominal		
j	Nominal		
k	Ordinal	Non-comparative	3 Point Likert Scale
l	Text		
m	Nominal		
n	Text		
o	Text		

5.4.3 Questionnaire for Teachers (Q-T)

The following information were asked to parents by using appropriate scales wherever applicable:

Ordinal non-comparative rating scale on 1 to 6 points was used as under:

1 = Extremely Negative,

2 = Very Negative,

3 = Average Negative,

4 = Average Positive,

5 = Very Positive,

6= Extremely Positive

a). The adequacy of material and time in the current school curriculum for overall personality development of the students on six points ordinal scale.

b). Observations on general health of adolescent boys and girls were considered.

c). The level of awareness about changes of puberty among boys and girls.

d). The adequacy of information on reproductive healthcare in the school curriculum.

e). The level of occurrence of change in emotional behaviour among adolescents.

f). The level of relationship between the teacher-adolescent students relationship.

g). The average % of students participates in competitive sports/arts / quiz.

h). The relationship between the participation in extra curricular activities and the intellectual / academic performance of the students on scale labeled inverse, Proportionate, Irrelevant and Can't say.

i). The adequacy of literature / books in English, Hindi and Gujarati language for parenting of teenagers in Indian culture on scale labeled Not at all, Very less, Average and adequate.

j).The level of importance on 6 points scale, with respect to overall personality development during the school life of the adolescents as per teachers on: stage events, elocution / debate, essay writing, outdoor sports, scout / guide training, outdoor camp/trekking, expertise in an art , expertise in a sport, vocabulary, positive attitude, self confidence, public speaking, and daily exercise.

k). Initiating first to provide information on reproductive health care to the adolescents were to be listed on scale labeled: Parents, Teachers, Doctors, NGO, Media, and Others.

l). Their suggestions / feedback for adolescence education for overall personality development of the student in an open ended question

Table 5.4.3 Data type and scales: Teachers' Questionnaire

Question	Data Types	Basic Scaling Type	Scaling Technique
a	Ordinal	Non-comparative	6 Point Scale
b	Ordinal	Non-comparative	7 Point Scale
c	Ordinal	Non-comparative	8 Point Scale
d	Ordinal	Non-comparative	9 Point Scale
e	Ordinal	Non-comparative	10 Point Scale
f	Ordinal	Non-comparative	11 Point Scale
g	Ordinal	Non-comparative	7 Point Likert Scale
h	Nominal		
i	Ordinal	Non-comparative	4 Point Scale
j	Ordinal	Non-comparative	6 Point Scale
k	Nominal		
l	Text		

5.5 Pre-Testing of Questionnaires

The initial testing of questionnaire (Annexure-5.5) was carried out with the students attending Skills For Adolescence (SFA) Camp-2003 at Lions Club Hall, Vadodara-Gujarat. Total of 10 boys and 21 girls participated. During the testing, mainly their difficulties in filling up the questionnaires were observed. Many parents suggested keeping follow up program on

adolescence development. Majority of students had mentioned that 'Mother' is the best source of information. It was revealed that the puberty changes in many girls start in the VI standard. Pubertal development is important as per the most of the respondents. Accordingly, the questions were redesigned for testing with lager sample.

5.6 Sample testing of questionnaires

The testing of questionnaire was carried out with standard VI to XII of co-education Utkarsh Vidhyalaya at Vadodara, Gujarat. The purpose of the testing was to arrive at final questionnaire after correcting the difficulties faced by the students in filling and understanding of the questionnaire. It was tested:

- to know student understanding of the questions, the language, jargons and difficult words.
- to know that the sample respondents are correct respondents with respect to age and knowledge to respond the questionnaire as well as need for adequate introduction of subject before response.
- To know the class room setting, boys and girls together, presence or absence of their teacher, presence of male or female administrator etc..
- To know whether important question is omitted and irrelevant question is asked

The structured questionnaire was prepared for the adolescents, the parents and the teachers in consultation with the guide. The adolescents studying in the standards VI, VII, VIII, IX, X, XI, XII (age group-12 to 18 years) were selected for testing of the questionnaire at Utkarsh school (English medium), Vadodara-Gujarat. The questionnaire for the adolescents was

administered in the presence of the researcher. Every question was explained in the classroom. Their queries on various questions were understood and explained during filling up of the same. Their written feedback with respect to questionnaire was compiled and suggestions incorporated for final questionnaire. Total 154 adolescents from various standards had participated for the sample test. Around 40 to 50 minutes on an average were required to fill up the questionnaire in the school classroom.

The parents' questionnaire was handed over to these adolescents. They got them filled by their parents at their home. The filled parents' questionnaires were collected by their class teachers and subsequently handed over to the researcher. Total 136 parents filled the test sample questionnaire. The principal and teachers of Utakarsh and Petrofils schools of Vadodara also reviewed the complete set of questionnaires. See annexure for the feedback on sample testing of the questionnaire with adolescents and parents.

5.7 Target groups determination

It was earlier suggested considering standard VI students also for the study, but the principals and teachers had different opinion during sample testing. They opined that VI standard students were very young for this study. The level of awareness even among the students of standard VII were found lower during the testing of the questionnaire. Therefore, the early adolescents group was considered from VII standard onwards. During the testing it was also observed that the students of standard X, XI, XII were busy with their academics as well as they had completed their early adolescence development period. Their interest and response were poor in filling up the questionnaire. Principals and teachers suggested carrying out the

research study with VII, VIII and IX standards students only. After taking into consideration all the suggestions, final target respondents were considered as under for primary data collection:

1) Adolescents studying in schools in Std. VII, VIII and IX.
2) Parents of the above adolescents as well as other parents.
3) Teachers of the same schools as well as other schools.

5.8 Sample size determination

In Gujarat; there were about 11.13 millions adolescents between the age of 10 to 19 years (Census of India-2001). Considering the literacy rate in Gujarat at 70 %, around 7.79 million adolescents are going to school and college in the age group of 10 years to 19 years. In SSC examination, around 6.5 lacs students had appeared in the past (GSEB). There are around 22 lacs students in the VII, VIII and IX standards in Gujarat. As the real size of the target respondents is very large, only cluster sample is considered for the study. The total sample size about 0.25 % of total population was considered i.e. about 5000 nos. including adolescents, parents and teachers. It is observed that cluster sample comprising of 4000 nos. of students, 800 nos. of parents and 100 teachers will give us a quite a good representation for the explorative study.

Table 5.8.A Standardwise Primary Students in Gujarat

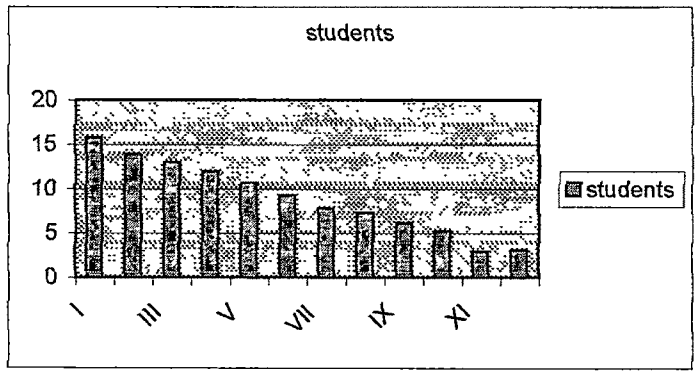
Standard	No. of Students		
	Boys	Girls	Total
1st	995514	583529	1579043
2nd	750204	640557	1390761
3rd	711081	592090	1303171
4th	644479	553908	1198387
5th	597437	474065	1071502
6th	523180	405065	928245
7th	449145	333387	782532
Total	4671040	3582601	8253641

Table 5.8.B Standard wise Secondary & Higher Secondary Students in Gujarat

Standard	No. of Students		
	Boys	Girls	Total
8th	438787	288878	727665
9th	369743	243201	612944
10th	310717	216595	527312
11th	179523	119692	299215
12th	180675	127638	308313
Total	1479445	996004	2475449

Source : Educational Statistical Information-Gujarat Government Year:2002-2003

Chart 5.8 Standardwise School Students in Gujarat



5.8.1 The target sample for the research

Majority of English medium schools were selected from Vadodara. Few schools were selected from other cities of Gujarat state. The schools were selected to arrive at proper representation of different segments taking into consideration of their nature viz. co-educational schools, only Girls' school, only Boys' school and Residential school. Co-educational schools catering to middle class, upper middle class and rich class were considered. Government aided as well as non-aided (private management) schools were also considered. Gujarati medium schools

were also considered. Interview was used to get the responses from the doctors consulting the adolescents in their respective professional field.

5.9 Field administering of final questionnaires

Research questionnaires were prepared separately for adolescents and parents based on the feedback and analysis from sample testing of the questionnaires. Few girl students had suggested keeping the separate questionnaire for the boys and the girls. But it was discussed and concluded that all the adolescents should know about own gender as well as about opposite gender also. The purpose can be served better with combined questionnaire for boys and girls.

The common questionnaires (Appendix-5.9A) for students (QS) for boys and girls were administered in the schools by the researcher himself. While questionnaires (Appendix-5.9B) for parents (QP) were handed over to students for getting it filled up by their parents at home. Unstructured interviews of medical professionals dealing with adolescents as well as school administrators were taken into consideration for their views on the subject. Various bookshops were explored to search for literature and books related to adolescence education. Non-Government Organizations (NGOs) were visited in Vadodara-Gujarat, to find out their experience in dealing with adolescence related issues.

The response from the parents was poor as expected by the school authorities. Although all of the parents should have responded in ideal situation, but principals suggested that 20 % may only respond. The general participation of parents in parent-teacher meeting was poor in most

of the cases. It was difficult to motivate the parents to respond and spare time for their sons/daughter adolescence education. It was expected that to get responses from teachers would be even more difficult. They seem to be busy due to one or another school related work.

So, it was planned that the researcher was to remain present in every schools of Vadodara city and to administer the questionnaire to the students with the prior permission of school principal (Annexure-5.9C). An introductory letter about the research study for adolescence education was prepared for the parents and adolescents. The introductory letter (Annexure-5.9D) was given along with the students/parents questionnaire. The researcher administered the questionnaire to students in the school classroom setting. The subject was introduced in the beginning and instructions were given for every question one after another, throughout the filling of the questionnaire. On an average it took 50 minutes to complete the filling of questionnaire by students. Researcher's wife accompanied to help student to explain the questions mainly to girl students. Although the subject of physical changes were sensitive and some giggling and whispering was observed initially.

The filled questionnaires of the students were collected immediately in the classroom after filling up. Parents' questionnaire was handed over to students, which were filled by their parents and returned to the class teacher in around a week's time. The researcher collected the parents' questionnaire subsequently. It was expected that response from parents might be poor in filling up and returning the questionnaire. Only around 25% of parents returned the filled questionnaire in spite of the reminders.

Few cities of Gujarat were also covered by the researcher namely Navsari, Surat, Amdavad, Rajkot. While in other cities of Gujarat, the class teacher was requested to administer the questionnaire to the students due to time slot availability. Parents were not considered due to time constraints and administrative difficulty to gather them.

The subject was introduced in Gujarati language in Gujarati Medium schools. All the questions were explained in Gujrati language. Except the questions L on human anatomy and physical changes, most of other questions were easy to understand in Gujrati.

The questionnaire for teachers and principals were administered directly by the researcher after introducing the subject. The time constraint was experienced at every school and also atleast three to four visits could only get the filled questionnaires with great difficulty. The experience in brief is detailed as under during administering of the questionnaires.

5.9.1 Few experiences during administering the questionnaires

Sofiya School and Petrofils School at Vadodara, requested to administer the questionnaire separately with boys and girls. So boys were taken to other classrooms and administered separately. In all other co-education school boys and girls were sitting on separate benches in the same classrooms.

St. Mary's School, Rajkot was school for only Boys. Principal agreed for only one introductory lecture on the subject for one hour by the researcher to all the students of

Standard VII, VIII and IX. Then after at their convenient time, class teacher administered the questionnaire in respective classrooms. The filled questionnaires were collected subsequently from them.

Balachadi Army School, Jamnangar was a residential school for boys only. Mr.Yogesh Pota, an adolescence educator arranged administering of the questionnaires and sent the filled questionnaires to the researcher.

Shaishav School, Vadodara and Convent School, Vadodara combined two divisions of same standard, to save on time. So, students were taken to the activity hall. Filling up of questionnaire was more uncomfortable in the activity hall, as students had to sit on the floor and fill up the questionnaires. Also presence of their teacher during the administering of the questionnaire could have been embarrassing to the students on such subjects. They did not open up and discussed freely.

The school classrooms sitting were ideal research site with student's strength ranging between 30 to 60 numbers. The students were quite comfortable during the 45 minutes to 60 minutes of elaborate administering of questionnaires. Introductory information (Appendix-5.9D) and subsequent clarifications were as under.

- The question " Based on teeth" is asked to know the health of your teeth.
- There is an increase in the visit to orthodontist by teenagers to fix uneven teeth.
- The question " Power in Left & Right Eye " is asked to know the heath of eyes. Even in school, school children have to wear spectacles. The eyesight is becoming poor.

- Pubic hair was explained in detail. Few pronounced it as 'public' hair.
- Breast bud development, child sexual abuse and wet dream needed explanation.
- Murmuring started as they started filling up about physical changes.
- Open-ended questions on feedback needed persuasion to write. In few classes it was not filled due to time constraints.
- Students wanted to know more details on physical changes and they asked the researcher to visit the school again.

5.10 Web Site development: www.teensnparents.com

An interactive research and educational website teensnparents.com had been developed with the help of M/s V-Can Technologies, Vadodara.. The web site contents included puberty changes, personality development, parenting of teenagers and marketing of teen products. It displayed detailed information on 'Teenage Products', whose first time use starts only during adolescence. Adolescents, parents as well as businesspersons asked information through email and their queries were replied through email promptly. Doctors of Baroda city had supported the concept for creating general preventive healthcare among adolescents and their parents. On-line questionnaires were also placed to study general awareness on puberty changes and personality skills among the parents and the adolescents. Also feedback from teachers and doctors on the subject was requested through on-line questionnaire. The respondents students and parents were informed on the objective and utility of the website. Data collection from search engine and email query planned.

5.11 Data validation and data entry

Primary data from adolescents, parents and teachers needed scrutiny for correctness and completeness. The data entry after proper validation was carried out.

5.11.1 Customized Software for Data-entry

A Window based data-entry software for multiple options as per the design of questionnaire was customized. Data masters were created in such a way that addition or deletion of any option in the future can be incorporated with ease. Testing of software with initial test data was carried out with 142 questionnaires received from students of Petrofills school-Vadodara and 90 questionnaires from their parents. Each completed data collection form was to be edited to assure that the data contained therein are legible and accurate (Boyd, 1990). Answers to open ended questions are often difficult to interpret and standardize. The incomplete and unanswered question can mean different things.

5.11.2 Data validation and codification

The researcher had examined all the questionnaires for subsequent computer data entry. Few uncompleted questionnaires were rejected. Most of the data were legible enough for data entry operator. All the questionnaires were numbered and packed standardwise, schoolwise. During data entry also researcher remained present to help the data entry operator. The data were codified for the use of SPSS software for further analysis. It took more than two months for complete data entry, codification and validation.

5.12 Data analysis tools

Different statistical data analysis tools were used on the codified data entered in EXCEL as well as SPSS format.

5.12.1 Factor Analysis

KMO Test: A measure of whether distribution of values is adequate for conducting factor analysis. Measure Levels: A measure >0.9 is marvelous, >0.8 is meritorious, >0.7 is middling, >0.6 is mediocre, >0.5 is miserable, and <0.5 is unacceptable.

Bartlett's Test: This is a measure of the multivariate normality of set of distribution. It also tests whether the correlation matrix is an identity matrix. A significant value <0.5 indicates that these data do not produce an identity matrix (or "differ significantly from identity") and are thus approximately multivariate normal and acceptable for factor analysis (Comrey, 1991).

Note: Correlation matrix is not an identity matrix and is approximately multivariate normal is assumption/ requirement of factor analysis.

5.12.2 Rank Correlations (Spearman's rho)

Spearman's rho: The most common correlation for use with two ordinal variables or an ordinal and an interval variable (Welkowitz, 1991). Rho for ranked data equals Pearson's r for ranked data. The formula for Spearman's rho is:

$$rho = 1 - [(6*\Box d^2)/(n^3 - n)]$$

where d is the difference in ranks between each pair of measurements

n is the sample size for the paired measurements

The value of rho will have a value between +1.0 and -1.0.

5.12.3 Chi-square Statistic

The chi-square statistic is computed by summing the squared deviations [observed value (fo) minus expected value (fe)] divided by the expected value for each cell (Fax, 1993).

$$\chi^2 = \sum \left[\frac{(f_o - f_e)^2}{f_e} \right]$$

If there is a large discrepancy between the observed values and the expected values, the $\square^2$ statistics would be large, suggesting a significant difference between observed and expected values. Along with this statistic, a probability value is computed. With $p<0.05$, it is commonly accepted that the observed values differ significantly from the expected values and that the two variables are not independent of each other.

A chi-square value is largely dependent on the number of dimensions and sample size, and thus comparisons of one chi-square value with another are often misleading. To control for this difficulty, Pearson suggested the **phi (□) statistic**, which divides the chi-square value by N and then takes the positive square root of the result. The purpose was to standardize a measure of association to values between 0 and 1 (with 0 indicating completely independent variable and value close to 1 indicating a strong association between variables). However, if one of the dimensions of the cross tabulation is larger than 2, □ may attain a value larger than 1.0. To control for this, **Cramer's V** was introduce (the positive square root of $\square^2/[N(k-1)]$, where k is the smaller of the number of rows and columns). This measure does vary between 0 and 1.0 and is a commonly used measure of the strength of association between variables in a chi-square analysis.

5.12.4 t-test for independent samples

The t-test assesses whether the means of two groups are *statistically* different from each other. This analysis is appropriate to compare the means of two groups (Keppel, 1973)

5.12.4.1 The t-Statistic: Equal Variances

The *t*-test statistic is the ratio:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s_{\overline{X}_1 - \overline{X}_2}}$$

The numerator: difference in independent group means (treatment effects plus error). *The denominator*: standard error of the difference between means (error).

We estimate the denominator using a pooled variance estimate, given by s_p^2:

$$s_p^2 = \frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}$$

and

$$s_{\overline{X}_1 - \overline{X}_2} = \sqrt{s_p^2\left(\frac{1}{n_1} - \frac{1}{n_2}\right)}$$

where s_1^2 and s_2^2 are the group variances, and n_1 and n_2 are the respective sample sizes. The degree of freedom $df = n_1 + n_2 - 2$.

5.12.4.2 The t-Statistic: Unequal Variances

The independent samples *t*-test is insensitive to unequal variances when $n_1 = n_2$. However, when samples are of unequal size, the effect of unequal variances becomes important. When the smaller sample has the largest variance the probability of committing a Type I error increases. When sample sizes and variances are unequal, the *t*-ratio is expressed in terms of *separate variances* of each sample.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

and the degrees of freedom are calculated from

$$df = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\left(\frac{s_1^2}{n_1}\right)^2\left(\frac{1}{n_1 - 1}\right) + \left(\frac{s_2^2}{n_2}\right)^2\left(\frac{1}{n_2 - 1}\right)}$$

5.12.5 SPSS software

SPSS (Statistical Package for the Social Sciences) is a data management and analysis product produced by SPSS, Inc. in Chicago, Illinois. Among its features are modules for statistical data analysis, including descriptive statistics such as plots, frequencies, charts, and lists, as well as sophisticated inferential and multivariate statistical procedures like analysis of variance (ANOVA), factor analysis, cluster analysis, and categorical data analysis (Nargundkar, 2004). SPSS is particularly well-suited to survey research, though by no means is it limited to just this topic of exploration.

SPSS is a modular product. The table below describes the module names and supplies a brief description of their functions.

Module	***Description***
Base System	Required to run SPSS. Reads data files; provides data and file manipulation, procedures for report writing, descriptive statistics, cross-tabulation tables *and analysis, t-tests, correlation, analysis of variance, regression, cluster* analysis, factor analysis, and nonparametric statistics.
Professional Statistics	Distance correlations, K-means clustering, hierarchical clustering, *multidimensional scaling; discriminant analysis, reliability analysis.*
Advanced Statistics	Discriminant analysis; loglinear, logistic, and nonlinear regression; probit and survival analysis; and multivariate and repeated measures analysis of variance.
Categories	Contains procedures for doing conjoint analysis and optimal scaling. Categories includes ANACOR, HOMALS, PRINCALS, and OVERALS, all dimension-reduction techniques used for perceptual mapping. Plots produced

	by these procedures can help you determine the structure of your data. An alternating least squares (ALS) method for parameter estimation is an option in several procedures. ALS allows all levels of variable measurement (nominal, ordinal, interval, and ratio) in the estimation phase.
Tables	Includes powerful table-building facilities for displaying data in high-quality, camera-ready formats. It can produce one-, two-, or three-dimensional tables in the tub-and-banner format. Customizing output is easy with Tables' flexible command language.
Trends	Provides time-series analysts a variety of identification, estimation, forecasting, and diagnostic tools. Plotting, smoothing, decomposition, regression, ARIMA modeling, and spectral analysis are a few of the *techniques available in Trends.*

This is not a complete listing of SPSS product modules; only the most commonly used modules are listed above.

5.12.6 Mann-Whitney U Test: two independent samples

The Mann-Whitney *U*-test is a nonparametric analog of the independent samples *t*-test (Sigel, 1988). The procedure tests the null hypothesis that the two samples are from the same population.

The *U*-Test Statistic

The basis of the *U*-test is a comparison of the sum of the ranks of scores for two groups. If there is a difference between the two groups, then the scores for one group should rank higher than the scores of the other group.

If there is no difference between the groups, then the total of the ranks for the each group should be similar.

The *U*-test statistic is calculated from

$$U_1 = R_1 - \frac{n_1(n_1+1)}{2}$$

$$U_2 = R_2 - \frac{n_2(n_2+1)}{2}$$

where R_1 and R_2 are the sums of the ranks of scores group 1 and group 2, and n_1 and n_2 are the corresponding sample sizes. The test statistic is the lower of the two values of U. we can reject the null hypothesis only when the critical value of U is greater than or equal to the calculated U.

5.12.7 ANOVA: ONE-WAY Classification

In a single-factor experiment, the one-way analysis of variance is used when three or more groups need to be compared. *One-way* refers to the fact the design has only one independent variable, or *factor*, with three or more *levels*.

Statistical Hypothesis :

The null hypothesis for a one-way multilevel study is stated in the form

$$H_0: \square_1 = \square_2 = \ldots = \square_k$$

where k is the number of groups or *levels* of the independent variable. The alternative hypothesis can be stated as a number of specific hypotheses

$$\text{e.g. } H_1: \square_1 < \square_2 = \square_3 \quad \text{or} \quad (\square_1 = \square_2) \square (\square_3 = \square_4)$$

The Analysis of Variances

The F-Ratio

Now that we have the between-groups variance MS_b representing the treatment effect, and within-groups variance MS_e representing the error, we can calculate the test statistic, F

$$F = \frac{MS_b}{MS_e}$$

When the null hypothesis cannot be rejected (there is no treatment effect), the error variance is similar to or greater than the between-groups variance, yielding a low F-ratio. If the treatment effect is strong, then the between-groups variance will be >> than the error variance, yielding a high F-ratio.

Critical F-value

As with the *t*-test, we need to compare the calculated *F*-ratio with a critical *F*-value that corresponds to a desired probability region of the *F* distribution. The critical *F*-value is found in a similar manner as the critical *t*-value, except we now have two degree of freedom variables: the degree of freedom for the between-groups effect (df_b) and the degree of freedom for the within-groups (error) effect (df_e).

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