



A Methodological Pathway to Quantify Perception of the Participants in Animal Fairs with relevance to National Dairy Mela at NDRI Karnal, India

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ABSTRACT

Mela is the Hindi language word for fair, which is a traditional media to learn, earn, participate and share information. The paper describes perception scale development process and identification of different prospects of perception of the participants by administering the tool on 60 randomly selected participants, during the three day event of national dairy mela from 25th to 27th February, 2015 at NDRI, Karnal. Final scale consisted of 20 statements (14 positive and 6 negative) for which the t-values were found to be significant at one percent level of significance at 18 df and Cronbach's alpha value of reliability was 0.851. Two other reliability tests were accomplished and Cochran's test of ANOVA was performed to test the significance level of all 3 reliability test and it was significant at 1 percent level ($p < 0.001$). Content validity of the scale (S-CVI value) was 0.831. PCA extracted 4 prospects viz., 'recognition prospect', 'learning prospect', 'get better prospect', and 'supportive prospect'. This methodological pathway viz., t-values cut-off for selection of statements based on degree of freedom rule, reliability triangulation, Cochran's test for reliability significance and extracting the latent constructs through PCA, can be followed by stakeholders for constructing different types of psychological scales. The attributes identified through PCA can be utilized in effective management and planning for organizing successful animal fairs.

Keywords: Animal fair, Perception scale, Scale construction technique, Cronbach, PCA

Livestock fairs are being organized in the Indian sub-continent since a long time and one of the oldest examples is the centuries old Sonapur fair in Bihar, which originated during the Chandragupta Maurya period (340 BC-298 BC) and is presently famed for its rural attraction and cattle trade and credited as Asia's biggest cattle fair (Anonymous, 2015). Following the old custom since 2009, dairy mela is being organized at National Dairy Research Institute, Karnal, Haryana from February 25th to 27th every year. In 2015 mela, 225 farmers participated in 29 categories for the competition including beauty contest for cattle and buffaloes (2 teeth, 3-4 teeth and >4 teeth; adult category), milk production etc (Lal *et al.* 2015). Studies reveal that with the passage of time, popularity of the melas declines due to several factors (Das *et al.* 2014). Government of India wants to attract youth towards agriculture and animal husbandry, the testimony

being "National Convention on Attracting and Retaining Youth in Agriculture" dated 27th January 2016 by joint collaboration of Indian Council of Agricultural Research (ICAR) and All India Agricultural Students Association (AIASA) at National Agricultural Science Centre, NASC complex, DPS Marg, New Delhi (Vasudeva, 2016). In the National Convention Chief Guest, Honourable Union Minister of Agriculture emphasized on various approaches to attract youth and the importance of traditional media such as agricultural, livestock and dairy fairs in achieving the goal. In 2015 fair, 225 farmers participated in the competition, while the number of visitors was around 12,000. Therefore, even if one participant is inclined towards the negative perceptual level s/he can influence a large number of visitors (Kramer *et al.* 2014). Peterson (1994) described various types of psychological scales viz., attitude, perception, perceived risk, conflict/stress,

cognition, emotion, intention, involvement/commitment, lifestyle/interest, motivation, performance (job-related), personality, preference, reported behavior, satisfaction (job), satisfaction (other), self-confidence/self-esteem, value/belief and miscellaneous constructs. So, the proposed article suggests a concrete methodological pathway for scale construction by taking ‘perception’ as an example. In this backdrop, the present study was conducted to describe a methodological approach to develop and validate a scale to measure the perception of participants towards national dairy mela at NDRI and to extract the different prospects of perception of the participants in order to get the latent construct.

MATERIALS AND METHODS

Gibson (1959) defined perception as the process by which an individual maintains contact with the environment. The method of summated rating suggested by Likert (1932) was followed in the development of scale. The following steps were considered for measuring the perception of participants towards national dairy fair at NDRI.

Collection of the statements

The first step in the construction of perception scale was to collect statements pertaining to it. Utmost care was taken to include both positive and negative statements in the list to reduce the effects of social desirability, positive response bias and in addition, negative items when imbedded among the positive items maintain the consistency of the respondents in answering the statements (Lal *et al.* 2014). A tentative list of 39 statements pertaining to perception was collected through consultation with extension experts, agricultural scientists and rural journalists.

Editing the statements

These statements were edited as per the 14 informal criteria enunciated by Likert (1932) and Edwards (1969). Out of 39 statements, 34 statements were retained after editing.

Response to raw statements

The proforma containing 34 statements on 5-point continuum i.e. Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA) were

mailed by post, e-mail and also handed over personally to 51 judges who were extension experts, agricultural scientists, agricultural coordinators and rural journalists. The judges were requested to examine each statement and then rate them on a five point continuum indicating the suitability of the statements. The judges were then requested to make necessary modifications and additions or deletions, if they desired so. Out of the 51 judges, 36 judges provided back their responses.

Item analysis

Statement analysis is an important step while constructing valid and reliable scale (Lal *et al.* 2014). The judges were asked to indicate their degree of response with each statement on a five point continuum ranging from Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA) with scoring of 5, 4, 3, 2, and 1; for positive statements and the scoring pattern was reversed i.e. 1, 2, 3, 4 and 5 for the negative statements. The total individual judge scores were calculated by summing up the score of each statement. Recently, few researchers *viz.*, Kant *et al.* (2013) and Lal *et al.* (2014) followed three point continuum to get responses from judges, but it is desirable to select five point continuum as it gives more degree of freedom for their choice (Edwards, 1969).

Calculation of t-values

Based upon the total individual scores, the judge scores were arranged in a descending order. The top 25 percent of judges with their total individual scores were considered as high group and the bottom 25% as the low group, so that these two groups provided criterion groups in terms of evaluating the individual statements (Lal *et al.* 2014). The t-values were worked out in order to discriminate the responses of high and low groups for the individual statements by using the under mentioned formula (Edwards, 1969). Thus, out of 36 judges to whom the statements were administered for the item analysis, 9 judges with highest and 9 judges with lowest scores were used as criterion groups to evaluate the individual statement.

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum_{i=1}^n (X_H - \bar{X}_H)^2 + \sum_{i=1}^n (X_L - \bar{X}_L)^2}{n(n-1)}}$$

The part of the above formula can be restated as:

$$\Sigma(X_H - \bar{X}_H)^2 = \Sigma X_H^2 - \frac{(\Sigma X_H)^2}{n} \text{ and}$$

$$\Sigma(X_L - \bar{X}_L)^2 = \Sigma X_L^2 - \frac{(\Sigma X_L)^2}{n}$$

Where,

\bar{X}_H = The mean score on a given statement for the high group

\bar{X}_L = The mean score on a given statement for the low group

X_H^2 = Sum of squares of the individual score on a given statement for high group

X_L^2 = Sum of squares of the individual score on a given statement for low group

X_H = Summation of scores on given statement for high group

X_L = Summation of scores on given statement for low group

n = Number of subject in low and high group

t = The extent to which a given statement differentiate between the high and low group.

= Summation

Reliability of the scale

A scale is reliable when it gives consistently the same results when applied to the same sample. The final set of the 20 statements which represent perception of participants towards national dairy fair was administered on a five point continuum to a fresh group of 30 farmers of non sample area. Reliability was calculated by using the formula of Spearman (1910) and Brown (1910).

$r_{SB} = \frac{2r_{hh}}{1 + r_{hh}}$ where, r_{hh} = Pearson correlation between odd and even.

The split-half Spearman-Brown procedure has been a standard method of test analysis for forty years. But, the conventional split-half approach has been repeatedly

criticized and one major criticism has been that split-half coefficients do not give the same information as the correlation between two forms given at different times (Cronbach, 1946). So, the most widely used and appreciated coefficient for assessing internal consistency, Cronbach's alpha (α) was used (Cronbach, 1951). The formula is:

$$\alpha = \frac{K}{K-1} \left(1 - \frac{\sum_{i=1}^{i=K} \sigma^2 y_i}{\sigma^2 X} \right)$$

K = Number of items in the scale

$\sigma^2 y_i$ = the variance of item i for the current sample of respondents

$\sigma^2 X$ = the variance of the scale

George and Mallery (2003) provided the following rules of thumb: “_ > .9 – Excellent, _ > .8 – Good, _ > .7 – Acceptable, _ > .6 – Questionable, _ > .5 – Poor, and _ < .5 – Unacceptable” to assess the Cronbach's alpha value. Schmitt (1996) propounded four caveats regarding the proper use of the Cronbach alpha coefficient and one of the caveat says that presenting only alpha when discussing the relationships of multiple measures is not sufficient and that is why inter-correlations must be presented as well. SPSS, version 20 was used for calculating another reliability test i.e. Guttman split-half coefficient of reliability. Cochran's test of ANOVA was used to know the significance level of different reliability values.

Validity of scale

Lindquist (1951) defined validity of a test as the accuracy with which it measures that which is intended to measure. The content validity of the scale was tested. The content validity is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. This method was used in the present scale to determine the content validity of the scale. As the content of the perception covered the entire universe of farmers through literature and expert opinion, it was assumed that present scale satisfied the content validity. Researchers advocated the use of following approach to specify that ratings of 1 and 2 are considered “content invalid,” while ratings of 3 and 4 are considered

to be “content valid” in calculating S-CVIs (Lynn, 1986). To extract the different prospect of perception of the participants, principal component analysis (PCA) was used. Utmost care was taken to fulfil the conditions of using PCA.

RESULTS AND DISCUSSION

Calculation of t-value

Statement-1 in (Table 2): I get social recognition by participating in dairy mela.

Table 1: Calculation of t-value for evaluating the difference in the mean response to a perception statement by a high group and a low group

Response Categories	High group					Low group				
	X	X ²	f	fX	fX ²	X	X ²	f	fX	fX ²
SA	5	25	7	35	175	5	25	0	0	0
A	4	16	1	4	16	4	16	0	0	0
UD	3	9	1	3	9	3	9	1	3	9
DA	2	4	0	0	0	2	4	3	6	12
SD	1	1	0	0	0	1	1	5	5	5
Sums (Σ)			9	42	200			9	14	26
			n _H	X _H	X _H ²			n _L	X _L	X _L ²

*Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA); X is respective weightage for a particular response in 5 point continuum; f is frequency in high group and a low group

$$\bar{X}_H = \frac{42}{9} = 4.67 \quad \bar{X}_L = \frac{14}{9} = 1.55$$

$$\Sigma(X_H - \bar{X}_H)^2 = \Sigma X_H^2 - \frac{(\Sigma X_H)^2}{n} = 200 - \frac{(42)^2}{9} = 4$$

$$\Sigma(X_L - \bar{X}_L)^2 = \Sigma X_L^2 - \frac{(\Sigma X_L)^2}{n} = 26 - \frac{(14)^2}{9} = 4.22$$

$$t = \frac{4.67 - 1.56}{\sqrt{\frac{(4 + 4.22)}{9(9-1)}}} = \frac{3.11}{0.34} = 9.21$$

The value of ‘t’ is a measure of the extent to which a given statement differentiates between the high score and low score groups (Edwards, 1969). Table 1 explains the

procedure of t-value calculation for ‘statement number 1’ of Table 2 and for subsequent statements the procedure remains the same and only frequency column value changes, which determines the overall t-value (Table 1). In this way, 34 statements were subjected to t-value calculation but only 20 statements were retained in the final scale (Table 2) as their t-value was 2.878. The t-value 2.878 (n₁+n₂-2 df at 1% level of significance i.e. at 18 degree of freedom (df) as there are 20 statements; 10 each in high group and low group and thus 10+10-2=18 df, two-tailed test) indicating the average response of high and low groups to a statement differs significantly. Consequently, 2.878 will serve as a cut-off for all the statements in Table 2, 2.878 the statements would be selected and below it statements would be selected. The degree of freedom rule was used by Lal *et al.* (2014), which make the statement selection more stringent than the Edwards’ rule of thumb 1.75 or the vague criterion of selecting 20-25 statements with largest t-values (Edwards, 1969). It would be worth mentioning that larger the t-value, stronger the statement in the scale and that is why items were arranged in rank order according to their t-values (Table 2). Thus 20 statements on “Participants perception towards national dairy fair” (14 positive and 6 negative) with significant discriminating values were retained in the final scale (Table 2). A critical look on Table 2 shows that majority of the respondents had positive perception about the ‘national dairy mela’ as evident from their higher mean score. Statements wise analysis of (Table 2) and factors affecting participants perception towards national dairy fair was done by Lal *et al.* (2015).

Table 2: Perception statements and their analysis

Sl.No.	Statements	t-value	Mean	SD
1	I get social recognition by participating in dairy mela	9.21**	4.07	1.13
2	The award money given in the mela should be enhanced	3.98**	4.50	1.21
3	I get chance to meet other progressive farmers in the dairy mela	3.64**	3.98	0.94
4	On-spot solution of problem was given during the interaction session with the experts	5.33**	3.77	0.97
5	I have come to mela, only for winning the competition	2.91**	2.98	0.65

6	Dairy mela should be extended to other regional stations of NDRI	3.42**	3.63	0.89
7	Opportunity cost of coming to dairy mela is low	8.99**	3.68	1.04
8	I faced problem in registering the animal for the competition	2.94**	3.57	0.78
9	Every year the level of dairy mela is improving	5.12**	3.73	0.87
10	There was poor arrangement of food and lodging	4.01**	3.37	1.17
11	The knowledge gained during dairy mela could not be received by staying at home.	3.58**	4.52	1.29
12	I encountered difficulty in getting information from the 'enquiry booth'	3.99**	3.93	0.93
13	Agriculture-related information provided by different stalls in the mela was of high standard	4.45**	4.37	1.09
14	Impression about NDRI dairy mela among the villagers is commendable	5.84**	4.17	1.01
15	Entertainment programme organised by the mela committee was fantastic	4.39**	3.53	0.76
16	Lucky draw was a gimmick in the dairy mela	2.93**	3.10	0.68
17	If proper lodging facilities are provided, I will come with my family on my own expense	7.11**	3.75	0.84
18	More scientific measures should be adopted by judges rather than just observation	5.26**	4.42	1.08
19	The decision of the judges was biased and unjust	2.89**	3.93	0.98
20	The scorecard proforma should be distributed among the farmers before the competition	3.69**	4.48	1.14

*Significant at 5% level; **significant at 1%; (df = 10+10-2= 18).

Table values of 't' at 18 df were 2.101 and 2.878 at 5 and 1% level of significance, respectively. It must be accentuated here that t-value in column 3 was obtained by getting the response from 36 judges, while mean and SD in column 4 and 5 was calculated by getting response from 60 participants in national dairy fair. Both positive (+) and negative (-) statements were taken to reduce the effects of social desirability and positive response bias. Statement number 5, 8, 10, 12, 16 and 19 were negative and rest of

them were positive (Table 2). 14 statements with their corresponding t-value <2.878 have not been included in the Table 2.

Reliability and validity of the scale

To quantify the reliability and validity of the scale, different methods were worked out. The coefficient of correlation between odd and even scores was 0.894 and Guttman split-half coefficient value was 0.876 (Table 3), which was found to be significant at 1% level, thereby testifying the reliability of the scale.

$$r_{SB} = \frac{2r_{hh}}{1+r_{hh}} = \frac{2*0.808}{1+0.808} = \frac{1.616}{1.808} = 0.894$$

Reliability was re-authenticated by Cronbach's alpha value, which is as follows:

$$\alpha = \frac{K}{K-1} \left(1 - \frac{\sum_{i=1}^{i=k} \sigma^2 y_i}{\sigma^2 X} \right) = \frac{20}{19} \left(1 - \frac{17.15}{89.75} \right) = 0.851$$

These values implied scale was consistent in measurement. Overall content validity (S-CVI value) of the scale was 0.831 (Table 3), which indicated that the scale was content-wise valid for administrating to the target respondents. Thus, the scale was finally administered to 60 randomly selected farmers out of total 225 participants from Haryana, Punjab, Uttar Pradesh, and Delhi states of India during the 3 days event of mela from February 25th-27th, 2015 on a 5 point continuum. The overall possible minimum and maximum scores ranged between 20 to 100 (Table 2).

Table 3: Reliability and validity statistics of the scales developed

Cronbach's Alpha	Part 1	Value	.852
		N of Items	10
	Part 2	Value	.850
		N of Items	10
		Total N of Items	20
Correlation between forms			.805
	Spearman-Brown coefficient	Equal length	.894
		Unequal length	.894

Guttman split-half coefficient		.876
Content validity	S-CVI value	0.831
ANOVA with Cochran's test	65.216	.000***

Different prospects of perception

In India and many other countries, researchers usually do not extract the latent constructs of the scale, as evident from few researches *viz.*, Semie *et al.* (2009), Kant *et al.* (2013) and Lal *et al.* (2014).

Table 4: Showing ‘Rotated component matrix’ with principal component (PC), Communalities (h²), eigen values (EVs), cumulative explained variance in percentage (CVin%)

Items	PC1	PC2	PC3	PC4	h ²
X1	0.913	-0.147	0.109	0.178	0.899
X2	0.838	-0.012	-0.062	0.048	0.709
X3	0.163	0.908	0.072	-0.079	0.862
X4	0.111	0.894	0.184	0.025	0.846
X5	0.043	0.136	0.729	-0.385	0.700
X6	-0.193	0.258	0.117	0.798	0.754
X7	0.834	0.279	-0.173	-0.058	0.807
X8	0.364	0.114	0.722	-0.211	0.711
X9	0.153	0.303	-0.335	0.717	0.742
X10	-0.521	0.189	0.715	0.32	0.921
X11	-0.336	0.884	0.102	0.193	0.942
X12	0.436	0.139	0.712	-0.121	0.731
X13	0.424	0.767	0.188	-0.078	0.809
X14	0.817	-0.038	0.134	0.126	0.703
X15	0.308	0.292	0.195	0.713	0.727
X16	-0.303	0.295	0.656	-0.323	0.713
X17	0.121	0.244	0.421	0.675	0.707
X18	0.261	0.739	0.161	0.254	0.705
X19	0.243	-0.166	0.641	0.456	0.705
X20	0.721	-0.257	0.342	0.117	0.717
EVs	4.735	4.211	3.545	2.919	
CVin%	23.7	44.7	62.5	77.0	

*20 items in the scale with the same sequence as in Table 2 are variables X1 to X20. They were taken as variables in order to get latent constructs of the perception scale through PCA.

But, the authors suggest here that, it is desirable because it carves out the latent constructs of the scale. Commonly, factor analysis method i.e. principal components analysis

(PCA) or exploratory factor analysis (EFA) is used to find out the latent constructs. As Comrey (1957) factor analyzed the Depression (D) scale of the Minnesota Multiphasic Personality Inventory (MMPI) and found 17 factors through EFA.

Hawcroft and Milfont (2010) reviewed 69 studies from 36 countries associated with ‘new environmental paradigm’ (NEP) scale and divulged that principal component analysis was used to get different construct of the NEP scale. So, after scale construction the responses were obtained by administering the scale to the target respondents and the values were factor analyzed by using principal components analysis (PCA). Principal component analysis (PCA) is a widely used method for factor extraction and so it was used by coding 20 items (Table 2 and Table 4) of the scale as variables X1 to X2 in order to extract the different prospects of perception of these 60 participants. But, before performing PCA two different tests were performed to know whether the present dataset can be PCA analysed or not.

The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO statistic) obtained in this study was .917 and KMOs in the .90s is “marvelous” so the sample selected in this study was adequate for factorial analysis. The Bartlett’s test of sphericity was significant (p<.001) and so factor analysis was found to be suitable. From Table 4 it is evident that four factors (Eigen values > 1) explained 77% variance in the dataset. A glance at each column of Table 4 helps to define each component according to the strongly associated variables.

Extracting the information from Table 4, the components (represented in column 2, 3, 4 and 5 in Table 4), which were clubbed up together were given specific nomenclature according to the attributes it represents. Principal component (PC 1) here represents ‘recognition prospect’, which incorporates 5 variables and explained 23.7% of variance. Principal components (PC 2) represents ‘learning prospect’, which also incorporates 5 variables and explained 21.0% of variance, while (PC 3) represents ‘get better prospect’, which incorporates 6 variables and explained 17.8% of variance. Lastly, (PC 4) represents ‘supportive prospect’ incorporating 4 variables and explained 14.5% of variance. The procedure explained above is shown through a flow diagram for scale construction (Figure 1).

Table 5: Different prospects of participants perception towards national dairy fair at NDRI

Factors	Variables/ Items	Attributes
Recognition prospect	X1, X2, X7, X14, X20	Items in the scale, which give social as well as financial recognition to the respondents.
Learning prospect	X3, X4, X11, X13, X18	Items with which some kind of learning is associated.
Get better prospect	X5, X8, X10, X12, X16, X19	Items representing need for improvement at management level and perceptual change in the respondents.
Supportive prospect	X6, X9, X15, X17	Items which either support the growth of a fair or adds value to it.

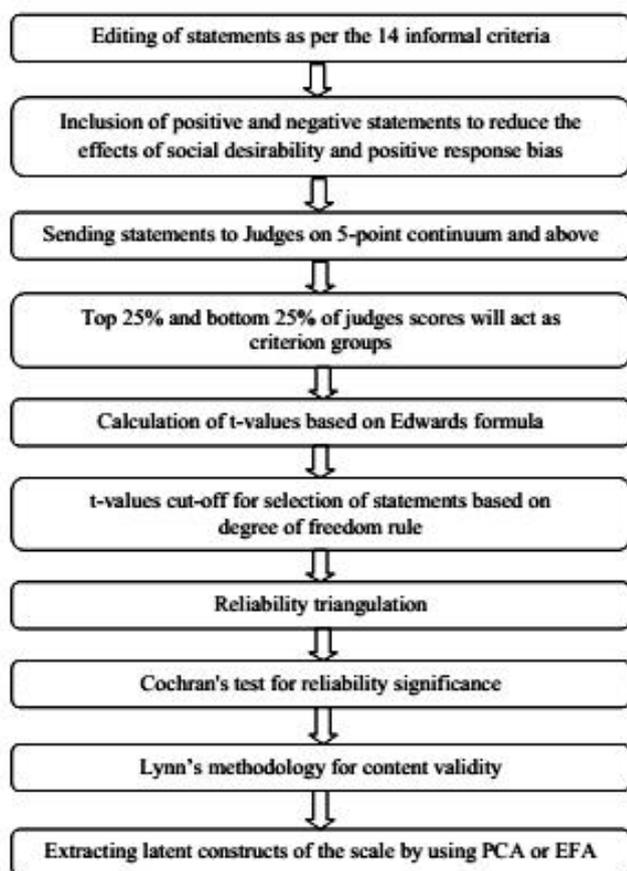


Fig. 1: Flow diagram to explain methodological pathway for scale construction

CONCLUSION

The authors propound the application of ‘degree of freedom rule’ for selecting the statements based on t-values, as it makes the statement selection more stringent and authentic than the Edward's rule of thumb. Considering the four cautions regarding the proper use of the Cronbach alpha coefficient two more reliability tests viz., Spearman-Brown coefficient and Guttman split-half coefficient of reliability are suggested to perform reliability triangulation in a non-sample area. Cochran's test of ANOVA should be run to test the significance level of the all three reliability tests. Then, scale-content validity index values (S-CVIs) should be calculated following Lynn’s methodology. Usually, researchers do not extract the latent constructs of the scale so prepared by using principal components analysis (PCA) or exploratory factor analysis (EFA), which the authors consider mandatory because it explores latent dimensions of the scale. Identification of different prospects of perception of the participants through PCA inferred that PC 1 accounted for largest share of the total data variability and the attributes identified can form the basis for effective management development in the forthcoming national dairy fairs at NDRI Karnal. This methodological pathway to measure perception can be followed by researchers and stakeholders to quantify the perception or any other psychological aspect of a participant towards any extension programme.

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