

Theoretical Biophysics Group

**BioCoRE Evaluation: A
preliminary Report on
Satisfaction Scale - SATCO**

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Evaluation of SATCO (Satisfaction with Collaboration) Scale

As set out in the original proposal, the BioCoRE evaluation program is expected to measure attitudes of BioCoRE users and when necessary develop new measures applicable to the collaboratory environment. The Satisfaction with Collaboration Scale (SATCO) is an attempt to achieve both these goals concurrently – to develop a new scale that measures an attitude that may impact evaluations of BioCoRE.

Scale Description:

The SATCO scale, included in the BioCoRE registration form, is comprised of five items organized in two subscales. A one-item subscale, the SATCO-COLL, measures basic attitude towards collaborative work in general. The second subscale, the SATCO-OG, uses four items to measure the user's attitude towards working collaboratively in an on-line group. Combined, the two subscales are intended to provide a gross measure of attitude towards working collaboratively in the BioCoRE environment.

The question stems for each subscale are listed below, followed by assessments of validity and reliability issues in the scale. Conclusions are then drawn regarding the scale.

Scale Items:

- Attitude towards collaboration (COLL)
 1. Collaborating with others on scientific projects is a rewarding experience (SATCO-COLL)
- Attitude towards on-line groups (OG)
 1. Working face-to-face with group members is preferable to working with them virtually (SATCO-OG-1). *
 2. It is more difficult to get work done in a face-to-face group than in a virtual group (SATCO-OG-2).
 3. A sense of trust in the behavior of others is harder to form in virtual groups than face-to-face groups (SATCO-OG-3). *
 4. Working as a member of a virtual group is preferable to working alone (SATCO-OG-4).

Responses were collected during the period from March 1, 2000 to November 11, 2000 using a seven-point Likert scale ranging from 1=Strongly Disagree to 7=Strongly Agree with a midpoint of 4=Unsure. One change was made in the scale wording in late August 2000: the word 'virtual' replaced 'on-line' in the question stems.

*Two items, the SATCO-OG-1 and the SATCO-OG-3, were reverse-scored.

Scale Evaluation

Responses to the scale items were taken from the BioCoRE registration database on November 11, 2000, for use in evaluating the validity and reliability of the scale. The data set was cleaned of information generated by BioCoRE developers, who knew the purpose of the scale and thus could not be considered valid respondents. The resulting data set represents the responses of 179 scientists, though in practice about 100 scientists answered this specific scale items, as the scale items are optional for BioCoRE registrants. Response rates across the entire survey items varied by question.

Scale Validity

Content validity. As a measure of attitude towards collaborative work practices in general, the COLL subscale has face validity, asking respondents whether they find collaborative work on scientific projects to be a rewarding experience. The OG subscale is slightly more complex, asking respondents in some items to compare working in on-line groups to working in face-to-face groups, and using reverse scoring in two items. The complexity of the items, and the reverse scoring, may have been a source of confusion for some respondents. However, the BioCoRE evaluation team concluded that all items had sufficient face validity in the first draft of the scale.

Construct validity. No prior scales on attitude towards working collaboratively were located to inform the development of the SATCO. One item, SATCO-OG-3, was based on a study of trust in on-line groups (Jarvenpaa & Leidner, 1998). The dimensionality of the scales is otherwise intuitive, i.e. based on what seemed commonsense items for the purpose of measuring attitude towards collaboration rather than on statements strictly dictated by theory.

Criterion validity. No scales with which the SATCO can reasonably be compared have been located as of writing of this report. Over time, the SATCO scores might be positively related to BioCoRE evaluation scores, i.e. individuals who favor collaboration in general may rate BioCoRE more highly, and vice versa.

Scale Reliability

Six criteria, as described by R. F. DeVellis (1991) in Scale Development: Theory and Applications were used to assess the reliability of the SATCO. The criteria include the assessment of (1) scale item intercorrelations, (2) applicability of reverse scoring, (3) item-scale correlations, (4) item variances, (5) item means, and (6) the coefficient alphas of the entire scale. Correlations and significance tests are produced using the bivariate correlations method in the SPSS-X statistical analysis program.

I. Scale item intercorrelations

High intercorrelations among scale items are a good indication of scale reliability, and also suggest that they yield a true measurement of the latent variable.

Table 1: Correlation Matrix for All Scale Items

		SATCO-COLL	SATCO-OG-1	SATCO-OG-2	SATCO-OG-3	SATCO-OG-4
SATCO-COLL	Pearson Correlation	1.000	.104	.073	-.005	.158
	Sig. (1-tailed)	.	.144	.230	.481	.053
	N	107	106	105	105	105
SATCO-OG-1	Pearson Correlation	.104	1.000	.144	.378**	-.254**
	Sig. (1-tailed)	.144	.	.072	.000	.005
	N	106	106	104	104	104
SATCO-OG-2	Pearson Correlation	.073	.144	1.000	-.116	-.022
	Sig. (1-tailed)	.230	.072	.	.119	.411
	N	105	104	105	105	105
SATCO-OG-3	Pearson Correlation	-.005	.378**	-.116	1.000	-.284**
	Sig. (1-tailed)	.481	.000	.119	.	.002
	N	105	104	105	105	105
SATCO-OG-4	Pearson Correlation	.158	-.254**	-.022	-.284**	1.000
	Sig. (1-tailed)	.053	.005	.411	.002	.
	N	105	104	105	105	105

** Correlation is significant at the .01 level (1-tailed).

The results of the intercorrelations are mixed. Of the significant correlations, only one is positive while two are unexpectedly negative, and all values are low (i.e. $r < .50$). The remaining non-significant values are a mix of low positive and negative correlations.

II. Applicability of reverse scoring

Negatively correlated items can indicate a need to reverse score items, as a means of clarifying the direction between scale items and their relation to the latent variable being assessed. In the SATCO, two items were reverse scored to indicate respondent attitude toward on-line groups. For example, if respondents preferred working face-to-face versus working with an on-line group, then the response was reverse-scored to indicate a lower score for on-line groups than the opposite case. However, both reverse-scored items (SATCO-OG-1, SATCO-OG-3) were in significant negative correlation with the final item in the scale, which was not reverse scored, and in significant positive correlation with each other. The results suggest that clarifying the direction of the question items, and eliminating the reverse scoring are necessary.

III. Item-scale correlations

In a highly intercorrelated scale, each item of the scale should have a high correlation with the remaining items in the scale. There are two methods of assessing item-scale correlations, termed

corrected and uncorrected. A corrected item-scale correlation compares an item to all the remaining items in the scale, excluding itself. In an uncorrected item-scale correlation, the item of interest is left in the scale to which it is compared.

A. Corrected item-scale correlations

The correlation matrix (see below, Table 2: Correlation Matrix for Corrected Scale) shows the correlations between a scale item and the remaining items in the scale.

There are three significant values in the corrected item-scale correlations, and only two are in the expected direction. The results for this criterion indicate low reliability.

B. Uncorrected item-scale correlations

The uncorrected item-scale correlations (see below, Table 3: Correlation Matrix for Uncorrected Scale) indicate statistical significance for all items with the uncorrected scale. The correlation values are fairly low, with only two values marginally exceeding $r = .50$. Overall, the results of the uncorrected item-scale comparison are mixed and indicate low reliability.

Table 2: Correlation Matrix for Corrected Scale

Corrected Item-scale Correlations With Items Remaining in Scale		
SATCO-COLL	Pearson Correlation	.165*
	Sig. (1-tailed)	.047
	N	104
SATCO-OG-1	Pearson Correlation	.208*
	Sig. (1-tailed)	.017
	N	104
SATCO-OG-2	Pearson Correlation	.028
	Sig. (1-tailed)	.389
	N	104
SATCO-OG-3	Pearson Correlation	-.008
	Sig. (1-tailed)	.469
	N	104
SATCO-OG-4	Pearson Correlation	-.216*
	Sig. (1-tailed)	.014
	N	104

Table 3: Correlation Matrix for Uncorrected Scale

Uncorrected Item-scale Correlations With Items Total Scale		
SATCO-COLL	Pearson Correlation	.441*
	Sig. (1-tailed)	.000
	N	104
SATCO-OG-1	Pearson Correlation	.626**
	Sig. (1-tailed)	.000
	N	104
SATCO-OG-2	Pearson Correlation	.533**
	Sig. (1-tailed)	.000
	N	104
SATCO-OG-3	Pearson Correlation	.457**
	Sig. (1-tailed)	.000
	N	104
SATCO-OG-4	Pearson Correlation	.227*
	Sig. (1-tailed)	.010
	N	104

* Correlation is significant at the .05 level (1-tailed).

** Correlation is significant at the .01 level (1-tailed).

IV. Scale item variances

High variance in response to a scale item indicates the item is capturing a meaningful level of diversity in the target population. The table below provides means, standard deviations, and variances for each item in the scale.

Table 4: Means, Standard Deviations, and Variances for Scale Items

	SATCO-COLL	SATCO-OG-1	SATCO-OG-2	SATCO-OG-3	SATCO-OG-4
Mean	6.46	2.79	3.50	3.87	5.50
Std Deviation	0.87	1.38	1.54	1.40	1.33
Variance	0.76	1.90	2.37	1.96	1.77

The responses to most of the items indicate moderate variance, with responses typically falling within one and a half units of the item mean. The SATCO-COLL, however, had low variance, with most responses not falling even one unit away from the item mean. Overall, the scale performs modestly to poorly on this criterion.

V. Item means

Two items means, the SATCO-OG-2 with a mean of 3.50 and the SATCO-OG-3 with a mean of 3.87, are near the response scale midpoint of ‘unsure’. The remaining items are one and half or more units away from the midpoint, with means near the center of the lower half or upper half of the response scale. Thus, there is partial success in meeting the criterion of item means near the scale midpoint.

VI. Coefficient alphas of the entire scale

The Cronbach’s alpha for the SATCO is low, with the SPSS-X scale reliability analysis procedure producing an alpha score of $\alpha = .04$. A lower alpha score was found for the OC subscale, with an alpha result of $\alpha = -.08$. No alpha score could be generated for the OG subscale, as this is a single-item scale.

Conclusion

The SATCO is weak in reliability, and has minimal support in validity. The scale needs substantial, perhaps total revision, if it is to provide meaningful information. A starting place is to re-write the reverse-scored items, and remove the comparisons of face-to-face and virtual teams incorporated into the questions. Outside expertise should be solicited for help in finding useful conceptual resources – theory, other scales, suggested question items, etc. – to help develop the scale.

In the interim, based on the above results changes have been made to the SATCO scale items. Specifically, it was decided that the SATCO would benefit from 1) simpler scale items that are 2) all phrased in the same direction. Removing the comparisons between face-to-face and virtual groups, and stating all items in the same direction produced new scale items as listed below:

- SATCO-COLL: Collaborating with others on scientific projects is always a rewarding experience.
- SATCO-OG-1: You get as much out of working with a virtual group as you do working with any group.
- SATCO-OG-2: It is easy to get work done in a virtual group.
- SATCO-OG-3: It is easy to develop trust in other group members when part of a virtual group.
- SATCO-OG-4: You feel less isolated when you work as part of a virtual group.

It is hoped these new items will produce a more reliable and valid scale. Future analyses will reveal the impact of these changes.

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