Reliability of the ecSatter Inventory as a Tool to Measure Eating Competence

Jodi L. Stotts, MS; Barbara Lohse, PhD, RD

ABSTRACT

Objective: To examine the reliability of the ecSatter Inventory (ecSI), a measure of eating competence.

Design: Self-report questionnaires were administered in person or by mail. Retesting occurred 2 to 6 weeks after completion of the first questionnaire.

Participants: Both administrations of the questionnaire were completed by 259 participants who were mostly food secure, white females with some college education; mean age was 26.9 ± 10.4 years.

Measures: Test-retest reliability and internal consistency.

Analysis: Spearman's rank correlation coefficients to estimate test-retest reliability and Cronbach alpha coefficients to estimate internal consistency.

Results: Spearman's rank correlation coefficient for ecSI total score was 0.68; subscale coefficients were 0.70 for eating attitudes, 0.70 for contextual skills, 0.65 for food acceptance, and 0.52 for internal regulation. Cronbach alpha coefficient for ecSI total score was 0.77. Subscale alphas coefficients were 0.80 for eating attitudes, 0.69 for contextual skills, 0.68 for food acceptance, and 0.66 for internal regulation.

Conclusions and Implications: This study provides psychometric evidence about the reliability of ecSI as a measure of eating competence in this sample. Although some ecSI items may require revision, results suggest that the instrument may be used to evaluate nutrition education designed to improve eating competence.

Key Words: eating competence, reliability, food behavior, psychometric testing

(*J Nutr Educ Behav.* 2007;39:S167-S170)

INTRODUCTION

The ecSatter Inventory (ecSI) is a questionnaire designed to empirically assess constructs of the Satter eating competence model (ecSatter).[1,2] This model conceptualizes functional eating attitudes and behavior.[2] According to ecSatter, individuals who are eating competent (1) are positive and orderly with eating; (2) have food acceptance skills, allowing increased variety throughout life; (3) guide food regulation based on internal cues of hunger, appetite, and satiety; and (4) show positive food context skills that allow reliable and rewarding access to food.[2]

ecSI has been validated with a large sample of the general population (N = 863).[1] Construct dimensionality and validity were confirmed by factor analysis and comparison to validated instruments, including the Three-Factor Eating Questionnaire,[3] Eating Disorders Inventory-2,[4] a food preference survey,[5,6] and pretested food preparation questions,[7] respectively. Factor analysis revealed 4 distinct constructs: eating attitudes, food acceptance, internal regulation, and contextual skills. In addition, specific behavioral profiles supported construct validity. Persons who were eating competent were more likely to experience weight satisfaction, be physically active, and meet fruit and vegetable intake recommendations. These findings were supported by Psota et al,[8] who found eating competence to be associated with a more healthful cardiovascular biomarker pattern. Thus, a goal of attaining eating competence is a goal of improving dietary quality, establishing good weight status, and optimizing health.

The purpose of this study was to assess the test-retest

reliability of ecSI to determine its usefulness as a measure of eating competence. In order to substantiate the ability of a new instrument to operationalize a theoretical concept, its psychometric properties, including reliability, must be evaluated.[9] Test-retest reliability is a measure of external consistency or temporal stability of an instrument. Good test-retest reliability ensures that an instrument can be used to determine the effect of one variable on another.[10] In nutrition education, temporal stability of an instrument is imperative if it is to be used to assess the need for and effectiveness of interventions.[10,11] ecSI will be used to measure success of nutrition education interventions developed to improve functional eating attitudes and behavior. As such, ecSI must be temporally stable, with scores fluctuating only in response to an independent variable or condition.[10]

DESCRIPTION OF STUDY
Recruitment

A convenience sample of adults in the United States participated in this reliability study of ecSI. Subjects were recruited via word of mouth and e-mail invitation. Overestimation of external reliability resulting from stable eating behavior was addressed by oversampling young adults whose eating behaviors are known to fluctuate and by securing an economically diverse sample.[12] To meet this goal, young adults were recruited from summer programs, college classrooms, and GED courses. Other participants recruited included employees at high schools and university offices, personal contacts, and clients at Pennsylvania WIC agencies. Exclusion criteria were age (younger than 18 or older than 65 years of age); limited English literacy; studying in or employment by a nutrition-related field; pregnancy or lactation; diagnosis of diabetes, cancer, or heart, liver, or lung disease in the past 5 years; undergoing dialysis; current tube feeding or total parenteral nutrition; or being a recipient of surgery for weight loss (eg, gastric bypass). As incentive for participation, subjects who completed both the first and second administrations of the questionnaire were eligible to be included in a drawing for one of five $100 gift cards. Winners were notified by telephone and then were mailed the gift card. Personal identifiers were destroyed thereafter. This study was approved by the university's Institutional Review Board for the Protection of Human Subjects.

Data Collection

The study was conducted from July to November 2006. Questionnaires were distributed by hand-delivery or mail. Mailed questionnaires included a self-addressed, stamped return envelope for ease of return. To assess test-retest reliability, ecSI was administered twice, with the second administration (Time 2) occurring 2 to 6 weeks after the initial administration (Time 1). Time 2 questionnaires completed within 6 weeks (42 days) after completion of

Time 1 questionnaires were deemed acceptable for inclusion in the study. This time period was chosen to decrease the likelihood of measurement error attributable to the ecSI.[11]

Measurements

ecSI was the primary instrument tested in this study. This self-report, paper-and-pencil questionnaire consists of 16 Likert-scaled items summed to yield a total ecSI score (possible score range: 0-48) and 4 subscale scores: eating attitudes (0-15), food acceptance (0-9), internal regulation (0-9), and contextual skills (0-15). In conjunction with the initial administration of the questionnaire, demographic information, food security (measured by USDA Household Food Security Scale[13]), and self-reported height and weight (to calculate body mass index) were collected, as were measures of dietary behavior not reported here. The entire questionnaire packet took approximately 15 minutes to complete.

Data Analysis

The analysis sample (n = 259) was restricted to participants who returned both Time 1 and Time 2 questionnaires within the allotted time frame and answered all ecSI items. A total of 370 respondents completed the first questionnaire; 273 (73.8%) also completed the second questionnaire. Of those participants who completed both questionnaires, 14 were excluded (5 due to missing responses on ecSI and 9 because the second questionnaire was returned after the acceptable range of time), resulting in the final analysis sample of 259. To explore the impact of the time interval between the first and second administrations of the questionnaire, the final sample was further divided into 2 retest groups—those who completed the Time 2 questionnaire 14 to 21 days after Time 1 (n = 109) and those who completed the Time 2 questionnaire 22 to 42 days after Time 1 (n = 150).

Participant characteristics were examined with descriptive statistics. Differences in respondent and Time 2 nonrespondent characteristics were compared with chi-square and independent sample t tests. Test-retest reliability of ecSI total and subscale scores was assessed with Spearman's rank correlation coefficients (rho, r_s). Test-retest reliability was confirmed with paired sample t tests. Analysis of variance was used to examine the main effects of descriptive variables on differences in ecSI total and subscale scores. ecSI total and subscale internal consistency reliability coefficients were determined by calculating Cronbach alpha (α). In addition, subscale alpha reliability coefficients were examined for internal consistency if individual items were removed from their respective subscales. Rho and alpha coefficients ≥ 0.70 have been reported as acceptable; however, no definitive cutoff value has been established.[9,11]

Therefore, for the purposes of this study, rho and alpha coefficients that approached 0.70 were considered acceptable. A value of $P < .05$ was considered statistically significant for all analyses. Data analyses were conducted using Statistical Package for the Social Sciences (version 13.0 for Windows, 2004, SPSS, Inc., Chicago, IL).

FINDINGS AND DISCUSSION
Description of Participants

Participant characteristics are shown in Table 1. Most participants were food secure white females with some college education. Mean age was 26.92 ± 10.41 (range 18–65). Mean Body Mass Index was 24.54 ± 4.67 kg/m^2 (range 16.24–40.35).

Participant characteristics did not differ between respondents who completed the Time 2 questionnaire either 14-21 days or 22-42 days after Time 1 (data not shown). Participants who completed only the Time 1 questionnaire

Table 1. Participant Characteristics (n = 259)

Variables	n	%
Sex		
Female	178	68.7
Male	81	31.3
Age		
18-25	163	62.9
26-35	52	20.1
36-45	19	7.3
46-55	19	7.3
56-65	6	2.3
Race/ethnicity		
Asian	10	3.9
Black or African American	10	3.9
Hispanic/Latino	4	1.5
White	231	89.2
Other	4	1.5
Level of education		
Some high school	13	5.0
High school diploma/GED	15	5.8
Some college	139	53.7
Technical/business school	5	1.9
College degree	59	22.8
Graduate/professional degree	28	10.8
Level of food security[a]		
Food secure	211	83.1
Food insecure	43	16.9
Body mass index (kg/m^2)[b]		
Underweight (<18.5)	8	3.1
Normal weight (18.5-24.9)	158	61.2
Overweight (25.0-29.9)	59	22.9
Obese (≥30.0)	33	12.8

[a]n = 254
[b]n = 258

did not differ from participants who completed both the Time 1 and 2 questionnaires on any participant characteristic with the exception of recruitment location. Nonresponders to the second questionnaire (n = 97; 26.2%) were significantly more likely to be recruited from low-income venues than those who completed both questionnaires (data not shown).

Test-retest Reliability

Temporal reliability correlations for ecSI total scale and each subscale score were significant ($P < .001$). As shown in Table 2, test-retest reliability was evident for ecSI total scale and 3 subscales—eating attitudes, food acceptance, and contextual skills. Test-retest reliability was confirmed with paired sample t tests, which were nonsignificant except for the internal regulation subscale ($P = .017$).

Internal regulation subscale reliability was low ($r_s = 0.52$). Change in the mean score for internal regulation subscale could not be attributed to any particular participant characteristic, including food security. Thus, low test-retest reliability for internal regulation subscale may be the result of construct issues.[11]

To determine whether the time interval between questionnaire completion influenced test-retest reliability, Time 1 and Time 2 ecSI scores were compared for differences between Time 2 questionnaire completion (14-21 days vs. 22-42 days). The ecSatter Inventory was consistently stable across a 2- to 6-week time period; that is, differences between the 2 groups were not significant (data not shown).

Internal Consistency

Internal consistency is concerned with an estimate of reliability based on the average correlation among items within a scale and is based on number of items.[9] Total scale and subscales for eating competence neared, met, or exceeded internal consistency acceptability criteria ($\alpha \geq 0.70$; Table 2). Time 1 reliability coefficient for ecSI total score was 0.77; subscale coefficients ranged from 0.66 for internal regulation to 0.80 for eating attitudes. (Time 2 reliability coefficients paralleled those found at Time 1; Time 2 Cronbach αs were 0.83 for ecSI total scale, 0.84 for eating attitudes, 0.70 for food acceptance, 0.73 for internal regulation, and 0.74 for contextual skills.) These findings were comparable to, although slightly lower than, those of Lohse et al,[1] who found the following Cronbach alphas: ecSI total scale ($\alpha = 0.85$), eating attitudes ($\alpha = 0.82$), food acceptance ($\alpha = 0.70$), internal regulation ($\alpha = 0.71$), and contextual skills ($\alpha = 0.79$). Higher scores found by Lohse and colleagues may be reflective of their larger, somewhat older and better-educated sample.

Examination of internal consistency if an item was deleted from its respective subscale revealed that Cronbach alpha for internal regulation would have been 0.83 if the item "I assume I will get enough to eat" was removed.

Table 2. Test-Retest Reliability and Internal Consistency of ecSatter Inventory (ecSI)

| ecSI Scales[†] | ecSI Scores[‡] | | Test-Retest Reliability | Internal Consistency[§] |
	Time 1	Time 2	r_s	α
Total score	31.31 ± 6.39 (12-45)	31.49 ± 6.89 (6-45)	0.68**	0.77
Eating attitudes	11.30 ± 3.02 (0-15)	11.22 ± 3.11 (0-15)	0.70**	0.80
Food acceptance	4.98 ± 2.16 (0-9)	4.92 ± 2.06 (0-9)	0.65**	0.68
Internal regulation	6.60 ± 1.72* (1-9)	6.85 ± 1.80* (1-9)	0.52**	0.66
Contextual skills	8.42 ± 2.93 (0-15)	8.50 ± 3.03 (0-15)	0.70**	0.69

*$P < .05$
**$P < .001$
[†]Possible score ranges are 0-48 (total ecSI score), 0-15 (eating attitudes or contextual skills) and 0-9 (food acceptance or internal regulation)
[‡]Mean ± standard deviation (range)
[§]Based on first administration of questionnaire

Separate analysis for food-secure and food-insecure groups demonstrated that this analysis was not confounded by food insecurity. If internal consistency is low, then either the scale is too short or items have very little in common.[9] The item in question for the internal regulation subscale may not complement the other items in their measurement of internal regulation. The authors suggest further development and evaluation of the internal regulation subscale.

Findings from this study have limitations. Participants were not randomly selected, resulting in a sample of primarily white, food-secure females with some college education. Although the recruitment strategy allowed for an economically diverse sample, participants recruited from low-income venues were more likely to drop out of the study. This systematic difference in attrition may have resulted in a nonresponse bias, possibly lessening the generalizability of these results to low-income audiences. Furthermore, although ecSI has since been translated to Spanish, only the English version was tested in this study. Thus, reliability of ecSI should be examined with such audiences as well as additional population groups, including other racial/ethnic groups and cultures and less-educated individuals, prior to use as an assessment tool.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The primary purpose of this study was to examine the reliability of ecSI as a tool to measure eating competence. Findings revealed ecSI to be a reliable measure for assessing the impact of eating competence-focused interventions. ecSI's sensitivity to measure the degree of change as a result of an intervention will require additional examination. These findings suggest the need for further assessment of the internal regulation subscale and additional testing of ecSI with a more heterogeneous sample.

REFERENCES

1. Lohse B, Satter E, Horacek T, Gebreselassie T, Oakland MJ. Measuring eating competence: Psychometric properties and validation of the ecSatter Inventory. *J Nutr Educ Behav (suppl)*. 2007;39:S154-S166.
2. Satter E. Eating competence: Definition and evidence for the Satter eating competence model. *J Nutr Educ Behav (suppl)*. 2007; 39:S142-S153.
3. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res*. 1985;29(1):71-83.
4. Garner DM. *Eating Disorders Inventory-2, Professional Manual*. Lutz, Fl: Psychological Assessment Resources, Inc.; 1991.
5. Drewnowski A, Hann C. Food preferences and reported frequencies of food consumption as predictors of current diet in young women. *Am J Clin Nutr*. 1999;70:28-36.
6. Drewnowski A, Hann C, Henderson SA, Gorenflo D. Both food preferences and food frequency scores predict fat intakes of women with breast cancer. *J Amer Diet Assoc*. 2000;100:1325-1333.
7. USDA Cooperative State Research Education and Research Service, Nutrition, Evaluation/Reporting System (ERS4), an evaluation tool of the Expanded Food and Nutrition Education Program (EFNEP). 2006. Available at: http://www.csrees.usda.gov/nea/food/efnep/ers/ers4.html. Accessed August 17, 2007.
8. Psota T, Lohse B, West SG. Associations between eating competence and cardiovascular disease biomarkers. *J Nutr Educ Behav (suppl)*. 2007;39:S171-S178.
9. Nunnally JC. *Psychometric Theory*. 2nd ed. New York: McGraw-Hill, 1978.
10. Black J, Champion DJ. *Methods and Issues in Social Research*. New York: Wiley; 1976.
11. Litwin MS. *How to Measure Survey Reliability and Validity*. Thousand Oaks, Calif: Sage Publications, Inc.; 1995.
12. Arnett JJ. *Emerging Adulthood: the Winding Road from the Late Teens through the Twenties*. New York: Oxford University Press; 2004.
13. Bickel G, Nord M, Price C, Hamilton W, Cook J. *Guide to Measuring Household Food Security, Revised 2000*. Alexandria, Va: US Department of Agriculture, Food and Nutrition Services; 2000.