Cognitive Indicators of Knowledge in Semantic Domains*

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ABSTRACT: This paper describes a further validation of the cultural consensus model (Romney, Weller, and Batchelder 1986). Informants first rated their knowledge in one of five semantic domains (birds, countries, diseases, fabrics, and flowers) and then free listed words from that domain. Informants next (in most cases) reported which of a set of items from a domain they could recognize and finally performed one or two structured tasks (matching or triads test and ranking) in the domain. Overall, informants who agreed more with others in a structured task (i.e., displayed greater cultural competence) free listed more words, rated themselves as more knowledgeable, and reported being able to recognize more items than informants who agreed less with others. In addition, consensus estimated answer keys for structured tasks corresponded closely with objective external standards when they were available. The results suggest that free listing capacity, in particular, might be useful as a rapid and preliminary measure of informants' knowledge levels in specific semantic domains.

KEY WORDS: cultural consensus analysis, free listing, intracultural variation, recognition ability, self-rating

Throughout the history of anthropology, definitions of culture have asserted that culture is shared. Yet when anthropologists interview informants, they frequently find disagreement. This intracultural variation challenges anthropologists to develop principled methods for determining cultural beliefs and measuring informants' levels of cultural knowledge.

In addressing these problems at the conceptual level over the past several decades, anthropologists have come to recognize culture sharing as a matter of degree. However, it has only been recently that anthropologists have devised systematic methods of measuring cultural knowledge and sought to validate their explicit characterizations of cultural knowledge. In his comprehensive study of Aguaruna classification of manioc plants, Boster (1985) showed that the pattern of agreement among informants reflected differences in knowledge that would be expected from various social structural and individual factors. Boster (1985) assessed individuals' knowledge levels by calculating the amount of agreement between each informant's responses to a standard set of interview questions and the aggregated responses of other informants. (Although most anthropologists are not aware of his work, Kaufman (1946) was perhaps first to discover that an individual's agreement with the aggregate indicates knowledge).

Romney, Weller, and Batchelder (1986) formalized this idea in their cultural consensus model (see also Batchelder and Romney 1988; Romney, Batchelder, and Weller 1987). They argued that under a few general assumptions, informants' knowledge levels, or cultural competences, in a semantic domain can be estimated directly from the pattern of interinformant agreement for a standard set of systematic interview questions. Specifically, cultural competence indexes the degree of an informant's concordance with other informants. Cultural consensus analysis also provides estimates of the "culturally correct" answers to the interview questions based on weighting informants' responses by their competences.

Researchers have tried to validate this notion of cultural knowledge by comparing cultural competence with indices of knowledge that are not based on the agreement among informants. Boster (1985) found that informants who agreed more with others in naming manioc plants displayed greater test-retest reliability than those who agreed less with others. In addition, Weller (1984) and Brewer, Romney, and Batchelder (1991) observed that more competent informants in paired comparison tasks exhibited greater internal consistency than less competent informants. Furthermore, Romney *et al.* (1986) showed that when objective external standards for the answers to interview questions were available (e.g., for class exams), informants' cultural competences were strongly related to their scores based on the external standards. Similarly, in several studies (Iannucci and Romney 1993/94; Romney *et al.* 1986, 1987; Romney, Webster, and Batchelder n.d.) consensus estimated answers matched closely the external standards.

In this paper, I describe another attempt to validate the cultural consensus model by comparing cultural competence with other measures of knowledge in semantic domains, including free listing capacity, self-rating of knowledge, and self-reported recognition ability. To the extent that cultural competence is the most theoretically informed and useful notion of cultural knowledge, this paper also examines the appropriateness of using these alternate measures for rapid and/or preliminary assessment of informants' knowledge levels. As such, this paper responds to Bernard, Pelto, Werner, Boster, Romney, Johnson, Ember, and Kasakoff's (1986) call for developing systematic procedures of identifying knowledgeable informants.

Free listing is a standard elicitation procedure in which an informant lists all the lexical items in a semantic domain s/he can think of (Weller and Romney 1988). The number of words an informant generates during free listing, which I call free listing capacity, has been used as an indicator of knowledge by Gatewood (1983, 1984) and suggested as a loose measure of knowledge by Borgatti (1990). Informants' free listing capacities suggest their levels of familiarity with and fluency in a particular domain, at least in a linguistic sense. While free listing from a domain for a reasonable length

of time (say 5 or 10 mins.) undoubtedly will not exhaust all the items in that domain known to the informant (cf. Brown 1923; Johnson, Johnson, and Mark 1951), the number of items listed is mostly a function of the total supply of items available to that informant and not merely a result of that informant's rate of output (Johnson *et al.* 1951).

Self-rating of knowledge in a semantic domain and self-reported recognition ability of particular items in a semantic domain were used as indicators of knowledge by Gatewood (1984). Self-rating of knowledge would seem to have some face validity since people would be expected to know whether they are expert in a domain. Similarly, it appears reasonable that more knowledgeable informants would report being able to recognize more items in a domain than less knowledgeable informants.

In order to validate the cultural consensus model by correlating cultural competence with other indicators of knowledge, there must be genuine intracultural variation in informants' knowledge with respect to the systematic interview questions. If informants do not differ in their underlying knowledge levels for a structured task, then no external variable will be reliably associated with competence. In this study, I implemented Weller's (1987) simulation procedures to identify those situations where genuine intracultural variation in informants' knowledge regarding systematic interview questions was suspect. This paper also compares informants' responses to the systematic interview questions with objective external standards and examines informant motivation as a possible influence on informants' observed knowledge levels.

METHOD

Informants

Informants were undergraduates at the University of California, Irvine and all were native speakers of English. They received course credit for participating in the study. Informants completed tasks in groups of 5 to 15 in a classroom, seated individually at desks fairly widely spaced apart.

Procedure

The relationships among the indices of knowledge were investigated in five semantic domains which have been frequently studied by cognitive anthropologists and cognitive psychologists: birds, countries of the world, diseases, fabrics, and flowers. Informants completed tasks in one domain only.

All informants performed tasks in the same sequence. First, informants answered questionnaires in which they gave demographic information about themselves and rated their knowledge in a given domain. The self-rating question asked informants "in comparison to other college studies, how much do you know about [domain name]?" Informants gave their self-ratings on a 7 point scale in which "1" was labeled "practically nothing", "4" was labeled "about average", and "7" was labeled "a great deal." This self-rating question and scale closely match those used by Gatewood (1984). Then, on a separate page, informants free listed from a semantic domain. The instructions for the free listing task were: "What are all the kinds of [domain name]? Please write down the names of all the [domain name] you can think of."[1] Informants were given 10 minutes to write their responses.

Subsequent tasks in a domain included a standard set of works. The standard sets of words for each domain were taken from those lexical items generated in free listing by a different group of approximately 21 informants. For each domain, high and low salience lists were constructed. Items' salience was operationalized here by frequency of mention in free lists (cf. Romney and D'Andrade 1964). High salience lists consisted of the 21 most frequently mentioned words in a domain and low salience lists consisted of words mentioned by at least two but no more than 40% of the informants (see the Appendix for these lists). A full 21-item low salience list for fabrics could not be constructed by these criteria. Therefore, words from Gatewood's (1984) fabrics list which were not already included in my high salience or incomplete low salience lists but were mentioned by at least 5 of his informants were added to make a complete 21-item low salience list. For the countries and fabrics domains, additional combined lists were created by merging the high and low salience lists for that domain (see below for details).

Thus, after the self-rating and free listing tasks, informants did additional tasks based on a standard word list. For combined lists, informants provided self-reports of their ability to recognize particular items on the list. All informants performed one or two "consensus" tasks, i.e., tasks for which responses may be analyzed with cultural consensus analysis. For high and low salience lists, informants performed a triads test and ranking task. For combined lists, informants only performed a matching task. In some cases for high and low salience lists, the final task informants did was a self-reported recognition task. (The recognition and consensus tasks are described in detail below).

Informants who performed the high salience list tasks were the first informants to participate in the study (except for the flowers domain, in which informants who performed the low salience list tasks were first). All of the various standard lists were created from their free listing responses. Some of these "first-stage" informants were not native speakers of English, so they were not included in this study. (Non-native English speakers might have knowledge in a domain that is not able to be fully expressed or measured in English). However, the standard lists for a domain

were based on the free lists of all "first-stage" informants, native and non-native English speakers alike.

Informants for high salience list tasks in the birds, countries, diseases, and fabrics domains and informants for the low salience list tasks in the flowers domain completed the self-rating and free listing tasks one day and then returned two days later for the consensus and recognition (in some cases) tasks. All other sets of informants performed each task during one interview session. The self-rating, free listing, recognition/consensus task sequence prevented the recognition and consensus tasks from influencing (by exposing informants to domain items) the free listing task.

For the self-reports of recognition ability, informants indicated on a individually randomized questionnaire which items they could recognize if they were to see (for birds, fabrics, and flowers), smell (for flowers), and/or touch (for fabrics) them. In the birds domain, informants gave self-reports of recognition ability only for the low salience list. For the combined countries list, informants indicated on an individually randomized questionnaire which countries they could locate on a map that did not show the names of the countries and cities. The self-report measure of recognition ability used here, which is based on a standard set of items, contrasts with the one used by Gatewood (1983, 1984), which is based on a different set of items for each informant (i.e., the items an informant free listed). My measure, though, approaches the one Gatewood (1984: 515–516) suggested as an improvement over his own.

For the triads tests, informants were presented with 70 sets of three items and asked to circle the item most different in meaning from the other two. Each triads test was individually randomized and constructed according to a lambda-one, balanced, incomplete block design (Burton and Nerlove 1976). For the countries domain, informants were instructed to judge the geographical proximity of the three countries in a triad. There was no triad in which the three countries were contiguous.

For the ranking tasks, informants received an individually randomized questionnaire of 21 items and were asked to rank the items from "1" to "21" on some dimension, with "1" indicating the most and "21" the least on that dimension. The dimensions for the birds, countries, diseases, fabrics, and flowers domains were size, population, contagion, coarseness, and fragrance, respectively. Previous work has demonstrated that size and contagion are major components of the semantic structures of the birds and diseases domains, respectively (e.g., Boster 1989; D'Andrade 1976). My pilot testing with another sample of UC Irvine undergraduates showed that coarseness was a primary organizing factor in the semantic structure of fabrics.

For the countries matching task, informants were given maps indicating only the borders of countries (Maps On File 1981). Each informant received six pages of maps (in one of six balanced orderings) with numbers indicating the 42 countries they were to identify (see the Appendix for which countries were numbered on which maps). The 42 countries consisted of all the counties in the high and low salience lists, except the U.S.S.R., which was replaced with Thailand (the 43rd most frequently mentioned country by high salience list informants). Numbers were randomly assigned to countries and matching questionnaires listed country names in individually randomized orders. Informants were asked to match the country numbers on the map to the country labels on the questionnaire.

For the fabrics matching task, informants were given 4″ × 6″ wire-ring notebooks of index cards which had 4″ × 4″ samples of fabrics stapled on the cards, one sample per numbered card. Each fabric notebook contained 27 different fabric samples (in individually randomized orders) and all samples of a particular fabric were cut from the same bolt of material. I obtained the fabrics from two local fabric stores and only included those fabrics which were labelled by the store with the same term informants had mentioned. Thus only 27 of the 32 fabrics from the high and low salience lists were used. Informants were asked to match the numbers of the fabric samples in the notebook with the fabric labels printed on a questionnaire.

Questionnaires for the self-reports of recognition ability, triads tests, ranking tasks, and countries matching tasks were produced with ANTHROPAC (Borgatti 1992). ANTHROPAC was also used for many of the data analyses.

Informants' motivation to perform well in the tasks was measured indirectly. Laura Yang, who at the time of data collection was an undergraduate at the University of California, Irvine, unobtrusively recorded the time at which informants for the combined lists arrived to participate in the study. All informants in a particular interview session had signed up several days earlier to participate in that session. Rosenthal, Kohn, Creenfield, and Carota (1966) showed that subjects who arrived at a psychology experiment earlier displayed a greater need for social approval than those subjects who arrived later. Persons with a high need for social approval might be more motivated to perform optimally in a study such as this. Thus, arrival time was used as a crude indicator of informant motivation.

RESULTS

Indicators of knowledge for high and low salience lists

Tables IA and IB show the summary statistics for the indicators of knowledge for the high and low salience lists in all domains. The free listing measure represents the number of different items an informant mentioned in 10 minutes. In making these counts, I did not omit any free listed items

TABLE IA
Descriptive statistics for indicators of knowledge: high salience lists.

Variable	Birds	Countries	Diseases	Fabrics	Flowers
# informants	13	14	10	13	27
Triads eigenvalue ratio	7.22	23.83	6.39	6.99	2.93
Triads competence Mean (s.d.)	0.52 (0.12)	0.76 (0.12)	0.62 (0.13)	0.52 (0.13)	0.32 (0.12)*
Range of simulated tri. comp. s.d.'s	0.06–0.11	0.05–0.09	0.06–0.09	0.06–0.11	0.09–0.12
Ranking eigenvalue ratio	36.85	7.87	6.44	8.00	4.17
Ranking competence Mean (s.d.)	0.94 (0.04)*	0.79 (0.10)*	0.79 (0.26)	0.76 (0.10)*	0.61 (0.15)*
Range of simulated rank. comp. s.d.'s	0.02–0.06	0.07–0.15	0.05–0.14.	0.05–0.15	0.10–0.24
Free listing Mean (s.d.)	25.00 (8.52)	44.29 (12.38)	19.80 (6.41)	13.00 (4.88)	14.81 (5.19)
Self-rating Mean (s.d.)	3.08 (1.38)	4.14 (0.77)	3.90 (1.37)	3.23 (1.30)	3.33 (1.21)
Recognition Mean (s.d.)	–	–	–	16.85 (2.41)	11.78 (3.93)

* Genuine intracultural variation in informants' knowledge on this task is suspect.

TABLE IB
Descriptive statistics for indicators of knowledge: low salience lists.

Variable	Birds	Countries	Diseases	Fabrics	Flowers
# informants	23	26	26	27	13
Triads eigenvalue ratio	10.00	9.67	4.79	5.13	2.15
Triads competence Mean (s.d.)	0.58 (0.15)	0.56 (0.21)	0.44 (0.13)*	0.42 (0.16)	0.30 (0.18)
Range of simulated tri. comp. s.d.'s	0.07–0.11	0.06–0.11	0.08–0.14	0.09–0.11	0.09–0.16
Ranking eigenvalue ratio	20.19	2.15	9.65	2.37	1.94
Ranking competence Mean (s.d.)	0.87 (0.09)*	0.43 (0.31)	0.81 (0.11)*	0.59 (0.16)*	0.47 (0.20)*
Range of simulated rank. comp. s.d.'s	0.05–0.09	0.15–0.26	0.05–0.11	0.09–0.21	0.11–0.31
Free listing Mean (s.d.)	26.61 (6.91)	46.69 (10.99)	18.27 (6.02)	15.70 (5.86)	18.62 (9.54)
Self-rating Mean (s.d.)	3.00 (1.17)	4.00 (1.02)	4.12 (1.11)	3.15 (1.35)	3.38 (1.19)
Recognition Mean (s.d.)	14.74 (3.32)	–	–	13.22 (4.21)	9.69 (5.85)

* Genuine intracultural variation in informants' knowledge on this task is suspect.

(except repetitions) from any informant's free list because I wanted to mimic the situation in which a researcher knows nothing or little about the domain under study. Less than 5% of informants had missing data on one or a very few triads for the high and low salience lists; these missing data were replaced with random data. Self-reported recognition ability refers to the number of items on a list which an informant indicated s/he could recognize.

For cultural consensus analysis, triads data were treated as multiple choice data. Although triads data technically violate the local independence (because each item appears in 10 different triads) and homogeneity of items (because some triadic judgments are clearly easier than others) axioms of the formal *process* model described by Romney *et al.* (1986), for my purposes these violations are relatively unimportant. I calculated the association between cultural competence and Weller's (1984) data-based reliability measure for the triads data in 17 domains from Romney, Brewer, and Batchelder's (1993) study: in every case, the two measures correlated above 0.99. Therefore, the choice of the process model competence measure over the data-based reliability index makes little difference in measuring informants' relative knowledge levels. Other researchers have analyzed triads data with consensus analysis in similar ways (e.g., Boster 1991). The ranking data were analyzed with the ordinal/interval scale *data* model for consensus analysis (Romney *et al.* 1987)

Cultural consensus analysis involves factoring the interinformant agreement matrix (corrected for guessing for multiple choice data) with minimum residual factor analysis (maximum likelihood factor analysis for ordinal/interval scale data). If this procedure yields a single factor solution (i.e., the first factor's eigenvalue is several (approximately 3) times larger than the second factor's eigenvalue), then the agreement data fit the consensus model. Informants' loadings on the first factor represent their cultural competences, or amount of agreement with others for their responses to the systematic interview questions. For the data to fit the cultural consensus model, all informants' competences should also be positive except for sampling variation. Thus, if the data fit the cultural consensus model, informants share knowledge on the culturally correct answers to the systematic interview questions.

For triads tests with high and low salience lists in the birds, countries, diseases, and fabrics domains, there were large eigenvalue ratios. The eigenvalue ratios for the high and low salience lists in the flowers domain were smaller (2.93 and 2.15, respectively), indicating poorer fits to the consensus model. There was one informant each with a negative competence for the low salience lists in the fabrics and flowers domains. Hence, overall, the triads data displayed acceptable fits to the cultural consensus model.

For the high salience lists, ranking data fit the cultural consensus model

well in all domains, with large eigenvalue ratios and no informants with negative competences. The eigenvalue ratios for the low salience lists in the countries, fabrics, and flowers domains were low, signifying poor fits to the consensus model. Three informants registered negative competences in the low salience list for countries, confirming the lack of fit to the consensus model for this list. Thus, the ranking data also fit the consensus model in most cases.

The samples of informants for the high and low salience lists in a domain were very similar in terms of their free listing capacities and self-ratings of knowledge. Informants for the high and low salience lists in the fabrics domain also were comparable to Gatewood's (1984) informants in terms of free listing and self-rating: Gatewood's (1984) informants mentioned a mean of 11.9 fabric terms and had mean self-rating of 3.06, which are very close to the mean values reported in Tables IA, IB, and IV. In addition, informants generally displayed greater consensus on triads and ranking tasks (as indexed by mean competence) for high salience lists than for low salience lists. Informants' self-reported recognition ability was also greater for high salience lists than for low salience lists in the fabrics and flowers domains.

To test for genuine intracultural variation in informants' knowledge for consensus tasks, I simulated triads and ranking response data for high and low salience lists in every domain using Weller's (1987) procedures. I simulated triads data by probabilistically creating responses to 70 3-option multiple choice questions for a set of simulated "informants." The number of informants simulated was equal to the number of informants who had performed triads tests for a given list in a domain. Each simulated informant was assigned the *same* probability of "knowing" the culturally correct answer to each question, which was the mean observed competence for the actual informants who performed that task. A simulated informant's response to each question was determined probabilistically and if the simulated informant did not "know" the culturally correct answer to the question, the response was determined randomly from the 3 response options (i.e., simulated "guessing"). The procedures for simulating the ranking data are somewhat more complex, although the basic ideas are similar to those just described. Interested readers should consult Weller (1987) for a thorough description of the simulation procedures.[2]

Thus, by employing these procedures, simulated data sets appropriate for consensus analysis were produced. I created 10 simulated data sets for each high and low salience list consensus task in every domain, and then submitted each simulated data set to cultural consensus analysis. I noted the standard deviation of simulated informants' competences for each simulated data set. This variation in simulated informants' competences results from random "guessing" and the probabilistic nature of which simulated informants "know" the correct answers to which questions, even though all simulated informants had the same underlying knowledge level. Tables IA and IB report the range of these standard deviations of competence for the 10 simulated data sets for each high and low salience list consensus task in the five domains. If the standard deviation of real informants' observed competences fell within this range, then I considered genuine intracultural variation in informants' knowledge for this task to be suspect. In such cases, the observed individual differences in competence could well be due to guessing and sampling variability. As a result, other indicators of knowledge might not reliably correlate with competence in these situations.

For the triads tests with high salience lists, there seemed to be genuine intracultural variation among informants in 4 of the 5 domains. However, for ranking tasks with high salience lists, genuine intracultural variation among informants appeared to be present in only 1 of 5 domains. Similarly, there was apparently genuine intracultural variation among informants for triads tests with low salience lists in 4 of 5 domains, and for ranking tasks with low salience lists in 1 of 5 domains.

Tables IIA and IIB present the correlations among the indicators of knowledge for high and low salience lists. Table III shows a summary of these correlations, including the mean Pearsonian correlation and cumulative Z-score for each pair of indicators. Mean Pearsonian correlations were obtained from Fisher's (1948) z-transformations and weighting by sample size, and cumulative Z-scores were computed by Stouffer's method of aggregation (Mosteller and Bush 1954) for the z-transformed correlations. I inspected scatterplots for all pairs of indicators and found no obvious nonlinear patterns or tendencies toward heteroschedasticity.

These tables demonstrate modest to moderate positive associations between cultural competence and the other indicators of knowledge. For correlations involving triads competence, the coefficients tended to be larger when there appeared to be genuine intracultural variation in knowledge for the triads test and when the data fit the consensus model (i.e., excluding low salience flowers). In those cases, free listing capacity was most strongly related to triads competence, with a mean correlation of 0.44, while self-rating of knowledge and self-reported recognition ability were more weakly associated with triads competence, with mean r's of 0.21 and 0.28, respectively. All triads competence × free listing capacity correlations were positive for those cases where there was genuine intracultural variation in knowledge for the triads tests and where the triads data fit the consensus model. The triads competence × self-rating of knowledge correlations, in contrast, were negative in 3 of these 7 cases. Even though genuine intracultural variation in the ranking tasks appeared suspect, real individual differences in knowledge for these tasks still may have been present, as indicated by the 10 all positive triads competence × ranking competence correlations and mean r of 0.29.

TABLE IIA
Correlations among indicators of knowledge: high salience lists.

Variables	Birds	Countries	Diseases	Fabrics	Flowers
Triads comp. × ranking comp.	0.13	0.06	0.02	0.44	0.25
Triads comp. × free listing	0.02	0.70	0.63	0.16	0.11
Triads comp. × self-rating	–0.21	0.48	0.22	–0.09	–0.05
Triads comp. × recognition	–	–	–	0.36	–0.09
Ranking comp. × free listing	0.29	–0.09	–0.06	0.36	–0.02
Ranking comp. × self-rating	–0.31	0.22	–0.18	–0.16	0.03
Ranking comp. × recognition	–	–	–	0.36	–0.31
Free listing × self-rating	–0.05	0.58	0.14	0.09	0.45
Free listing × recognition	–	–	–	0.77	0.73
Self-rating × recognition	–	–	–	0.33	0.38

Note: Correlations which are *not* underlined involve a competence variable from a consensus task where genuine intracultural variation in informants' knowledge is suspect or the data do not fit the consensus model.

TABLE IIB
Correlations among indicators of knowledge: low salience lists.

Variables	Birds	Countries	Diseases	Fabrics	Flowers
Triads comp. × ranking comp.	0.48	0.06	0.22	0.52	0.45
Triads comp. × free listing	0.11	0.67	–0.08	0.48	–0.18
Triads comp. × self-rating	–0.05	0.53	0.19	0.20	–0.08
Triads comp. × recognition	0.09	–	–	0.40	–0.27
Ranking comp. × free listing	0.59	0.00	–0.11	0.46	–0.03
Ranking comp. × self-rating	0.37	–0.08	–0.06	0.48	0.06
Ranking comp. × recognition	0.44	–	–	0.60	0.36
Free listing × self-rating	0.40	0.55	0.66	0.55	0.43
Free listing × recognition	0.56	–	–	0.85	0.71
Self-rating × recognition	0.56	–	–	0.58	0.57

Note: Correlations which are *not* underlined involve a competence variable from a consensus task where genuine intracultural variation in informants' knowledge is suspect or the data do not fit the consensus model.

The correlations between ranking competence and the other indicators also showed that informants' ranking competences may have carried some small "signal" representing individual differences in knowledge beyond the "noise" of guessing and sampling variation. Ranking competence correlated mildly with free listing capacity and self-reported recognition ability and very weakly with self-rating of knowledge. Free listing capacity tended to be moderately positively associated with self-rating of knowledge, although these two indicators were slightly negatively correlated in the birds domain for the high salience list. The strongest correlations among any of the indicators of knowledge tended to be between free listing capacity and

TABLE III
Summary of correlations among indicators of knowledge for high and low salience lists.

Variables	Mean r[a]	Cumulative Z[b]
Triads comp. × rank. comp.	0.29	3.63
Triads comp. × free listing		
All 10 lists	0.29	3.77
7 lists w/ genuine intracult. var. in triads knowl.	0.44	4.67
Triads comp. × self-rating		
All 10 lists	0.15	1.72
7 lists w/ genuine intracult. var. in triads knowl.	0.21	1.89
Triads comp. × recognition		
All 5 lists w/ recog. data	0.12	1.05
3 lists w/ genuine intracult. var. in triads knowl.	0.28	2.12
Ranking comp. × free listing	0.17	2.03
Ranking comp. × self-rating	0.09	0.85
Ranking comp. × recognition	0.29	2.83
Free listing × self-rating	0.46	5.76
Free listing × recognition	0.74	8.75
Self-rating × recognition	0.50	5.01

[a] Calculated using Fisher's (1948) z-transformations.
[b] Calculated using Stouffer's method of aggregation (Mosteller and Bush 1954).

self-reported recognition ability, mean $r = 0.74$. Self-rating of knowledge and self-reported recognition ability were less strongly related, mean $r = 0.50$. The pairwise correlations between indicators of knowledge were not noticeably different in magnitude between high and low salience lists.

Indicators of knowledge for combined lists

For the combined lists in the countries and fabrics domains, the mean number of items informants free listed and informants' mean self-rating of knowledge were very close to the corresponding mean values in those domains for the high and low salience lists (see Table IV). Informants' matching data were submitted to the multiple choice model of cultural consensus analysis. Since a formal model for the matching response format has not been entirely worked out (Batchelder and Romney 1989), I used the multiple choice model as a good approximation. In these analyses, the number of multiple choice options for a given question (i.e., particular country or fabric name to be matched) was equal to the number of items on the combined list. There were clear single factor solutions, with large eigenvalue ratios and no negative competences, for both countries and fabrics domains (see Table IV). Thus, the matching data fit the consensus model.

Simulations of matching data also involved the multiple choice format. The same simulation procedures described earlier for multiple choice data

TABLE IV
Descriptive statistics for indicators of knowledge: Combined lists.

Variable	Countries	Fabrics
# informants	21	23
Matching eigenvalue ratio	15.02	12.03
Matching competence mean (s.d.)	0.67 (0.21)	0.60 (0.17)
Range of simulated competence s.d.'s	0.06–0.10	0.08–0.11
Free listing mean (s.d.)	47.95 (11.58)	15.65 (4.90)
Self-rating mean (s.d.)	4.14 (0.56)	3.09 (1.21)
Recognition mean (s.d.)	23.57 (8.21)	17.83 (4.31)

were used here, except that the number of response options was equal to the number of items on the combined list. The standard deviation of informants' observed matching competence was greater than standard deviations of simulated informants' competences for both countries and fabrics domains (see Table IV). These results signified there was genuine intracultural variation among informants for the matching tasks.

Table V shows the intercorrelations among the four indicators for the combined lists. In almost every case, matching competence was moderately to strongly related to the other indicators of knowledge. Matching competence correlated most strongly with self-reported recognition ability in both domains. In fact, the correlation between these two indicators was the highest inter-indicator correlation in each domain. While the association between matching competence and free listing capacity was substantial in both domains (r's = 0.68 and 0.44 for countries and fabrics, respectively), matching competence and self-rating of knowledge only exhibited a positive relationship in the countries domain. As with the high and low salience lists, free listing capacity and self-rating of knowledge were not reliably related in the combined lists. Also similar to the high and low salience lists, self-reported recognition ability tended to be more strongly correlated with free listing capacity than with self-rating of knowledge.

TABLE V
Correlations among indicators of knowledge: Combined lists.

Variables	Countries	Fabrics
Competence × free listing	0.68	0.44
Competence × self-rating	0.49	−0.04
Competence × recognition	0.85	0.67
Free listing × self-rating	0.37	0.04
Free listing × recognition	0.60	0.61
Self-rating × recognition	0.60	0.27

Time of arrival at the interview session was not strongly or consistently correlated with any indicator of knowledge (the r's involving arrival time ranged between –0.24 and 0.35 for the two domains). In particular, arrival time (large negative values indicated early arrival) was associated with matching competence $r = -0.18$ in the countries domain and $r = 0.04$ in the fabrics domain.

Agreement among indicators of knowledge

To test which indicators agreed most with other indicators in measuring informants' knowledge levels, I performed minimum residual factor analyses of two inter-indicator correlation matrices. If the analyses showed single factor solutions, this would indicate that the different indicators were converging in their measurement of a single underlying knowledge construct. Indicators' loadings on the first factor in such a scenario would represent their relative efficacy in measuring that construct. The first inter-indicator correlation matrix was assembled from the correlations in Table III, excluding ranking competence and including the correlations with triads competence based on those cases where genuine intracultural variation was present. The second correlation matrix included mean correlations for the pairs of indicators listed in Table V.

Factor analyses showed single factor solutions for both matrices, with eigenvalue ratios of 11.9 and 10.2, respectively. For the first correlation matrix, the loadings on the first factor were 0.41, 0.91, 0.55, and 0.82 for triads competence, free listing capacity, self-rating of knowledge, and self-reported recognition ability, respectively. The somewhat low loading for triads competence most probably was due to the restricted range of intracultural variation among informants for the triads tests. For the second correlation matrix, the loadings were 0.79, 0.65, 0.37, and 0.99 for matching competence, free listing capacity, self-rating of knowledge, and self-reported recognition ability, respectively. In both analyses, the self-rating of knowledge loadings were the smallest of the alternate indicators.

Validation of consensus model with objective external standards

I compared the consensus estimated answer keys (based on a procedure that weights informants' responses by their competences – see Romney *et al.* 1986, 1987 for details) with objective external standards (when available) to test further the validity of the cultural consensus model. For the high salience list of countries, the consensus estimated rank order correlated 0.71 with the rank order of the countries' actual populations (1990/1991 estimates obtained from Hoffman 1993 and State Committee of the U.S.S.R. on Statistics 1989), while the answer key based on the rank order of countries' mean ranks correlated 0.72 with the rank order of the actual populations. For the low salience list of countries, the consensus estimated rank order correlated with the rank order of the actual populations 0.84, whereas the mean rank answer key correlated with the rank order of the actual populations 0.85. That the consensus and mean rank answer keys did not really differ in their correspondence to the external standard is consistent with the earlier finding that genuine intracultural variation among informants for these ranking tasks was suspect. Weighting informants' responses by their competences would not improve the validity of the answer key if the variance in competence was merely the result of guessing and sampling variation.

For the countries matching task, the consensus estimated answer key showed all correct answers according to a world atlas (Rand McNally and Co. 1987), while the majority response answer key yielded one incorrect answer according to the atlas. In the fabrics domain, 3 items on the consensus estimated answer key were incorrectly matched according to the fabric labels from the local fabric stores. Four items, however, were incorrectly matched (with respect to the fabric stores' labels) on the majority response answer key. Additionally, when informants' responses were scored against these external standards, the proportion of correct answers was virtually isomorphic to competence. For the countries matching task, competence correlated 0.99 with proportion correct (scored according to the atlas) and for the fabrics matching task, competence correlated 0.97 with proportion correct (scored according to the fabric stores' labels).

DISCUSSION

This study supplies validating support for the cultural consensus model. Overall, each alternate indicator of knowledge correlated positively with cultural competence and all measures converged in measuring a single underlying knowledge construct. When there were objective external standards for the answers to the consensus task questions, the consensus estimated answer keys produced very similar answers to the external standards and were in greater agreement with these standards than the majority response answer keys were for the matching tasks. Also, the proportion of correct answers according to these external standards was almost perfectly correlated with competence. Furthermore, an unobtrusive measure of informants' motivation was unrelated to any indicator of knowledge.

Of the alternate measures of informant knowledge, free listing capacity and self-reported recognition ability corresponded most closely with cultural competence. The *quantity* of domain information a person possesses (number of items s/he can free list, number of items s/he reports to be able to recognize) does indeed appear related to the *quality* of domain information s/he holds (as reflected by agreement with others). These findings are consistent with other studies. Boster (1985) observed that more competent Aguaruna informants (i.e., those who agreed more with others) in a manioc identification task used a greater number of variety names than less competent informants (i.e., those who agreed less with others). This result suggests that the higher competence informants knew the names of more manioc types than the lower competence informants. The association between self-reported recognition ability and objectively measured knowledge was also indicated by Berdie (1971). He found that undergraduates who performed better on a multiple choice test regarding facts about particular famous persons (artists, authors, and public figures) reported knowing more about the famous persons overall than undergraduates who performed worse on the multiple choice test.

Moreover, the relationship between cultural competence and free listing capacity documented in this paper generalizes already established associations between domain knowledge and amount of recall in *episodic* memory tasks. Cognitive psychologists have demonstrated that high domain knowledge experts recall more (text, lexical items, new information, etc. related to a particular semantic domain) than low domain knowledge novices in tasks where the researcher presents subjects with the material to be recalled (e.g., McKeithen, Reitman, Rueter, and Hirtle 1981; Morris, Tweedy, and Gruneberg 1985; Norman, Brooks, and Allen 1989; Schneider and Bjorklund 1992; Spilich, Vesonder, Chiesi, and Voss 1979). In these studies, individuals' knowledge levels were inferred from their education level or occupation, or measured by tests of knowledge for which researchers knew the correct answers *a priori*. In addition, subjects in these studies were explicitly given time to study the material for later recall. My results show, however, that higher domain knowledge informants (as determined by a measure of knowledge that does not require researchers to know the correct answers *a priori*) recall more in a *semantic* memory task (where recall is based on material learned over a long period of time) than lower domain knowledge informants.[3]

In the current study, the relationship between self-rating of knowledge and competence tended to be modest and unreliable. In general, self-rating of knowledge was a poorer quality measure of knowledge than the other indicators, as demonstrated by the factor analyses of the inter-indicator correlation matrices. Self-rating of knowledge was not always consistently related to free listing capacity and it was less strongly associated with self-reported recognition ability than free listing capacity was.

The lower quality of self-rating of knowledge as an indicator of knowledge could be due to the fact that a self-rating is based on a single response (or item, in psychometric terms), whereas the other measures are based on multiple responses (items), and therefore may contain more information. Self-rating of knowledge is also distinct from the other indicators of knowledge in that the others directly tap facets of linguistic knowledge, while a self-rating does not. Other possible explanations for the relative

weakness of self-rating of knowledge as an indicator include: informants making self-ratings with reference to their personal networks (with domain knowledge distributed unevenly across different personal networks) instead of college students in general, the small amount of feedback individuals tend to receive about their domain knowledge, the specificity of the domains, and/or individual differences in the use of self-rating scales.

Indeed, one or several of these factors may account for the variable validity of self-ratings of other attributes. For example, self-ratings of such abilities as manual speed and accuracy, numerical ability, and spatial orientation were only modestly correlated with scores on standard tests of those abilities (r's between 0.05 and 0.41) in 114 undergraduates (DeNisi and Shaw 1977). In contrast, Schrauger and Osberg (1981) found in a review of many studies that the correlations between students' self-ratings of academic ability or self-predicted grades and students' actual grades in the following academic term(s) were somewhat higher, ranging between 0.41 and 0.64. Also, Iannucci (1991) found that in a college sorority where informants were well-acquainted with each other, informants' self-ranks on several traits (physical attractiveness, assertiveness, and intelligence) were correlated with consensual peer rankings in the range of 0.54 to 0.66.

There appeared to be little genuine intracultural variation among informants for some of the triads tests and most of the ranking tasks. The correlations between competence and the other indicators tended to be more strongly positive when there was noticeable intracultural variation among informants on the consensus tasks than when there was not. Careful inspection of Tables IA, IB, IIA, IIB, IV, and V reveals that the strongest associations between cultural competence and free listing capacity, in particular, occurred when intracultural variation in informants' knowledge on the consensus task was comparatively large with respect to the simulations. The lack of appreciable intracultural variation most likely depressed the association between cultural competence and internal consistency of responses in paired comparison tasks observed in previous research. In fact, the two tasks in which Weller's (1984) informants displayed the smallest variance in competence were the same tasks in which the competence – consistency relationship was the weakest. Likewise, there were two samples which did not display the expected relationship between competence and consistency in Brewer *et al.*'s (1991) study. By employing the same simulation procedures for the ranking data described earlier (Weller 1987), I found that genuine intracultural variation in informants' knowledge on the paired comparison task in these two samples was also doubtful.

Despite the questionable degree of intracultural variation in the ranking tasks, there still remained a perceptible relationship between cultural competence in triads test and ranking tasks, with a mean r of 0.29 for the high and low salience lists. Boster (1985) also showed that informants' competences in three separate tasks (general, easy manioc, hard manioc plant identification) were moderately related, with r's ranging between 0.35 and 0.6. For the two tasks with the greatest variation in competence in Weller's (1984) study, informants' competences in the two tasks were also reasonably correlated (rho = 0.58). Hence, competence in one task in a domain corresponds to competence in another task in a domain.

Boster (1985) and Weller (1984) noted that individual differences in knowledge can only be ascertained after analyzing inter-informant agreement. The results from the present study, however, suggest that free listing capacity might be useful as a rapid and preliminary measure of informants' knowledge in specific semantic domains. After conducting brief free listing interviews with a number of informants, a researcher could then pick a subset of informants who mentioned the most terms in the free listing task for further interviewing. Applied anthropologists, in particular, could benefit from using this quick and easy data-driven (Johnson 1990) method of identifying knowledgeable informants (cf. van Willigen and Final 1991).

Furthermore, free listing capacity could be used in conjunction with cultural consensus analysis in determining which informants are truly knowledgeable. Boster and Johnson (1989) found that novice undergraduates with little fishing experience agreed more with each other on the similarity of line-drawn fish stimuli than did expert fishermen. Novices made their judgments on the basis of morphological criteria while experts made their judgements in terms of both functional and morphological criteria, resulting in their lower agreement. In a case like this, experts surely would free list more items from the domain under study than novices, which would alert researchers that agreement on a structured task may be superficial and not appropriately considered a reflection of cultural knowledge.[4] Free listing capacity also could be a useful indicator of knowledge when there are only a few knowledgeable informants in a sample and no overall consensus exists among informants in their responses to systematic interview questions. However, free listing capacity might not have universal applicability as an indicator of knowledge. It might not signify knowledge in domains with a small and/or fixed number of items (e.g., methods of AIDS transmission). In such domains, informants who free list many items might not be very knowledgeable.

The results from the present study add to the growing literature on the distribution of cultural knowledge and characteristics of knowledgeable informants. Other work has shown that there are several non-cognitive indicators of knowledge, including age and length of experience with a domain (Boster 1985; Brewer 1992a; Garro 1986; Weller 1984), literacy (Weller 1984), normalcy of experience (Weller, Romney, and Orr 1985), and centrality in a social network (Brewer 1992a, 1992b). Future research should investigate peer assessment of knowledge and other potential indicators of knowledge to validate further the cultural consensus model and to refine procedures for selecting knowledgeable informants. Peer assessments are perhaps the most reliable and valid predictors of numerous individual attributes, such as job performance (Love 1981), leadership ability (Amir, Kovarsky, and Sharan 1970) and personality traits (Iannucci 1991; Romney *et al.* n.d.). More work is also required in different domains and with informants in other cultures to generalize the findings reported here.

NOTES

* An earlier version of this paper was presented at the 92nd Annual Meeting of the American Anthropological Association in Washington, D.C. This research was supported by an Air Force Laboratory Graduate Fellowship awarded to the author by the Air Force Office of Scientific Research. I thank A. Kimball Romney and William H. Batchelder for their suggestions at various points during this research and Laura Yang for her assistance in data collection.

1 The first sentence of free listing instructions for the countries domain was "What are all the countries in the world?"

2 I modified Weller's (1987) simulation procedures for ranking data slightly by transforming the interval scale values produced in the simulations to ranks.

3 The only published study on the relationship between free listing capacity and knowledge I found in my search of the literature was Hutchinson's (1983) report that pharmacy students (presumed experts) free listed significantly more brand names of nonprescription cold remedies than marketing students (presumed novices).

4 Boster and Johnson (1990) were primarily concerned with comparing novices and experts' patterns of agreement, not determining which set of informants knew more about fish. This example merely shows that free listing capacity can be used to test whether cultural competence in a particular task is a reflection of cultural knowledge.

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APPENDIX

ITEM LISTS

High salience

Birds: pigeon, hummingbird, crow, parrot, eagle, seagull, robin, dove, bluejay, chicken, hawk, owl, pelican, parakeet, vulture, flamingo, sparrow, duck, ostrich, quail, turkey

Countries[a]: China, Japan, Italy, France, Canada, Vietnam, Switzerland, U.S.A., Spain, Mexico, Iran, Chile, Germany, Iraq, England, Egypt, Greece, Finland, Israel, U.S.S.R., Sweden

Diseases: A.I.D.S., cancer, Alzheimer's disease, syphilis, gonorrhea, leukemia, herpes, flu, polio, diabetes, tuberculosis, chicken pox, measles, hepatitis, heart disease, malaria, smallpox, Parkinson's disease, Down's syndrome, Lou Gehrig's disease, alcoholism

Fabrics: cotton, silk, polyester, rayon, wool, leather, nylon, suede, spandex, velvet, satin, canvas, taffeta, chiffon, cashmere, denim, linen, lace, flannel, acrylic, lycra

Flowers: rose, carnation, daisy, tulip, sunflower, lily, violet, dandelion, orchid, chrysanthemum, daffodil, iris, poppy, lilac, bird of paradise, baby's breath, gardenia, pansy, petunia, magnolia, marigold

Low salience

Birds: condor, finch, toucan, raven, blackbird, peacock, swallow, goose, penguin, woodpecker, bald eagle, canary, rooster, cockatoo, swan, cockatiel, cardinal, roadrunner, crane, bluebird, mockingbird

Countries[a]: Laos, New Zealand, Haiti, North Korea, Ecuador, Zimbabwe, Indonesia, Malaysia, El Salvador, Yugoslavia, Jamaica, Kuwait, Colombia, Mongolia, Romania, Peru, Jordan, Paraguay, Lebanon, Nicaragua, Kenya

Diseases: multiple sclerosis, cold, Lyme disease, ulcer, tumor, gingivitis, tetanus, yeast infection, rabies, cataracts, mumps, cerebral palsy, Huntington's disease, emphysema, elephantitis, hemophilia, pneumonia, whooping cough, allergy, strep throat, schizophrenia

Fabrics: canvas, taffeta, chiffon, cashmere, denim, linen, lace, flannel, vinyl, acrylic, lycra, dacron, corduroy, tweed, lame, felt, angora, plastic, seersucker, gabardine, crepe

Flowers: poppy, lilac, bird of paradise, baby's breath, gardenia, pansy, petunia, magnolia, marigold, hibiscus, geranium, cherry blossom, morning glory, mum, impatiens, tiger lily, water lily, buttercup, sweet pea, snapdragon, azalea

Combined lists

Countries[a]:

Map area	Countries numbered on map
World	New Zealand
Asia	Iraq, Kuwait, Iran, Mongolia, China, North Korea, Japan, Laos, Thailand, Vietnam, Malaysia, Indonesia
Africa/Middle East	Lebanon, Israel, Jordan, Egypt, Kenya, Zimbabwe
Europe	Finland, Sweden, England, Germany, France, Switzerland, Spain, Italy, Yugoslavia, Romania, Greece
North America	Canada, U.S.A., Mexico, El Salvador, Nicaragua
South America	Colombia, Ecuador, Peru, Chile, Paraguay

Fabrics: cotton, silk, polyester, rayon, wool, nylon, velvet, satin, canvas, taffeta, chiffon, denim, linen, lace, flannel, vinyl, acrylic, lycra, dacron, corduroy, tweed, lame, felt, plastic, seersucker, gabardine, crepe

[a] The U.S.S.R. was still an intact country when the high and low salience tasks data were collected and Yugoslavia was still an intact country when both high and low salience and matching tasks data were collected.

Pile Sort Analysis of siSwati Terms for Acute Respiratory Infections

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ABSTRACT: This paper reports on the use of the pile sort technique to explore categories for 30 siSwati terms for acute respiratory infections.

We interviewed 29 mothers of children under the age of 5 who were randomly selected from 5 urban and 12 rural sites throughout Swaziland, as well as the 17 health providers and 13 traditional healers whom mothers reported they would contact if their child became ill.

Results of our study suggest that there are siSwati illness terms that correspond to many of the signs and symptoms of upper and lower acute respiratory infection. The respondents differentiated these terms into at least two distinct groups: one group included terms associated with the symptoms of common colds or flu that mothers manage at home, while the other group included terms that refer to more serious illnesses for which individual caretakers usually seek further professional treatment. However, the "cognitive boundary" between these two groups is not always clear. We expected differences in the folk and biomedical

Journal of Quantitative Anthropology 5, 129–147, 1995.