AN ABSTRACT OF THE THESIS OF

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Title: The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimation and Attraction Scale

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Terry M. Wood

The purposes of this study were to (a) outline a three-stage methodology combining functional/conceptual equivalence, item equivalence, and equivalence in construct operationalization to investigate the cross-cultural validity of psychological test instruments, and (b) to examine the cross-cultural equivalence of the Physical Estimation and Attraction Scale (Sonstroem, 1978) for English-speaking and Thai adolescent boys. Functional/conceptual equivalence or translation accuracy was assessed in the first stage using four well-known translation methods: pragmatic translation, a modified Delphi technique, back translation, and a bilingual method. Based on these analyses the Thai version of the PEAS was judged to have adequate functional/conceptual equivalence. In the second stage the item equivalence of PEAS items

across cultures was analyzed via item response theory. The subjects consisted of 499 boys aged 14-19 years attending Oregon public schools and 1009 boys aged 14-19 years in Thailand public schools. Employing a two-parameter logistic model, IRT difficulty and discrimination parameters were estimated using the PC-BILOG program for the 54 attraction and 33 estimation items in each PEAS version. Statistical comparison of IRT parameters across cultures for each PEAS item separately revealed that twelve attraction and three estimation items had acceptable item equivalence, six attraction items and four estimation items contained translation inaccuracies, while thirty six attraction and 26 estimation items were judged to have differences in cross-cultural meaning. Stage three of the model assessed the equivalence in construct operationalization of the translated instrument (i.e., the equivalence in the meaning of the underlying latent trait). The presence of ill-conditioned interitem correlation matrices in both the English and Thai data sets prohibited such an analysis in the present study.

The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimation and Attraction Scale

by

Kongsak Charoenruk

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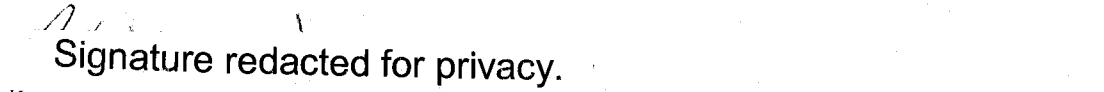

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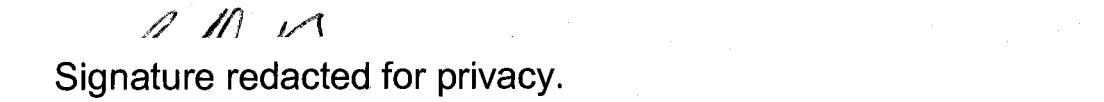

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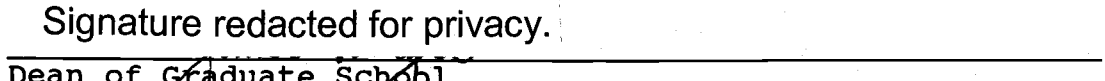

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Chapter 1

INTRODUCTION

Cross-cultural research is generally concerned with behavior conditioned by living in a given country, culture, or environment, and its specific objective is to make comparisons of behavior between cultures (Brislin, Lonner, & Thorndike, 1973). Berry (1979) presented two models commonly used in designing, conducting, and interpreting such research. The first is the unicultural model, in which subcultures are studied in relation to the dominant culture. The second is the cross-cultural model, where one cultural group is studied in relation to other culture groups.

Psychological characteristics in different societies can only be validly compared if the characteristics share similar meaning and can be measured on the same scales (Leung & Drasgow, 1986). Therefore in cross-cultural research, a concern of significant interest is the equivalence of measurement instruments across culture groups. Witkin and Berry (1975) commented on the difficulties and dilemmas encountered when studying cross-cultural group differences, stating:

> "On the one hand, it can not be assumed that Western instruments of proven psychometric adequacy carry their desirable psychometric properties with them when transported to new cultural settings. Even more serious, unless appropriately modified, such Western instruments may suit neither the experience nor the comprehension of the new population. On the other hand, when Western instruments are modified in an effort to suit them to a new cultural milieu, or when entirely new instruments are created, it cannot be assumed, in the absence of specific checks, that these modified or new instruments are valid and reliable." (p. 19)

Many types of measurement equivalence have been proposed in the literature. Berry (1980) identified three types of equivalence. When two or more behaviors are related to the solution of the similar or the same problems, functional equivalence has been met. Conceptual equivalence exists when the research materials have identical meaning in the cultures being examined. Hui and Triandis (1985) noted that functional equivalence and conceptual equivalence have a similar meaning. Metric equivalence occurs when psychometric properties of data obtained from more than one culture exhibit the same structure. Similarly, Poortinga (1975) and Hui and Triandis (1985) identified scalar equivalence as the situation when the scale scores are directly compared (i.e., metric equivalence).

Hui (1982) subsequently identified two additional types of equivalence, construct operationalization and item equivalence. Equivalence as construct operationalization refers to construct validity, and can

be demonstrated by showing that the correlation between variables is similar across cultures. Item equivalence is similar to metric/scalar equivalence and exists when the instrument used in different cultures evidences identical item responses. This equivalence requires a cross-cultural comparison of item characteristic curves (derived using item response theory) for each item in the instrument.

Cross-cultural researchers typically focus on one of the methodological strategies for assessing measurement equivalence (Hui, Drasgow, & Chang, 1983; Hulin, Drasgow, & Komocar, 1982; Hulin & Mayer, 1986; Parsons & Hulin, 1982). However, Hui and Triandis (1983) stated that the problem of cross-cultural equivalence is not solved by any one of the methods. An appropriate way to achieve equivalence is by using several methods that deal with different kinds of equivalence (see Figure 1.1).

Functional/Conceptual Equivalence

Language differences are an obstacle in cross-cultural research, especially when studying abstract concepts and social attitude (Schmeidler & Windholz, 1972) because the language in which the test is written can influence the scores obtained (Yang & Bond, 1980). The problem of cross-language meaning arises when cross-cultural researchers must translate materials from one language and culture to another while preserving the

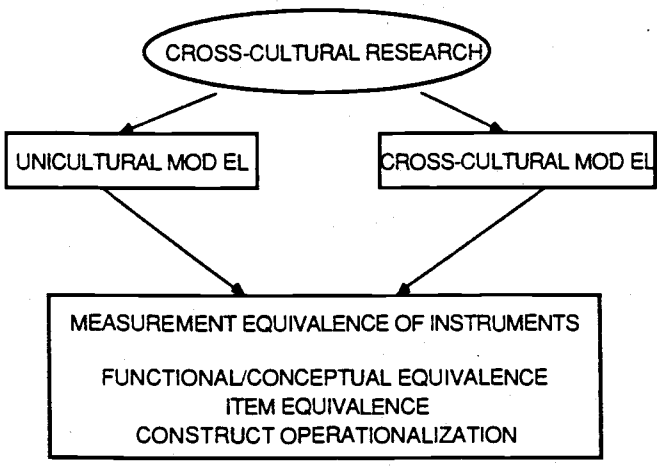

Figure 1.1. A Model for Assessing Measurement Equivalence in Cross-Cultural Research.

psychological meaning of the original materials (Hulin et al., 1982; Hulin & Mayer, 1986). Therefore when translating a test instrument into another language the onus is on the researcher to provide evidence for functional/conceptual equivalence of the translation. Several methods for translating tests are supported in the literature including back translation (Brislin, 1970; Hulin, 1987; Kline, 1983), the bilingual technique (Hulin et al., 1982; Katerberg, Smith, & Hoy, 1977), and the committee approach (Campbell, Brislin, Stewart, & Werner, 1970).

Item Equivalence

Jensen (1980) warned that translating a test from one language to another is risky and should be accomplished in connection with a proper psychometric scaling method. The definition of equivalence of items and scales across languages and cultures dictates specific criteria that must be satisfied before scores obtained on different language versions of the scales can be compared (Hulin, 1987). This type of equivalence requires a study of item characteristic curves (ICC) using item response theory (IRT). Hulin et al. (1982) noted that IRT analyses are useful because they provide information about the quality of translation, the meaning of the items in relation to the underlying latent trait, the equivalence of test and scale scores across the samples from the different cultures, and the identity of items that need revision.

IRT models are typically associated with aptitude measurement; however, IRT theorists (Hambleton & Cook, 1977; Lord, 1977; Wright, 1977) have suggested that the applicability of the IRT models to attitude measurement is also worth investigating. In the field of physical education, Wood (1987) suggested applying the IRT model in a cross-cultural exploration of attitudes toward and participation in physical activities using a psychological model of physical activity and its

measurement instrument, the Physical Estimation and Attraction Scale (Sonstroem, 1974). The Physical Estimation and Attraction Scale (PEAS) assesses two aspects of perceived orientation toward physical activity in adolescent boys. Estimation (EST) measures an individual's self-rating of his capabilities in sport and vigorous activity. Attraction (ATTR) assesses liking for and interest in a wide range of physical pursuits. The PEAS was developed for English-speaking high school aged boys grades 9 through 12. Before the PEAS can be employed with adolescent boys in other cultures the functional/conceptual equivalence must be established between the foreign language version and the English version of the test. In addition the scalar/metric equivalence of each PEAS item across cultures must be examined via comparison of ICCs.

Equivalence in Construct Operationalization

Construct operationalization refers to the construct validity of the test across cultures. Construct validity is concerned with the psychological constructs that are reflected in the scores of the test. Lord and Novick (1968) defined construct validity as "the degree to which a test measures the construct it was designed to measure" (p. 278). Another definition of construct validity is "the extent to which test performance can be interpreted

in terms of certain psychological constructs" (Gronlund, 1981, p. 82). This implies that construct validation relies on providing evidence that the test scores reflect the constructs presumed to underlie the test (Cronbach & Meehl, 1955).

Cronbach (1970) proposed three steps in construct validation as follows:

(a) Constructs which might account for test performance are suggested. This is an act of imagination based on observation or logical study of the test. Cronbach and Meehl (1955) identified this step as the process of creating a nomological network.

(b) Testable hypotheses from the theory surrounding the construct are derived. This is a purely logical operation. Hypotheses may be generated in a wide variety of ways depending on the characteristic measured.

(c) Empirical studies to test hypotheses are carried out (p. 142-143).

There is no single model that can be used as a framework for exploring construct validity. One popular approach, however, is comparing the hypothesized dimensionality of the construct with the dimensionality of the measurement device via the statistical technique

of factor analysis. One may postulate a factorial structure (i.e., dimensionality) for a specific instrument given one's assumption about both the trait that is being measured and the theory from which it was derived. A confirmatory factor analysis can then be performed to test the "fit" between the hypothesized factorial structure and the factorial structure measured by the test instrument (Golden, Sawicki, & Franzen, 1984, p. 31-34).

Equivalence of test instruments across cultures is a central concern for cross-cultural researchers. This study will outline a three-stage methodology combining functional/conceptual equivalence, item equivalence, and evidence for construct operationalization in determining the equivalence of affective tests used in cross-cultural research. To demonstrate the methodology, the cross-cultural equivalence of the PEAS for English-speaking and Thai adolescent boys will be examined.

Statement of the Problem

The purposes of this study were as follows:

(a) To outline a three-stage methodology combining functional/conceptual equivalence, item equivalence, and construct operationalization for investigating the cross-cultural equivalence of affective test instruments.

(b) To examine the cross-cultural equivalence of the Physical Estimation and Attraction Scale (Sonstroem, 1974, 1978) for English-speaking and Thai adolescent boys.

Delimitations

The study was delimited to the following:

(a) The subjects were high school aged boys, grades 8 through 12, in the United States (State of Oregon) and in Thailand (Bangkok Province).

(b) All subjects attended public high school.

Operational Definition

Attitude toward physical activity was determined by respondent's written responses to the PEAS.

Limitations

Subjects used in this study were volunteers. Sample units in the United States were intact school classes of convenience. In Thailand, students were randomly selected from volunteer schools.

Assumption

It was assumed that subjects responded truthfully to the 33 EST and 54 ATTR items of the PEAS.

Chapter 2

REVIEW OF LITERATURE

The review of literature is divided into the following sections:

(a) Physical Estimation and Attraction Scale

(b) Techniques for Validating Translations

(c) Item Response Theory.

Physical Estimation and Attraction Scale

The Physical Estimation and Attraction Scale (PEAS) was developed by Sonstroem (1974, 1976, 1978) to assess participation in physical activity along two dimensions--estimation of one's physical ability (EST) and attraction toward physical activity (ATTR). This model was designed "as an attempt to identify mechanisms of physical activity participation and receipt of psychological benefits derived from activity" (Sonstroem & Kamper, 1980, p. 686). Sonstroem hypothesized that the strong belief in personal physical competence (EST) and an attraction to physical activity (ATTR) would lead to higher levels of participation and a consequent increase in fitness and self-esteem (Fox, Corbin, & Couldry, 1985).

Under Sonstroem's model, EST and ATTR scales were expected to be positively related to and complement each other in predicting physical activity involvement and outcomes. Estimation was viewed as a pivotal link between fitness and self-esteem, whereas influences on behavior were mediated by attraction (Safrit, Wood, & Dishman, 1985). A diagrammatic representation of Sonstroem's model is presented in Figure 2.1.

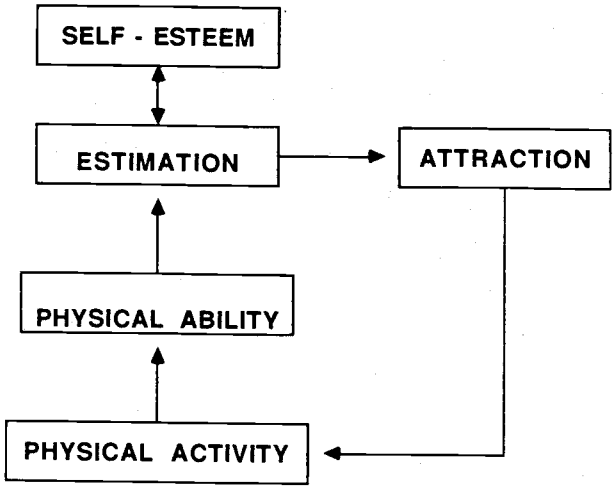

Figure 2.1. Psychological Model for Physical Activity (Sonstroem, 1978).

To operationalize the model, Sonstroem developed the PEAS for assessing attitude toward physical activity for high school aged boys in grades 9 through 12. The PEAS consists of 100 items to which students respond either "true" or "false" as it pertains to him. Of the 100

items, 33 measure physical estimation, 54 measure physical attraction, and 13 are neutral that are not scored, but are included to hide the nature of the scale. Appendix D contains a copy of the scale and a score sheet.

Construct Validity of the PEAS

Neale, Sonstroem, and Metz (1969) measured physical fitness, general self-esteem, and attitude toward physical activities of 165 adolescent boys grades 7-12 from Minneapolis high schools. Results indicated that high-fit boys were higher in self-estimates of physical ability and self-reported attraction to physical activities compared to low-fit boys. However, the two groups were not significantly different in general self-esteem nor in reported extent of participation in voluntary physical activities. The results of this study provided evidence that physical fitness is related to self-perceived attitudes in relation to physical activities and demonstrated a close relationship between estimates of abilities in, and self-perceived attraction to, physical activities of a vigorous nature.

Sonstroem (1974) examined the relationships of estimation, attraction, and obtained factor scores with outside criterion. A sample of 187 adolescent boys in grades 9 through 12 from three Rhode Island high schools was used in this study. Factor analysis revealed 7

factors in the PEAS. Three factors in estimation were identified as physical ascendance, confidence and coordination, and recreational skill potential. Three attraction factors were identified as endorsement of physical activity, attraction to robust activity, and attraction to tennis. The last factor called "interest and ability in running" included both estimation and attraction items with more of the latter. The estimation items and the attraction items were not related to each other. Item response in the PEAS was not found to be related to the intelligence of respondents. However, the estimation of one's physical ability bore a positive and significant relationship to physical fitness, height, and to athletic experience.

Sonstroem (1976) studied the validity of self-perceptions regarding physical and athletic ability. Samples of high schools and junior high schools males from four Rhode Island schools were administered the PEAS, the Tennessee Self-Concept Scale (Fitts, 1965), and the physical fitness battery consisting of pull-ups, softball throw, standing long jump, and 600 yard run from the AAHPERD Youth Fitness Test. Contrary to previous research (Neale et al., 1969), no significant relationship was found between self-esteem and physical fitness. Sonstroem (1978) noted that while self-esteem was regarded to be relatively stable in the adult, less

was known regarding its constancy in younger populations. Additionally, the validity of the estimation scale was extended to include significant relationships with indices of emotional adjustment other than self-esteem.

The PEAS was constructed for high school aged boys in grades 9 through 12. Some researchers conducted the study using different populations. Dishman (1978) examined the associations between the PEAS and aerobic power in young adult males and females. He found that fitness did not correlate with attraction to physical activity. Attraction and estimation had low correlation with an aerobic power test (12-minute run around a 91-meter course) for both males and females .

Fox et al. (1985) investigated the adequacy of the model and the PEAS for explaining the involvement of college-aged females in physical activity. Results indicated that although the model worked similarly for both genders, there were important differences. For example, the attraction scale did not contribute to the model for the females in this study, but it did for males. Physical estimation emerged as a key factor, particularly for females, in its relationship with self-esteem, fitness, and physical activity levels.

Safrit et al. (1985) indicated that the PEAS could be revised and shortened for men and women. The results of the study revealed a robust factor or items that

apparently tap perceptions of general physical competence and a perceived strength factor. Those using PEAS with adult populations should consider the scale's unique factor structure for various populations.

Reliability of the PEAS

Kuder-Richardson internal consistency coefficients (KR-20) of .87 for estimation and .89 for attraction have been obtained (Sonstroem, 1974). Stability coefficients of .92 and .94 for estimation and attraction respectively were obtained with 40 high school males over a two-week period (Sonstroem, 1976). These results indicate that the PEAS is a reliable instrument which consistently measures the attitude toward physical participation for high school aged boys.

Techniques for Validating Translations

Accurate translation of a psychological scale from a source language to a target language permits research concerning latent psychological traits and constructs among members of different cultures (Hulin, 1987). Initial translation of an instrument to the target language can be one of four types (Casagrande, 1954):

(a) Pragmatic translation involves translating a message as efficiently and as accurately as possible.

(b) Aesthetic-poetic translation or the evocation of moods, feelings, and affect in the target language that are identical to those evoked by the material in the source language.

(c) Ethnographic translation in which the meaning and the cultural constant of the source language materials must be maintained in the target language.

(d) Linguistic translation which is concerned with equivalence of meanings of both morphemes and grammatical forms of the two languages.

The translation of psychological scales and items from a source to a target language does not fit into the standard classification of translations (Hulin, 1987). Pragmatic translation emphasizes the content of the message rather than its aesthetic form, grammatical form or cultural context. Aesthetic-poetic translation encourages the subjects to express their moods and feelings identically in both cultures, but the purpose of translation in the psychological scale is to allow the subjects to express their moods and feelings in the target language that are equivalent to their report in the original language. The ethnographic translation is concerned with the explanation of assessing the reaction to cultural events or behavioral intentions which are not required in the translation of the psychological scale.

The main purpose of linguistic translation is identical for structural or grammatical form in both languages. It is not a practical translation to be used with different languages which have different forms of structures.

After the construction of the target language material, one or more of the following procedures are commonly employed to evaluate the translation accuracy (Campbell et al., 1970):

(a) Back translation. The back translation procedure typically employs one group of bilingual individuals translating material from the source to the target language. A second group of bilinguals translates material back from the target language to the source language. The original and back translated materials are then compared. Differences are noted and corrected and two, three, or more iterations are carried out as needed to produce translated material that is equivalent to the original source language material.

(b) Bilingual technique. A group of bilingual individuals takes a test in both languages. The resulting set of scores are analyzed to examine the extent to which the two versions of the scales have similar or different information. If the statistical results are highly

correlated, it means that the translated language material is similar or the same information as the original language material. If a low correlation is evidenced, the translated language material should be reviewed.

(c) Committee approach. A group of qualified bilinguals is selected to serve as the committee. Each person is requested to translate the instrument from the original language to the target language. After translation, the committee meets together and the translated language instrument is reviewed. This process is finished when the committee accepts the translated language instrument as equivalent to the original instrument in every item. The committee approach may be inappropriate when time and cost make group meeting impossible. In the case of time and cost restrictions, the Delphi technique can be substituted for the committee approach. This technique does not require a "committee of the whole" to translate the instrument or to have face-to-face contact. Committee members are simply requested to indicate if each item of the translated language instrument is

acceptable or in need of revision. They are also asked to write the revised statements for the items which are not acceptable. To terminate the procedure, the committee must agree that all translated items have the same or similar information as the source items.

(d) Pretest procedure. After the initial translation, the translated language instrument is administered to subjects who are targeted for the instrument. Respondents are asked to comment on the meaning of test items. This process increases the probability that future subjects will understand the items of the translated language instrument. Items are reviewed if they are questioned.

The technique most recommended by cross-cultural researchers for assessing the quality of translation is back translation (Hulin, 1987). However, while back translation appears necessary it is not sufficient to ensure comparability of meaning of equivalence of translation. Hulin, Drasgow, and Parsons (1983) pointed out two shortcomings of back translation: (a) highly skilled translators can sometimes produce acceptable back translations from badly garbled translations by a series of inferences and insightful guesses, and (b) reproduction of the original meaning does not address

directly the meaningfulness of the material in the target language. Similarly, translations that retain grammatical forms of the original language are easy to back translate but may not be meaningful to target language monolinguals (Brislin, 1970). Therefore, while back translation seems a necessary first step in the analysis of any translation, it is not a panacea since similarity of original material and back translation does not guarantee equivalence (Doob, 1980; Hulin, 1987). Some researchers, thus recommend using back translation along with other techniques such as the bilingual technique and/or the committee approach (e.g., Butcher & Gur, 1974; Katerberg et al., 1977; Margalit & Mauger, 1985; Sullivan, Suzuki, & Kando, 1986).

An example of translation in physical education research is the study by Poitras (1983). Poitras studied the attitudes toward physical education of French-speaking and English-speaking students, parents, and teachers. The Physical Education Attitude Inventory Short Form (Wear, 1951) was translated from the English to the French language using the bilingual technique. The result was a high correlation (r = .911) coupled with a statistically non-significant difference (p > .01). Poitras concluded that the test had been effectively translated into the French language and the two instruments were equivalent.

Item Response Theory (IRT)

The traditional procedure of scale construction is based upon classical test theory (CTT) and its concept of reliability (Douglass, Khavari, & Farber, 1979). However, CTT has weak assumptions, for example: (a) the expected value of the error score is zero, (b) the correlation between the true score and the error score is zero, and (c) the correlation between error scores on different items is zero (Hambleton & Swaminathan, 1985; Lord & Novick, 1968). While these assumptions can be met easily by most test score data sets, CTT has failed to provide satisfactory solutions to many testing problems such as the design of a test, the identification of biased items, and the quality of the test scores (Hambleton & Swaminathan, 1985). Item response theory, or latent trait theory, has been used by researchers as an alternative to CTT, in particular by cross-cultural researchers for assessing the equivalence of items and scales across languages from different cultures.

IRT is an attempt to model an examinee's performance on a test item as a function of characteristics of the item and the examinee's ability on some unobserved (i.e., latent) trait (Skaggs & Lissitz, 1986). In contrast to CTT, IRT treats each item of a test and subjects' responses to each item as the unit of analysis rather than focussing on total test scores. IRT has some

advantages over CTT (Spray, 1988; Wood, 1987). For example, IRT describes a functional mathematical relationship between an examinee's underlying ability and one or more characteristics of an item such as item difficulty or the probability of the examinee responding to an item correctly. Moreover, for a given item, item characteristics are invariant across populations and different tests. Such invariance provides a basis for judging the equivalence of test items across populations and tests.

Hambleton and Swaminathan (1985) summarize the characteristics of IRT as follows:

(a) It is a model which supposes that examinee performance on a test can be predicted or explained in terms of one or more characteristics referred to as traits.

(b) An item response model specifies a relationship between the observable examinee item performance and the trait or abilities assumed to underlie performance on the test.

(c) A successful item response model provides a means of estimating scores for examinees on the traits.

(d) The traits must be estimated or inferred from observable examinee performance on a set of test items.

The item response model specifies a relationship described by a mathematical function between the observable examinee performance on an item and the unobservable traits or abilities assumed to underlie performance on the test. Therefore, item response models are mathematical models, which are based on specific assumptions about the test data (Baker, 1985). The assumptions are as follows:

(a) Dimensionality. IRT assumes that a single latent ability is sufficient to explain or account for examinee performance (i.e., latent traits are referred to as unidimensional). However, Drasgow and Parsons (1983) found that the IRT is fairly robust to violations of unidimensionality, while Spray (1988) reported on the use of multidimensional item response theory.

(b) Local independence. This assumption states that an examinee's responses to different items in a test are statistically independent. For this assumption to be true, an examinee's performance on one item must not effect, either for better or for worse, his or her responses to any other item in a test.

(c) Item characteristic curve (ICC). An item characteristic curve (ICC) is a mathematical function that relates one or more item characteristics (e.g., the probability of success on an item) to the ability measured by the item set or test that contains it.

The ICC plays an important role in item response models (Hui et al., 1983). Each item in a test will have its own ICC. When the data are collected from the subjects of interest, each subject has a total test score that is placed somewhere on the ability scale. This ability score will be denoted by the Greek letter theta (θ). Note that ability scales for ICCs are scaled as standard scores with an average score denoted by zero, scores above average denoted by positive scores, and scores below average by negatively signed scores. At each ability level there will be a certain probability denoted by $P(\theta)$ that the subject with that ability will give a correct answer to the item. When the $P(\theta)$ is plotted as a function of ability (e.g., a one-parameter logistic function), the result will be a smooth S-shaped curve such as shown in Figure 2.2.

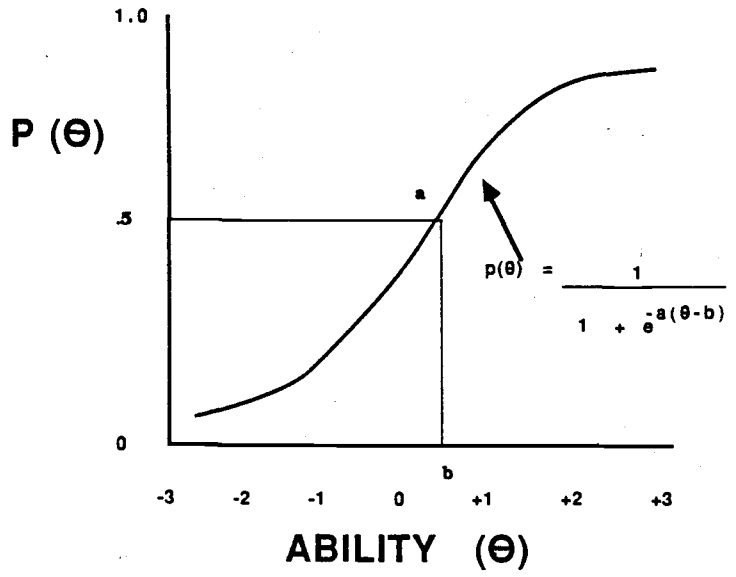

Figure 2.2. Item Characteristic Curve.

Significant properties of an ICC are described below:

(a) Item difficulty is represented by the point on the ability scale (Θ) corresponding to a P(Θ) = .5. For example, an item characterized as "easy" functions at Θ < 0, where zero is considered to be average ability. Such an item is said to function among the low ability examinees and is represented by an ICC which is shifted to the left of center. A difficult item functions among the high ability examinees and is represented by a difficulty parameter >0 and an ICC curve shifted to the right of center.

(b) Item discrimination describes how well an item can differentiate between examinees having abilities below the item location and those having abilities above the item location. This property reflects the steepness of the ICC in the middle section (i.e. where $P(\theta) = .5$). The steeper the slope at $P(\theta) = .5$ the better the item can discriminate.

(c) A third item parameter which can be identified is the guessing parameter which represents the probability of examinees with low ability correctly answering an item by guessing. This property is demonstrated by the lower asymptote of the ICC which can be set above zero (Baker, 1985; Hambleton & Swaminathan, 1985). The guessing parameter is used only in three-parameter models.

ICCs are analogous to regression lines in that they describe a mathematical relationship or function linking a single variable (e.g., the underlying ability θ) with one or more descriptor variables (e.g., item difficulty). Under IRT, a common mathematical model for the ICC is the cumulative form of the logistic function (Baker, 1985). The logistic function describes a family of functions, three of which have proven utility in IRT research:

(a) The one-parameter logistic model or Rasch model (Rasch, 1960) which uses only the difficulty parameter to describe the ICC. Under this model all items are assumed to have the same discrimination parameter and it is assumed that no guessing takes place.

(b) The two-parameter logistic model (Baker, 1985) which uses both the difficulty and the discrimination parameters to describe the ICC.

(c) The three-parameter logistic model which adds a guessing parameter to the two-parameter model in order to describe the ICC.

Estimating Item Parameters (Item Calibration)

"Because the actual values of the parameters of the items in a test are unknown, one of the tasks performed when a test is analyzed under item response theory is to estimate these parameters. When the observed proportions of correct response in ability groups are plotted from actual test score data, the basic task is to find the item characteristic curve that best fits the observed proportions of correct response. To do so one must first select a model for the curve to be fitted. The procedure used to fit the curve is based upon maximum likelihood estimation. The initial values for the item parameters are established a priori. Then, using these estimates, the value of $P(\theta)$ is computed at each ability level via

the equation for the item characteristic curve model. The agreement of the observed value and computed value of $P(\theta)$ is determined across all ability groups. Adjustments to the estimated item parameters are then found that result in better agreement between the item characteristic curve defined by the estimated values of the parameters and the observed proportions of correct response. This process of adjusting the estimates is continued until the adjustments get so small that little improvement in the agreement is possible. At this point, the estimation procedure is terminated and the current values are the item parameter estimates. Given these values, the equation for the item characteristic curve is used to compute the probability of correct response $P(\theta)$ at each ability level and the item characteristic curve can be plotted. The resulting curve is the item characteristic curve that best fits the response data for that item. An important consideration within IRT is whether a particular item characteristic curve model fits the item response data for an item. The agreement of the observed proportions of correct response and those yielded by the fitted item characteristic curve for an item is measured by the chi-square goodness-of-fit index" (Baker, 1985, p.35-36).

In IRT analysis, an item provides equivalent measurement of the latent variables across two cultures if ICCs (i.e., as indicated by the item parameters) for the item are identical in the two cultures (Hui et al., 1983). Discrepant ICCs indicate nonequivalence. The extent and direction of the discrepancies indicate possible reasons for the translation bias such as mean shifting across languages, discrimination power differences, different guessing strategies in the two languages or cultures (Hulin, 1987). ICCs are compared via a statistical test of the difference between item parameters (Lord, 1980).

Many studies in the cross-cultural psychology area have used IRT as a basic analytical tool to validate the equivalence of measurement across languages. Andrich and Kline (1981) used a one-parameter logistic model to examine the relative item parameter values of a personality inventory with respect to populations, cross-classified by gender and country (male and female students in England and Australia). The results indicated that the scale values were significantly different using chi-square among populations in half of the items and implied that the personality inventory could not be interpreted in the same way across populations.

Hui et al. (1983) compared American Hispanic and mainstream Americans on the dimension of modernity. The

25-item Modernity Scale (Inkeles & Smith, 1974) was administered to 432 Hispanic and mainstream navy recruits. Analyses based on a two-parameter logistic model indicated that there was no item bias in either of the two ethic groups. Comparison of the two groups on attitude using IRT indicated that the mainstream population was not different from the Hispanic population concerning modernity.

Leung and Drasgow (1986) studied the relationship between self-esteem and delinquent behavior in three ethnic groups. A two-parameter logistic model and chi-square statistics were used to assess the measurement equivalence and item bias of a 10-item self-esteem scale and a 7-item delinquent behavior scale across the three groups. Two biased items from the self-esteem scale were eliminated, and the relationship between the remaining eight items and the delinquent behavior scale was examined in the three groups.

Hulin et al. (1982) used the method of detecting item bias developed from a two-parameter logistic model to analyze the fidelity of translations of psychological scales into foreign languages. The ICCs obtained from responses to the original and target language versions of the instrument were examined for significance differences using an *F*-test. Data from a Spanish translation of the Job Descriptive Index administered to 203 Spanish-

speaking employees were used to illustrate the method. Significance tests indicated that three items on the 72-item instrument were biased; however, it was concluded that the overall quality of the translation was quite good.

Hulin and Mayer (1986) investigated the fidelity of an English to Hebrew translation of the Job Descriptive Index, a job satisfaction index. A two-parameter logistic model was used to identify item bias in the translation. Approximately one-third of the items in the Job Descriptive Index were not invariant across languages and subpopulations. There were at least two major sources of variance that contributed to the observed measurement nonequivalence of these items. One was linguistic variance introduced through the translation process. The other included subpopulation cultural differences that indicated they might be dealing with more than one population with respect to some concepts and items.

All research dealing with the application of IRT to attitude surveys has employed either the one-parameter or two-parameter logistic model (Goldman & Raju, 1986). Several studies (e.g., Parsons & Hulin, 1982, Waller, 1981) have suggested that the three-parameter model may not be appropriate for attitude inventories. Waller (1981) maintained that since guessing parameters in the three-parameter model can be assumed to be zero, research

should be aimed at assessing the appropriateness of one-parameter and two-parameter models. While much of the initial research on IRT test equating focused on the Rasch model (Skaggs & Lissitz, 1986), Hulin et al. (1983) found that the two-parameter logistic model provides a good description of attitude data job satisfaction. However, no single method has been found to be consistently superior to the others. The item difficulty parameter has been estimated reasonably well for both one- and two-parameter logistic models (Goldman & Raju, 1986). The Rasch model does have some special properties that make it especially attractive to users. First, since the model involves fewer item parameters, it is easier to work with. Second, the problems with parameter estimation are considerably fewer in number than for the more general models (Hambleton & Swaminathan, 1985). It is also an appropriate model for dichotomous data and a very popular model (Safrit, 1987). Thissen and Wainer (1982) indicated that a reasonable strategy for fitting item response models to data is to try the one-parameter logistic model first. If many items cause problems regarding the lack of fit, other models can be used.

Chapter 3

METHODS AND PROCEDURES

The purpose of the study was to outline a method for examining the cross-cultural equivalence of affective test instruments using the PEAS for Thai and English-speaking adolescent boys. The methodology, presented in Figure 3.1, involved three stages: (a) translating the PEAS from English language to Thai language and examining the accuracy of the translation (i.e., providing evidence for functional/conceptual equivalence), (b) assessing via IRT the item equivalence of the Thai and English versions of the PEAS, and (c) employing confirmatory factor analysis to examine equivalence in construct operationalization of the two PEAS versions.

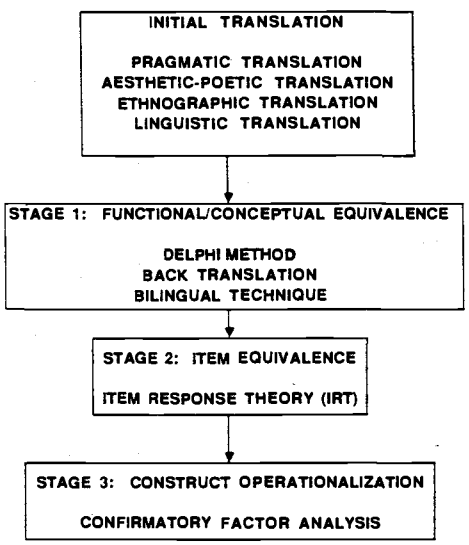

Figure 3.1. Assessing Cross-Cultural Equivalence.

Stage 1: Assessing Functional/Conceptual Equivalence

A crucial and necessary first step in developing test instruments which reflect cross-cultural equivalence is the translation of the source instrument into the foreign language and subsequent examination of the degree to which the translated version reflects the "true" meaning of the source version. This is the realm of assessing functional/conceptual equivalence.

Initial translation (see Figure 3.1) of the PEAS from English to Thai was undertaken by the investigator following the principle of pragmatic translation as outlined by Casagrande (1954). The investigator translated each item to maximize the accuracy in meaning between the two languages. For instance, some activities in the English test items were changed for the Thai translation in order to avoid confusion (e.g., marathon running, long-distance swimming, rugby football, wind surfing club, soccer, and volleyball were substituted for cross-country skiing, channel swimming, football, white water canoe club, hockey, and touch football respectively). Functional/conceptual equivalence was assessed using three methods offered by Campbell et al. (1970) and Linstone and Turoff (1975).

Delphi Method

The Delphi method involves group communication, the process allows a group of individuals, as a whole, to

deal with a complex problem (Linstone & Turoff, 1975). The Delphi method is recognized as a more objective and accurate means for collecting opinion data than group discussion or other methods of personal interaction. Many investigations have used the Delphi method in an effort to validate questionnaire statements for a variety of educational programs. For example, Stamps (1979) used the Delphi method to validate a questionnaire for the study of the acceptance and the conceptual clustering of personal finance competencies, while Samahito (1983) employed the method in a study of competency needs for master's degree programs in physical education in Thailand. More recently, Lambrecht (1986) used the Delphi method for validating a questionnaire aimed at assessing the competencies of athletic club managers to manage athletic clubs and to identify the curriculum content area for developing a sport management curriculum.

Selection of the Delphi panel. According to Linstone and Turoff (1975), a Delphi panel of 5 to 10 members is adequate. Samahito (1983) reported six members as acceptable, therefore, six panel members were used in this study. The following criteria were used for selecting the panel: (a) he/she is of Thai nationality, (b) he/she had studied in the United States to earn a master and/or doctoral degree, and (c) he/she is bilingual (English/Thai).

Procedures. After selecting the members of the Delphi panel, the following procedures were used for assessing functional/conceptual equivalence of the Thai language instrument:

(a) Both versions of the PEAS were forwarded to each Delphi member. Each panel member was asked to evaluate the translation for each item of the PEAS by indicating whether the item had equivalent meaning across translations or should be revised. If the item should be revised, the panel members were asked to write the revised statement beside the item.

(b) Based on the panel evaluations from (a) the translation was revised by the investigator. Most items were accepted by the Delphi members; however, they changed and added words to improve the clarity and grammar of certain items in the Thai language version.

(c) The revised Thai language instrument was returned to the panel members for a second evaluation to ensure that the members agreed to the revisions made based on step (a). Additional Delphi rounds were not necessary since each revised item was acceptable to all panel members.

Back Translation

Many researchers have accepted back translation as the best method for assessing translation accuracy. In the present investigation the Thai language instrument was translated back to the English language by qualified translators.

Selection of translators. Selection of qualified translators is a crucial part of the back translation method. For the purposes of this investigation the following criteria were employed to select translators:

(a) The translators had to meet the three criteria set for the Delphi panel.

(b) He/she had previous experience in translation from English language to Thai language and vice versa.

(c) He/she was not familiar with the PEAS.

Procedures. The following procedures were employed for translating the Thai language instrument back to the English language:

(a) The Thai language instrument was mailed to the translator for back translation. The translator was instructed to write the English language translation for each item in a space provided under the Thai language version of the item.

(b) The back translated language instrument was compared to the original English version of the

PEAS for meaning and accuracy. From a discussion between the investigator and the investigator's adviser, eleven items were back-translated a second time. These were items 1, 9, 11, 15, 17, 28, 30, 50, 69, 88, and 97.

(c) A second qualified translator was requested to back translate the 11 items listed above in (b). With the exception of item 88, the second translation resulted in items with acceptable similarity in meaning. Item 88 was further revised by adding words to the Thai version.

Bilingual Technique

The bilingual technique was the third and final method used for assessing the functional/conceptual equivalence of the Thai language instrument. The method employs bilingual individuals as subjects in an empirical investigation of translation accuracy. The aim of the technique is to provide evidence that bilingual individuals will score similarly on both versions of the instrument. The procedures followed in this study are described below.

Subjects. The subjects were 34 male and female Thai students attending Oregon State University. The sample was a sample of convenience.

Procedures. The Thai students were randomly divided into two groups. The English and Thai versions of the

PEAS were administered to the subjects in a counterbalanced order with one week between administrations. That is, subjects in Group A received the Thai version first and the English version a week later, while Group B received the English version first and the Thai version a week later.

Statistical analysis. Translation accuracy under the bilingual technique is viewed from the perspective of consistency of scoring over two versions of the instrument. To provide evidence for such consistency, responses over the two administrations of the instrument were tallied in a contingency table for each item separately as shown in Figure 3.2. To the left of the figure, the possible responses "true" and "false" for the English instrument are displayed. Across the top of the table, the possible responses "true" and "false" are identified for the Thai instrument. If a subject chooses the same answers on both tests, a tally was placed in cell A (true) or in cell D (false) of the table. If a subject answered "true" in the English instrument but "false" in the Thai instrument, the tally was placed in cell C. In cell B of the table, a tally was placed for a subject who answered "false" in the English instrument and "true" in the Thai instrument. All cell totals were converted to proportions for the statistical analysis.

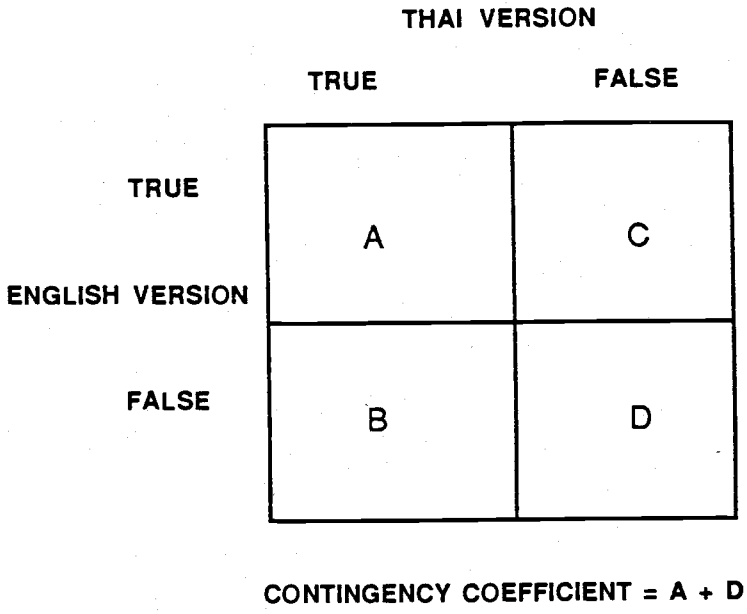

Figure 3.2. Contingency Table for Quantifying Translation Accuracy.

A contingency coefficient (C), calculated by summing the proportions of cells A and D, provided an index of the agreement between the subjects' responses over the two versions of the instrument for a given item. A value of C below 0.50 is unacceptable since we would expect such agreement by chance alone (i.e., respondents could randomly answer the item and theoretically achieve .50 agreement). Therefore, values of C between .50 and 1.00 are interpretable, with values close to 1.00 (perfect agreement) indicating translation accuracy. Table 3.1 presents the contingency coefficients (C) for the 87-PEAS items.

Table 3.1

Agreement Indices (C) and Cell Frequencies

for Estimating the PEAS Translation Accuracy

Item	Cell Frequency				C
	E1/T1	E2/T2	E2/T1	E1/T2	
2	10	16	4	4	.76
4	3	29	1	1	.94
5	11	17	1	5	.82
6	7	19	5	3	.76
8	4	24	4	2	.82
10	11	16	5	2	.79
13	10	17	5	2	.79
16	20	8	4	2	.82
17	16	11	3	4	.79
18	34	0	0	0	1.00
19	13	14	2	5	.79
22	11	16	3	4	.79
23	14	14	1	5	.82
24	14	13	5	2	.79
25	23	4	3	4	.79
26	7	20	1	6	.79
27	9	19	3	3	.82
29	16	11	5	2	.79
30	23	4	3	4	.79
31	25	2	4	3	.79
32	26	2	3	3	.82
33	10	18	3	3	.82
34	12	15	2	5	.79
35	6	22	4	2	.82
36	10	17	1	6	.79
37	25	1	4	4	.76
38	12	16	5	1	.82
39	16	12	2	4	.82
40	25	2	4	3	.79
41	25	2	4	3	.79
42	29	2	0	0	.91
43	7	20	3	4	.79
44	24	6	3	1	.88
45	2	25	0	7	.79
46	3	25	3	3	.82
47	8	20	4	2	.82
48	9	18	2	5	.79
49	1	33	0	0	1.00

Table 3.1 (Continued)

Agreement Indices (C) and Cell Frequencies

for Estimating the PEAS Translation Accuracy

Item	Cell Frequency				C
	E1/T1	E2/T2	E2/T1	E1/T2	
50	4	23	3	4	.79
51	20	8	3	3	.82
52	10	17	2	5	.79
53	15	12	4	3	.79
54	10	19	2	3	.85
55	2	25	1	6	.79
56	7	20	1	6	.79
57	22	5	3	4	.79
58	23	6	4	1	.85
59	4	24	3	3	.82
60	13	13	2	6	.76
61	11	15	5	3	.76
62	4	23	3	4	.79
63	22	4	3	5	.76
64	17	14	3	0	.91
65	14	13	3	4	.79
66	2	27	2	3	.85
67	7	19	5	3	.76
68	13	16	0	5	.85
69	5	22	3	4	.79
70	15	12	4	3	.79
71	27	2	2	3	.85
72	8	19	5	2	.79
73	6	21	4	3	.79
74	3	27	3	1	.88
75	10	19	4	1	.85
76	4	18	3	9	.64
77	6	25	2	1	.91
78	8	19	2	5	.79
79	17	9	5	3	.76
80	15	11	5	3	.76
81	8	18	1	7	.76
82	6	20	4	4	.76
83	22	4	6	2	.76
84	11	16	4	3	.79
85	31	1	1	1	.94
86	25	3	4	2	.82
87	13	14	4	3	.79

Table 3.1 (Continued)

Agreement Indices (C) and Cell Frequencies

for Estimating the PEAS Translation Accuracy

Item	Cell Frequency				C
	E1/T1	E2/T2	E2/T1	E1/T2	
88	16	10	3	5	.76
89	9	17	4	4	.76
91	17	10	5	2	.79
92	20	7	7	0	.79
94	13	12	3	6	.74
95	4	27	1	2	.91
96	9	23	1	1	.94
97	24	5	2	3	.85
98	22	6	1	5	.82
99	0	31	2	1	.91
100	21	7	4	2	.82

Table 3.1 reveals values of C ranging from 1.00 to 0.64 (median = .79). The translation of the PEAS from English language to Thai language was judged as having similar meaning in each item of the instrument.

Further proof of translation equivalence is given by comparing the mean scores of the attraction scale across test versions and mean scores of the estimation scale across test versions (see Table 3.2). Dependent measures t-tests of mean differences revealed no significant differences in either the estimation or attraction scales ($p > .05$, $df = 33$).

Table 3.2

Means and Standard Deviations of Attraction and Estimation Subtest Scores for Thai and English Versions

Subtest	Mean	Standard Deviation
Thai Version		
Attraction	27.32	7.98
Estimation	14.41	8.10
English Version		
Attraction	27.74	7.92
Estimation	14.35	7.29

Stage 2: Assessing Item Equivalence

A primary focus of this study was to investigate the equivalence of Thai and English versions of the PEAS. This stage analyzed the equivalence of PEAS items across cultures via item response theory as suggested by Hulin et al. (1982).

Subjects

Since both IRT and confirmatory factor analysis (Stage 3) were employed in this study, sample size was determined by the minimum rule of thumb which provided stable estimation in both procedures. To provide a stable estimation of item parameters, researchers suggest using large sample sizes ($n > 200$) when employing IRT (e.g., Hui et al., 1983; Wood, 1987). However a common "rule of

thumb" for estimating stable factor analysis parameters is a minimum of 10 respondents per each item of an instrument (Brislin et al., 1973; Courtney, 1984). Since there are 100 items in the PEAS, 13 of which are designed to identify response distortion, one thousand (100 x 10) subjects from each population should be tested to ensure stable parameter estimation for both the IRT and confirmatory factor analysis procedures. However, the subjects used in this study in the United States were limited by the amount of students available in each class.

The subjects of this study consisted of 499 boys aged 14 - 19 years in grades 8 through 12 from public schools in the cities of Corvallis and Albany, in the State of Oregon and 1009 boys aged 14 - 19 years in grades 8 through 12 in Bangkok Province, Thailand. Prior to data collection in the United States an application for exemption from human subjects review was obtained from the Oregon State University Office of Research, Graduate Studies, and International Programs (see Appendix A).

Procedures

PEAS data were collected in Thailand in February, 1988 by an assistant to the principal investigator. The procedures for collecting data in Thailand were as follows:

(a) The assistant investigator randomly selected four schools and contacted the principal in each school to obtain permission for collecting data.

(b) The students in each grade level of the schools were selected by simple random sampling.

(c) Data were collected on site by the assistant investigator with help from classroom teachers.

(d) Before administering the questionnaire, the assistant investigator or classroom teacher explained the objectives of the research to the students and read procedures for answering the questionnaire as shown in Appendix F.

(e) There was no time limit set for students to answer the questionnaire.

In the United States intact classes of students designated by the school were sampled and data were collected in May - June, 1988. Permission for data collection in the Albany and Corvallis school districts was obtained from the appropriate district administration officials prior to data collection (see Appendix B).

Oregon data were collected by physical education teachers appointed by school principals for that task. Teachers involved in data collection were interviewed and trained by the principal investigator. Administration

procedures were similar to those used for the Thai sample with the exception that the investigator (or his assistant) was not present.

Only answer sheets for which there were no missing responses were used in the analysis. Data for no more than 20 subjects in each sample were discarded because of missing data or because of suspected response distortion. There were 1009 answer sheets for Thai subjects and 499 answer sheets for the American subjects used in this study. Each of the 87 items of the PEAS was scored as "1" for a "true" response and "0" for a "false" response and appropriate items were reversed according to the PEAS answer key (see Appendix D). Data were input to a computer ASCII file via Lotus 123 for subsequent analyses.

Statistical Analysis

The two-parameter logistic model was used to assess the item equivalence of the instruments. Item parameters and ICCs for each test item in both the English and Thai versions of the PEAS were estimated using the computer program PC-BILOG (Mislevy & Bock, 1986) on an IBM-AT microcomputer. EST and ATTR items were treated separately since they represent distinct constructs. The procedures involved two steps:

(a) estimating item parameters for each item using marginal maximum likelihood procedures (item calibration) and creating an ICC for each item in both instruments using the following formula for the two-parameter logistic model (Baker, 1985):

$$P(\Theta) = \frac{1}{1 + e^{-\underline{a}(\Theta - \underline{b})}}$$

where,

Θ is an ability level,
$P(\Theta)$ is the probability that a randomly selected examinee with ability Θ answer item correctly,
e is the constant 2.718,
$\underline{b}$ is the difficulty parameter, and
$\underline{a}$ is the discrimination parameter.

Note that the PC-BILOG program defaults were used for this stage of the analysis.

(b) assessing the cross-cultural equivalence of IRT difficulty and discrimination parameters for each item separately using a $\underline{Z}$-statistic (Lord, 1980). To limit the experimentwise Type I error rate to .05, a Bonferroni method was employed in which each comparison was tested at the .0006 level of significance (i.e., .05/87 = .0006). The formula to calculate the $\underline{Z}$-statistic is shown below:

$$Z_i = \frac{X_T - X_E}{\sqrt{(\text{S.E. of } X_T)^2 + (\text{S.E. of } X_E)^2}}$$

where,

Z is the Z-statistic for item i,
X_T is the estimated parameter a or b for Thai version item i,
X_E is the estimated parameter a or b for English version item i,
S.E. of X_T is a standard error of a or b for Thai version item i, and
S.E. of X_E is a standard error of a or b for English version item i.

Stage 3: Examining Equivalence of Construct Operationalization

Factor analysis is a technique for determining the latent variables that underlie a large number of observed variables unique to a situation. It is a method that reduces relationships among many observable variables to a key number of latent factors. Simply stated in geometric terms, factor analysis is a means for finding a set of dimensions which account for the relationship among the variables under study (Brislin et al., 1973).

Factor analytic procedures can be generally categorized into exploratory procedures and confirmatory procedures. In the former no a priori factor structure is specified. Every observed variable is allowed to load on every factor. Such procedures are often described as "data driven" since the resulting factor structure is a product of the rather subjective post hoc interpretation

of the user. In contrast, confirmatory factor analytic methods allow for a priori specification of both factor loadings and between factor correlations based upon prior knowledge or theory. Furthermore, the method provides a statistical test of the fit between the specified model and the factor structure resulting from the observed data. Confirmatory factor analysis is thus known as a "theory driven" procedure.

Confirmatory factor analysis involves three steps: (a) identification of the model parameters, (b) estimation of factor parameters, and (c) testing the goodness of fit between the hypothesized factor structure and the observed factor structure (Long, 1983). The computer program PC-LISREL 6 (Jöreskog & Sörbom, 1986) is commonly employed to execute confirmatory factor analyses. The following procedures are advocated for the present study:

(a) An inter-item correlation matrix (R) of tetrachoric coefficients with 1.00s along the main diagonal is created for the PEAS English data. The factor structure of R is determined via exploratory factor analytic procedures using the SPSSX computer program (SPSS, 1986). Factor loadings and between factor correlations are used to specify the factor model with which to compare the Thai version.

(b) The English version factor loadings and between factor correlations are input along with a Thai version of $\underline{R}$ to the LISREL 6 computer program. LISREL 6 determines the factor structure of the Thai data and statistically compares the structure to the English version factor structure using maximum likelihood procedures and the chi-square goodness-of-fit test (Jöreskog & Sörbom, 1986).

Chapter 4

RESULTS AND DISCUSSION

Chapter 4 consists of two sections. The first section presents a summary of the IRT analysis focusing on a comparison of the IRT analysis with traditional item statistics, followed by a discussion of the interpretation of the IRT analysis and its contribution to the cross-cultural validation of a psychological test instrument. A discussion of the analysis of construct operationalization provides the focus for the second section.

IRT Analysis

Item (Psychometric) Equivalence

IRT parameters were generated via the PC-BILOG computer program. PC-BILOG separates IRT analysis into 3 phases. In Phase I traditional item analysis statistics are computed such as the item discrimination index represented by the biserial correlation (r_b) and the item difficulty statistic (ID) or the proportion of subjects responding "positively" to an item. The biserial correlation is simply the correlation between the responses to an item and the total score for a subtest. A high positive r_b is the desired result since such values indicate that respondents who tend to answer an item "positively" tend to achieve a high subtest total

score, while respondents who record an negative response tend to score low on the subtest total score (Jensen, 1980).

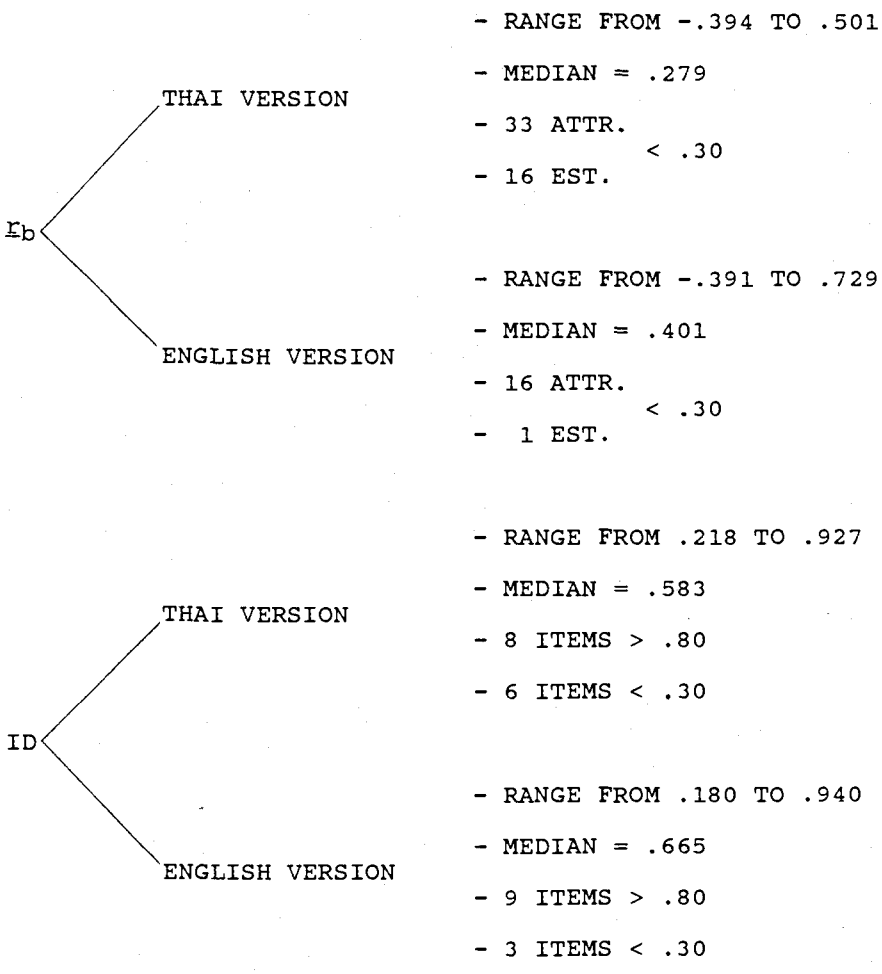

Figure 4.1. Summary of Traditional Item Statistics.

Tables 4.1 and 4.2 present the ID and r_b statistics for the Thai and English samples respectively. Figure 4.1 provides a summary of these results. Item

discrimination statistics ranged from -.394 to .501 (Median = .279) in the Thai sample and from -.391 to .729 (Median = .401) in the English sample. Although the desired magnitude of r_b depends on the purposes for which a test will be used, a common rule of thumb considers values $\geq$ .40 as indicating very good discrimination, .30 - .39 as indicating good discrimination, .20 - .29 indicating marginal discriminatory power, and values $\leq$ .20 as unacceptable (Ebel, 1965). Forty-nine items in the Thai version (33 attraction and 16 estimation) and 17 English version items (16 attraction and 1 estimation) had discrimination values below .30. Overall, items in the Thai version of the PEAS revealed less discriminating power than English version items as evidenced by a lower median value for r_b and a greater frequency of values close to zero in magnitude or negative in algebraic sign. Discrimination values with a negative sign (e.g., Thai items 8, 50, 94 and English item 50) are an undesirable result as they indicate that respondents who tended to answer "positively" to the item also tended to score low on the PEAS and vice versa.

Table 4.1

Traditional Item Analysis Statistics

for the PEAS Thai Version

Item	ID	r_b	Item	ID	r_b
ATTRACTION					
2	.795	.279	63	.750	.349
4	.364	.242	65	.553	.305
8	.223	-.184	66	.411	.159
16	.811	.306	71	.752	.212
17	.690	.491	74	.743	.275
18	.927	.422	75	.718	.425
22	.651	.404	76	.659	.275
23	.619	.243	78	.703	.294
24	.218	.104	80	.341	.167
25	.660	.378	82	.632	.209
27	.612	.240	83	.804	.289
29	.583	.229	85	.846	.353
30	.739	.197	86	.357	.081
31	.523	.384	89	.504	.188
32	.775	.478	92	.838	.321
34	.631	.322	96	.732	.437
36	.393	.231	97	.787	.403
37	.398	.188	98	.554	.214
41	.312	.114	99	.484	.034
42	.899	.370	100	.812	.200
43	.499	.188			
44	.428	.251	ESTIMATION		
45	.473	.181			
46	.466	.202	5	.636	.060
47	.711	.477	6	.511	.381
50	.249	-.394	10	.612	.466
51	.514	.274	13	.626	.438
52	.533	.198	19	.543	.067
53	.507	.383	26	.518	.442
55	.417	.203	33	.517	.491
56	.588	.201	35	.718	.350
57	.770	.373	38	.635	.501
58	.547	.371	39	.687	.412
61	.690	.417	40	.425	.368

Table 4.1 (Continued)

Traditional Item Analysis Statistics

for the PEAS Thai Version

Item	ID	r_b	Item	ID	r_b
48	.667	.240	72	.593	.478
49	.314	.294	73	.276	.292
54	.531	.270	77	.575	.445
59	.800	.128	79	.507	.196
60	.435	.180	81	.554	.424
62	.597	.466	84	.529	.243
64	.595	.277	87	.790	.091
67	.694	.387	88	.510	.389
68	.566	.468	91	.291	.126
69	.644	.307	94	.329	-.003
70	.532	.294	95	.294	.182

The greater the magnitude of the ID value for an item, the greater the percentage of respondents who answered the item "positively". An item for which ID = 1.00 indicates that all respondents answered the item positively (an "easy" item), while an item for which ID = 0.00 shows that none of the respondents answered positively to the item (a "hard" item). Items for which ID is close to 1.00 or 0.00 are not useful since these items fail to discriminate among respondents. Maximum discrimination occurs when ID falls at approximately .50. Item difficulty values ranged from .218 to .927 (Median = .583) in the Thai sample and from .180 to .940 (Median = .665) in the English sample. Thai items 16, 18, 42, 59, 83, 85, 92, and 100 revealed difficulty values exceeding

Table 4.2

Traditional Item Analysis Statistics

for the PEAS English Version

Item	ID	r_b	Item	ID	r_b
ATTRACTION					
2	.778	.483	74	.828	.319
4	.453	.266	75	.433	.364
8	.860	.614	76	.806	.337
16	.635	.238	78	.653	.347
17	.677	.385	80	.309	.046
18	.940	.302	82	.754	.519
22	.423	.212	83	.762	.620
23	.768	.517	85	.749	.555
24	.226	.050	86	.641	.233
25	.715	.588	89	.497	.375
27	.651	.233	92	.519	.377
29	.625	.251	96	.717	.470
30	.737	.271	97	.685	.469
31	.385	.210	98	.681	.338
32	.539	.455	99	.473	.142
34	.595	.304	100	.770	.536
36	.725	.507			
37	.557	.473	ESTIMATION		
41	.489	.291			
42	.752	.705	5	.792	.343
43	.776	.656	6	.469	.495
44	.743	.307	10	.635	.604
45	.605	.344	13	.549	.380
46	.641	.481	19	.770	.499
47	.341	.189	26	.665	.491
50	.180	-.391	33	.471	.456
51	.735	.349	35	.810	.533
52	.627	.262	38	.533	.507
53	.721	.379	39	.731	.654
55	.371	.139	40	.766	.599
56	.816	.363	48	.888	.386
57	.754	.641	49	.222	.110
58	.667	.572	54	.667	.398
61	.635	.651	59	.878	.411
63	.651	.522	60	.818	.349
65	.786	.596	62	.571	.468
66	.455	.397	64	.649	.309
71	.595	.092	67	.669	.393

Table 4.2 (Continued)

Traditional Item Analysis Statistics

for the PEAS English Version

Item	ID	r_b	Item	ID	r_b
68	.641	.530	81	.735	.729
69	.719	.579	84	.756	.460
70	.745	.413	87	.790	.091
72	.485	.429	88	.607	.541
73	.545	.573	91	.291	.126
77	.655	.401	94	.329	-.003
79	.665	.325	95	.294	.182

.800, indicating that most Thai respondents responded positively to these items. In contrast, Thai items 8, 24, 50, 73, 91, and 95 were associated with ID values below .300, indicating that few Thai respondents answered positively to these items. Analysis of ID values for the English version shows that items 8, 18, 35, 48, 56, 59, 60, 74, and 76 were answered positively by most English respondents, while items 24, 49, and 50 were answered with few positive responses.

Comparison of traditional item analysis statistics across the Thai and English versions of the PEAS provides some evidence that the instruments are different. However, as Hulin (1987) pointed out, such comparisons are fraught with difficulties since such statistics are population dependent. Comparing the mean ID statistic across different language versions assumes that "the

distributions of the trait being assessed by the items in the populations being compared are equal or known a priori" (Hulin, 1987, p. 118), while differences in r_b may be a result of differences in the translation or to differences in item means, item covariances, and/or variability in the latent trait. To overcome these difficulties Hulin suggests employing IRT analysis of items since

> ... psychometrically equivalent items (stimuli) evoke a specified response, from the set of permissible responses, with the same probability among individuals with equivalent amounts of the characteristic assessed by the item or scale comprising the items (stimuli). In the case of psychological scales and questionnaires, the response options or alternatives to each item are the permissible responses. If the source and target language versions of items elicit equal probabilities of a specified response from individuals with equal amounts of the trait assessed by the items, psychometric equivalence of the source and translated item is supported. (p. 123)

To analyze the item equivalence of the PEAS the two-parameter logistic IRT model was selected with item discrimination (a) and item difficulty (b) free to vary across items, but the value of item guessing (c) fixed at zero. The model was chosen because, in attitude measurement using the PEAS, there is no reason for individuals to guess the correct response in any items (Hulin et al., 1983). Employing PC-BILOG (Phase II) the two-parameter logistic model was fit to all items in the Thai and English samples separately using a maximum

likelihood procedure. Since the PEAS consists of two dimensions -- attraction and estimation -- IRT parameters were calibrated for each subscale separately. IRT parameters for each item in both the English and Thai samples are provided in Appendix G.

Table 4.3 presents means ($\bar{X}$), standard deviations (SD), minimum, and maximum values for the IRT parameters for each sample.

Table 4.3

IRT Parameter Descriptive Statistics

for the PEAS Thai and English Versions

ICC para.	Mean	Standard Deviation	Minimum	Maximum
ATTRACTION				
Thai				
a	.677	.340	.080	1.394
b	-.046	2.758	-2.592	13.867
English				
a	.904	.456	.135	2.066
b	-.373	2.045	-3.159	11.287
ESTIMATION				
Thai				
a	.739	.404	.180	1.538
b	.333	1.633	-4.265	3.992
English				
a	1.046	.352	.358	2.272
b	-.803	1.058	-2.540	3.595

To judge the fit of the IRT model to the data, PC-BILOG computes a chi-square goodness-of-fit test for each item (see Appendix G). Nonsignificant chi-square statistics ($p > .05$) indicate adequate fit of the model for a given item. For the PEAS Thai version, there were five items of the attraction scale and six items of the estimation scale showing poor fit of item parameter estimates. Table 4.4 summarizes these results.

Table 4.4

PEAS Thai Version

Items Evidencing Poor IRT Model Fit

Item	a parameter	b parameter	Chi-square
ATTRACTION			
2	.632	-.306	25.6*
8	.127	9.819	32.6*
44	.537	.560	29.1*
50	.080	13.867	70.3*
66	.365	1.002	30.5*
ESTIMATION			
33	1.534	-.056	20.6*
35	.680	-1.504	17.0*
40	.700	.470	16.8*
49	.673	1.265	21.1*
59	.321	-4.406	16.0*
70	.464	-.295	21.5*

*$p < .05$.

For the PEAS English version poor model fit was evidenced in five attraction items and two estimation items as shown in Table 4.5.

Table 4.5

PEAS English Version

Items Evidencing Poor IRT Model Fit

Item	a parameters	b parameters	Chi-square
ATTRACTION			
47	.385	1.769	29.8*
50	.135	11.287	32.6*
56	.947	-1.816	15.9*
76	.927	-1.766	19.2*
82	1.383	-1.068	19.6*
ESTIMATION			
5	.711	-2.074	15.0*
6	1.067	.131	19.0*

*p <.05.

The rationale for using IRT to assess psychometric or scalar equivalence of translated items stems from the invariance principle of IRT. Assuming that respondents from the source and target languages are subpopulations from the same population, the invariance principle suggests that IRT parameters from source and translated versions of a test instrument should, within sampling error, be the same. That is, "if individuals with the

same amounts of the trait being estimated have different probabilities of making a specified response to the item when responding to different language versions of the items or scales, the items are said to be biased or nonequivalent" (Hulin, 1987, p. 138). While visual inspection of ICCs (see Appendix I for ICCs for each PEAS item) would provide evidence of nonequivalence across test versions (Baker, 1985), a more accurate assessment involves the statistical comparison of IRT parameters across language versions for each item separately. Significant differences between IRT parameters for each item across test versions were analyzed using a Z-score method outlined by Lord (1980). To limit the experimentwise Type I error rate to .05, a Bonferroni method was employed in which each comparison was tested at the .0006 level of significance.

Results of the Z-score analysis are presented in Tables 4.6 - 4.8. Only 15 of the 87 PEAS items (12 attraction and 3 estimation items) revealed nonsignificant differences in both parameters (see Table 4.6). These results are supported by visual comparison of the ICCs for each of these items across language versions. Figures 4.1 and 4.2 present Thai and English ICCs respectively for Items 10 and 24, clearly illustrating the identical shape, slope (item discrimination), and location (item difficulty) of these

curves. Employing Hulin's (1987) interpretation of IRT comparisons across language versions of a psychological test instrument, the items in Table 4.6 present similar stimuli across cultures in measuring the latent trait of interest and are considered to be item equivalent.

Table 4.6

Items Revealing Nonsignificant Differences in Both a and b Parameters

Item	Thai		English		Z-score	
	a	b	a	b	a	b
ATTRACTION						
24	.274	4.724	.277	4.500	-.053	.231
27	.458	-1.053	.447	-1.477	.287	2.006
29	.513	-.698	.505	-1.070	.129	2.450
30	.509	-2.161	.531	-2.056	-.331	-.368
34	.730	-.825	.650	-.648	1.219	1.718
50	.086	13.867	.135	11.287	-1.534	.621
55	.412	.831	.308	1.753	1.897	3.105
74	.785	-1.517	.870	-2.041	-1.083	2.853
78	.687	-1.374	.673	-1.031	.073	2.470
80	.372	1.816	.264	3.104	2.022	2.334
96	1.123	-1.105	1.033	-1.081	1.166	-.257
99	.237	.273	.391	.284	-2.861	-.667
ESTIMATION						
10	1.441	-.440	1.421	-.554	.225	2.258
64	.491	-.826	.603	-1.111	-1.801	1.985
67	.905	-1.052	.809	-1.011	1.493	-.392

*$p \leq .0006$.

Two items considered to be item equivalent are described below along with their associated ICCs (see Figures 4.2 and 4.3):

Estimation Item 10

"I am in better physical condition than most boys my age."

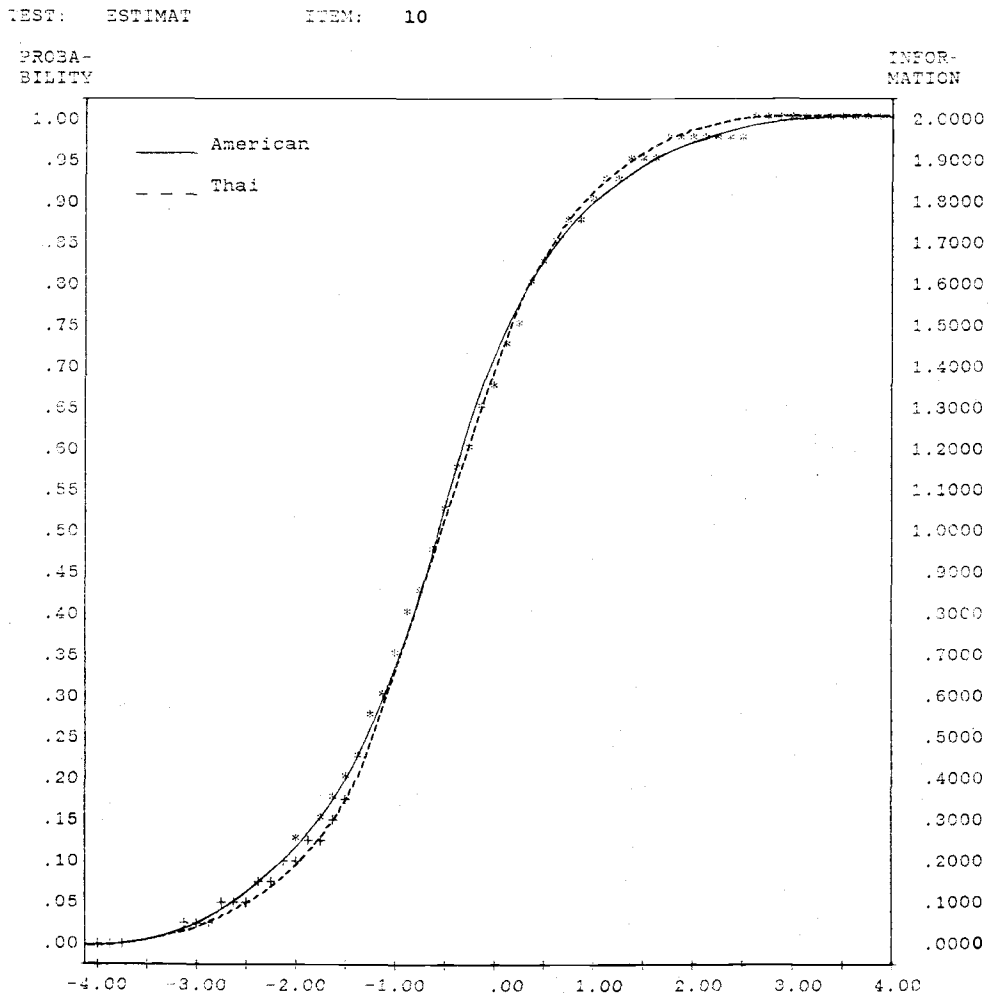

Figure 4.2. ICCs for Estimation Item 10.

Attraction Item 24

"I would rather visit an amusement park than watch a tennis match."

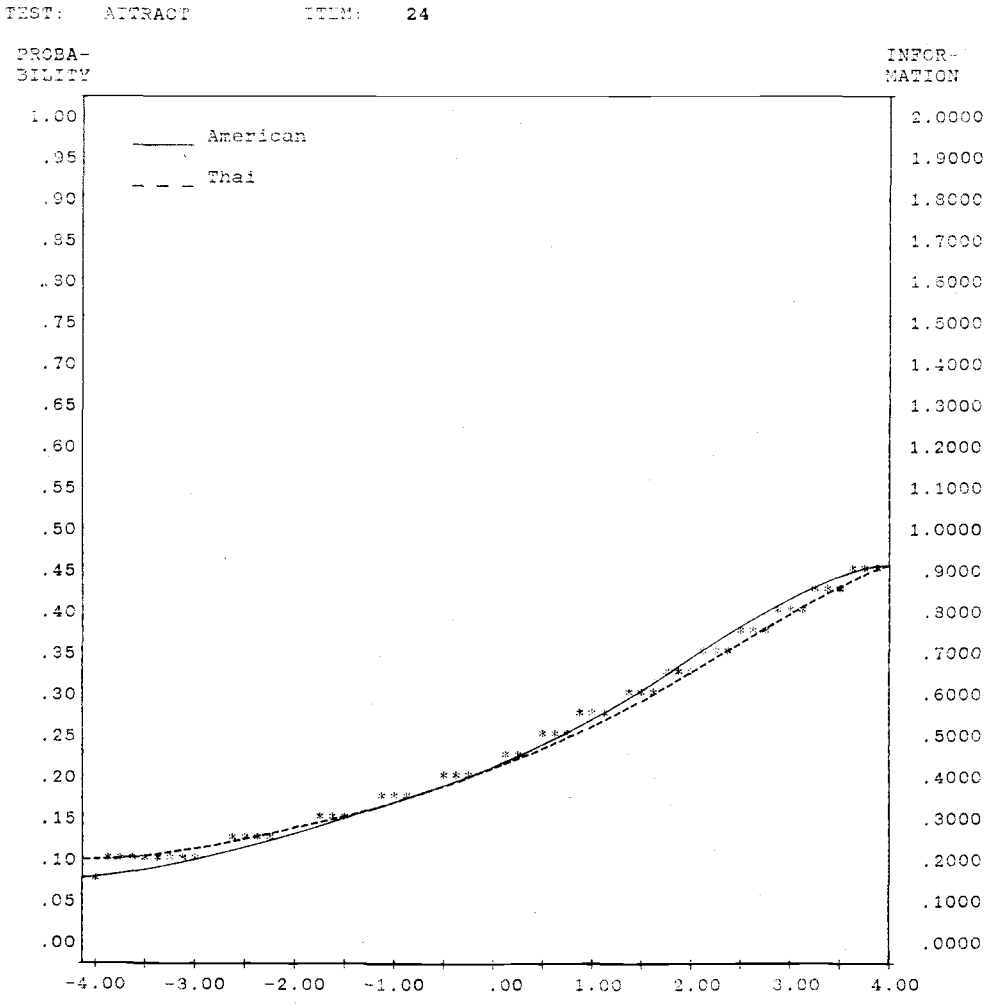

Figure 4.3. ICCs for Attraction Item 24.

Six attraction items and four estimation items exhibited nonsignificant differences for the a parameter and significant differences for the b parameter (see Table 4.7). Visual inspection of the ICCs for the Thai and English versions of Item 26 (Figure 4.4) and Item 44 (Figure 4.5) show the similar slopes (item discrimination) but different locations (item difficulty). Interpretation of these results are not as straightforward as those presented in Table 4.6 because differences in IRT parameters can indicate a poorly translated item or an item which is accurately translated but has little substantive meaning in the target culture. Hulin (1987) suggested that items which differ in the location (b) parameter only are indicative of poor translation quality. Such items should be carefully examined for words and phrases which may be changed to improve the fidelity of the item.

Table 4.7

Items Revealing Nonsignificant Differences

Between the a Parameters

and Significant Differences Between the b Parameters

Item	Thai		English		Z-score	
	a	b	a	b	a	b
ATTRACTION						
4	.451	1.282	.555	.360	-1.710	6.332*
44	.537	.560	.653	-1.766	-1.811	13.584*
52	.403	-.351	.517	-1.065	-1.868	4.753*
53	.867	-.055	.916	-1.205	-.686	12.143*
76	.723	-1.016	.927	-1.766	-2.807	5.365*
97	1.147	-1.396	1.079	-.880	.844	-5.570*
ESTIMATION						
6	1.077	-.060	1.067	.131	.123	-3.643*
26	1.133	-.089	1.050	-.812	1.054	10.563*
68	1.123	-.300	1.126	-.660	-.038	5.782*
77	1.049	-.356	.844	-.887	2.804	6.309*

*$p \leq .0006$.

The ICCs of Items 26 and 44 are examples of nonequivalence in item difficulty:

Estimation Item 26

"I am better coordinated than most people I know."

The ICCs (Figure 4.4) of this item in both the Thai and English versions show differences in item popularity parameter (b). Thai and American boys have a low estimate of their coordination. It is possible that the Thai translation of the word "coordination" may have a different meaning.

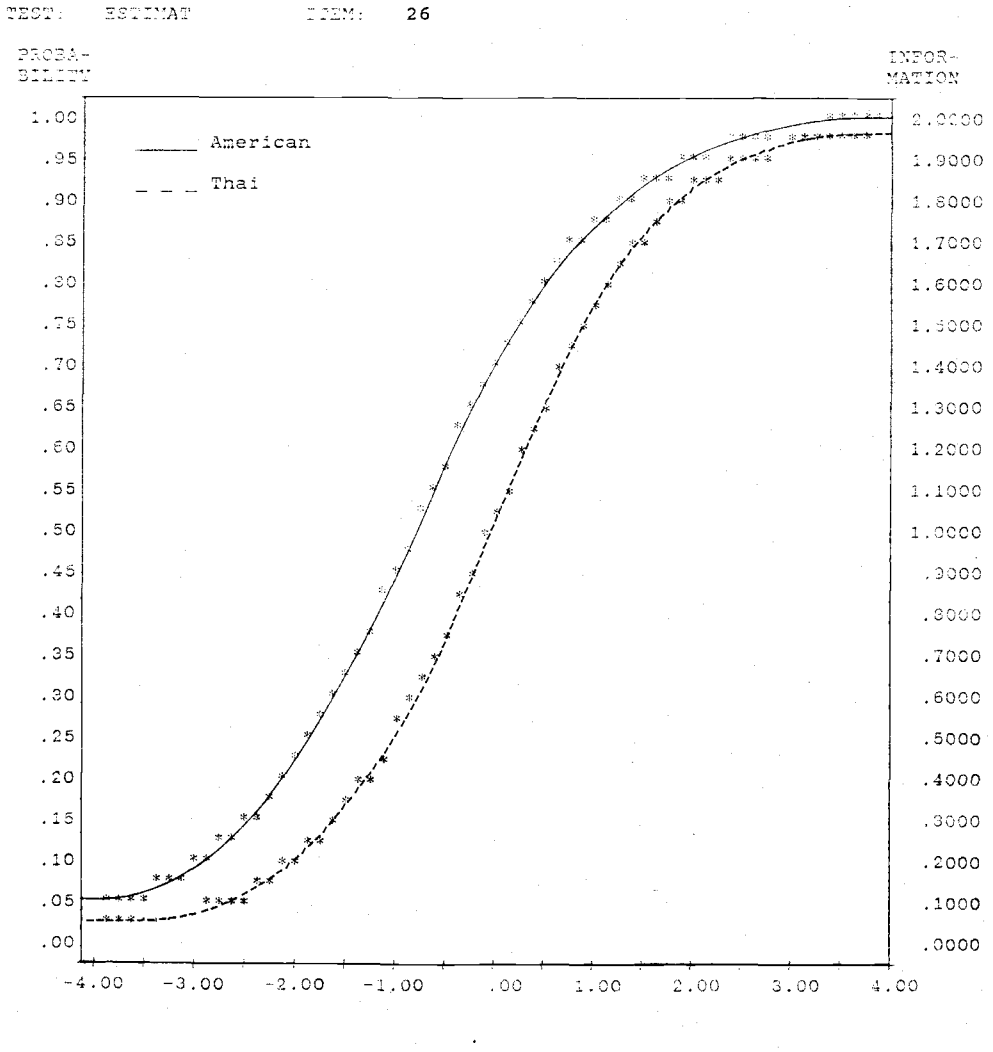

Figure 4.4. ICCs for Estimation Item 26.

Attraction Item 44

"I prefer to watch an exciting basketball game to playing it myself." The ICCs (Figure 4.5) for this item indicate that Thai boys seem more likely to play in a basketball game than to watch a basketball

game. One possible explanation is that in the U.S. professional and collegiate basketball is a popular spectator sport. The absence of comparable spectator programs in Thailand may result in a greater interest in direct participation in basketball. Substitution of the word "football" (i.e., soccer) for basketball may alleviate the problem.

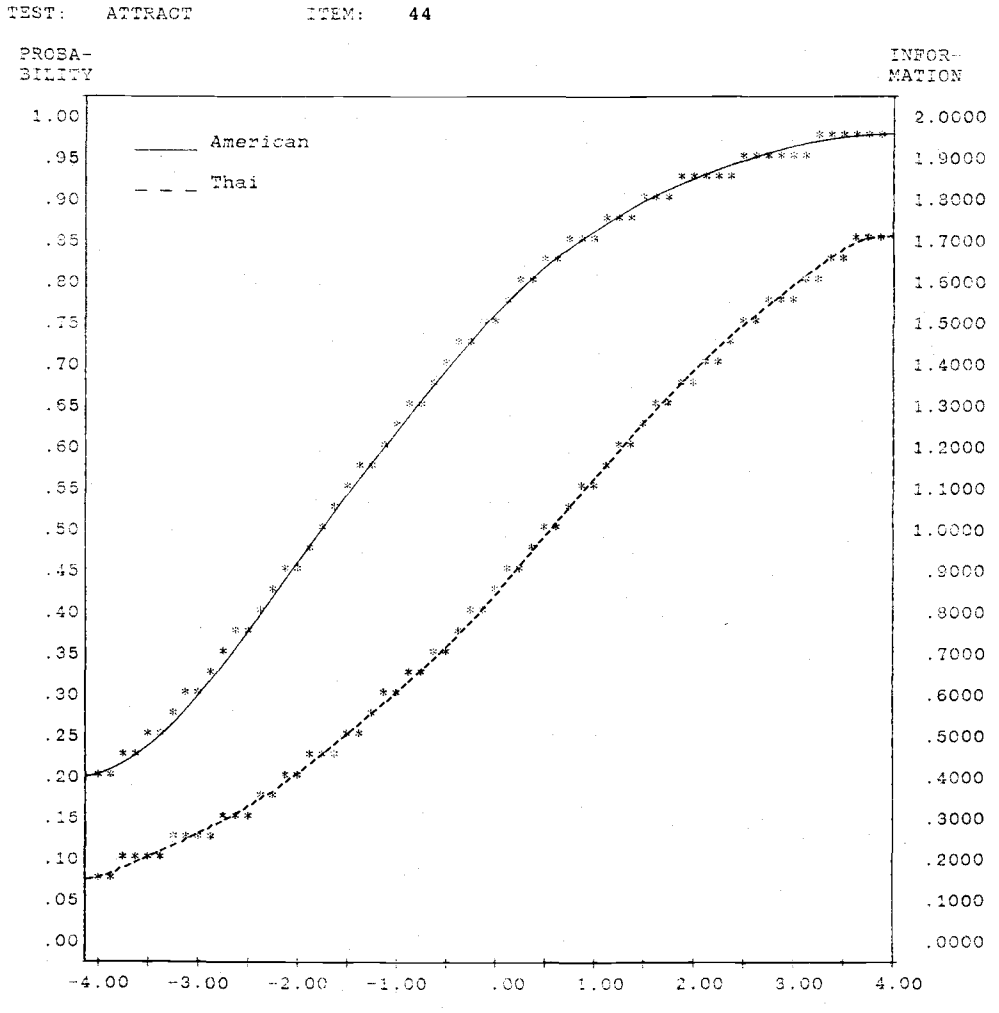

Figure 4.5. ICCs for Attraction Item 44.

Table 4.8 presents 14 items (7 attraction and 7 estimation) which show significant differences between the a parameters and nonsignificant differences between the b parameters. Similarity of item difficulty locations and differences in item discrimination slopes were also exhibited in the ICCs as shown in Figures 4.6 and 4.7 for Items 19 and 82. Again, following Hulin's (1987) interpretation items which reveal similar locations but discrepant slopes are likely suffering from emic item content or substantive differences in meaning across cultures. Such items should be deleted from the test instrument.

Table 4.8

Items Revealing Significant Differences Between the a Parameters and Nonsignificant Differences Between the b Parameters

Item	Thai		English		Z-score	
	a	b	a	b	a	b
ATTRACTION						
17	1.292	-.813	.779	-1.069	6.975*	2.575
18	1.356	-2.309	.985	-3.159	3.529*	2.852
23	.530	-.984	1.340	-1.160	-10.048*	1.585
25	.886	-.873	1.481	-.854	-7.243*	-.256
71	.565	-2.090	.313	-1.258	4.192*	-3.091
82	.503	-1.145	1.383	-1.068	-12.188*	-.664
89	.396	-.056	.748	.014	-5.470*	-.762
ESTIMATION						
5	.215	-2.625	.711	-2.074	-7.856*	-1.279
19	.213	-.821	1.052	-1.398	-12.590*	2.945
35	.680	-1.504	1.197	-1.528	-6.609*	.176
39	1.053	-.906	1.584	-.920	-6.422*	.202
59	.321	-4.406	.935	-2.434	-7.712*	-3.154
62	1.213	-.417	.955	-.370	3.281*	-.781
69	.566	-1.124	1.387	-.930	-10.423*	-1.816

*$p \leq .0006$.

Two items, 19 and 82, demonstrate cross-cultural nonequivalence:

Estimation Item 19

"I just do not have the coordination necessary to look like a graceful skier (gymnast in the Thai version)." The ICCs for this item (see Figure 4.6) show that the item discriminates more effectively in the English version than the Thai version. Coupled

with the fact that most of the Thai students answered negatively to this item leads to the conclusion that gymnastics is a new activity to which Thai boys may not have had much exposure.

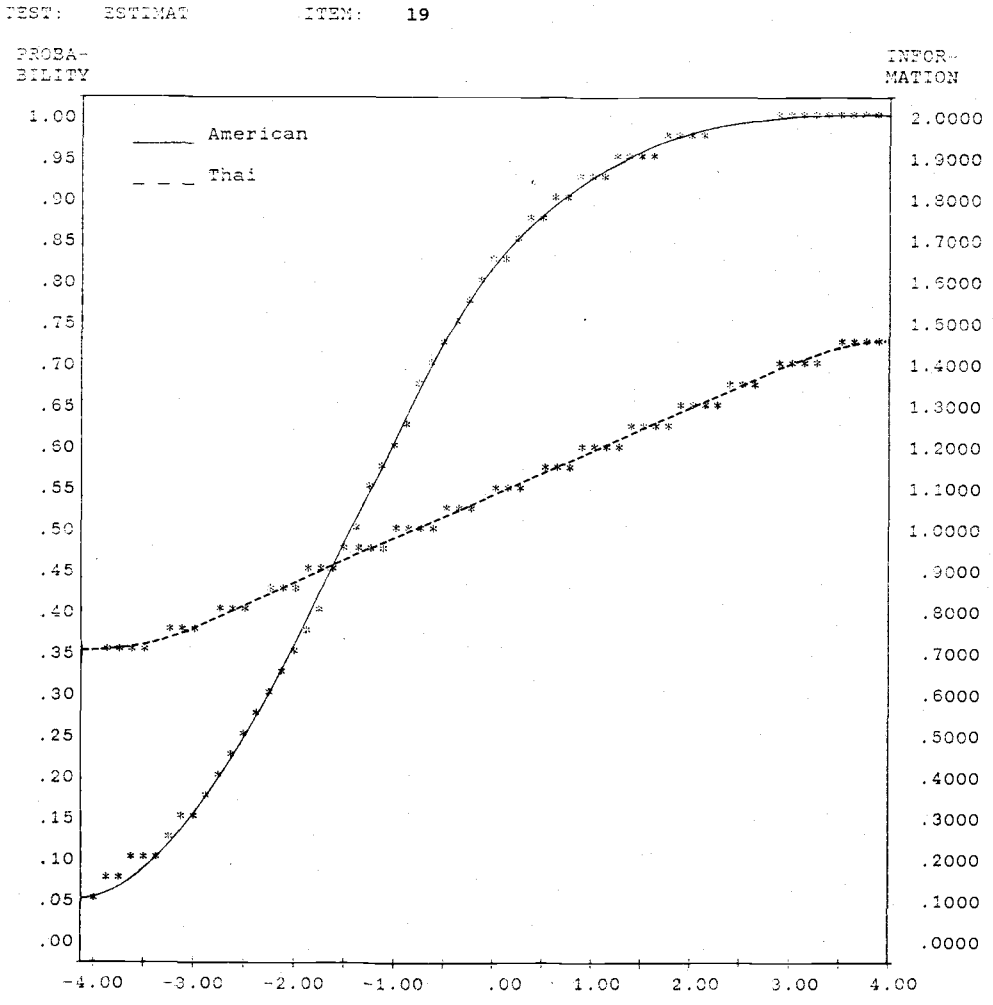

Figure 4.6. ICCs for Estimation Item 19.

Attraction Item 82

"Being strong and highly fit is not really that important to me." Figure 4.7 shows the ICCs for this item. Many Thai boys are not attracted to being strong and possessing a highly fit body. They may not have been trained physically before or they may not have knowledge on how to improve their body conditioning.

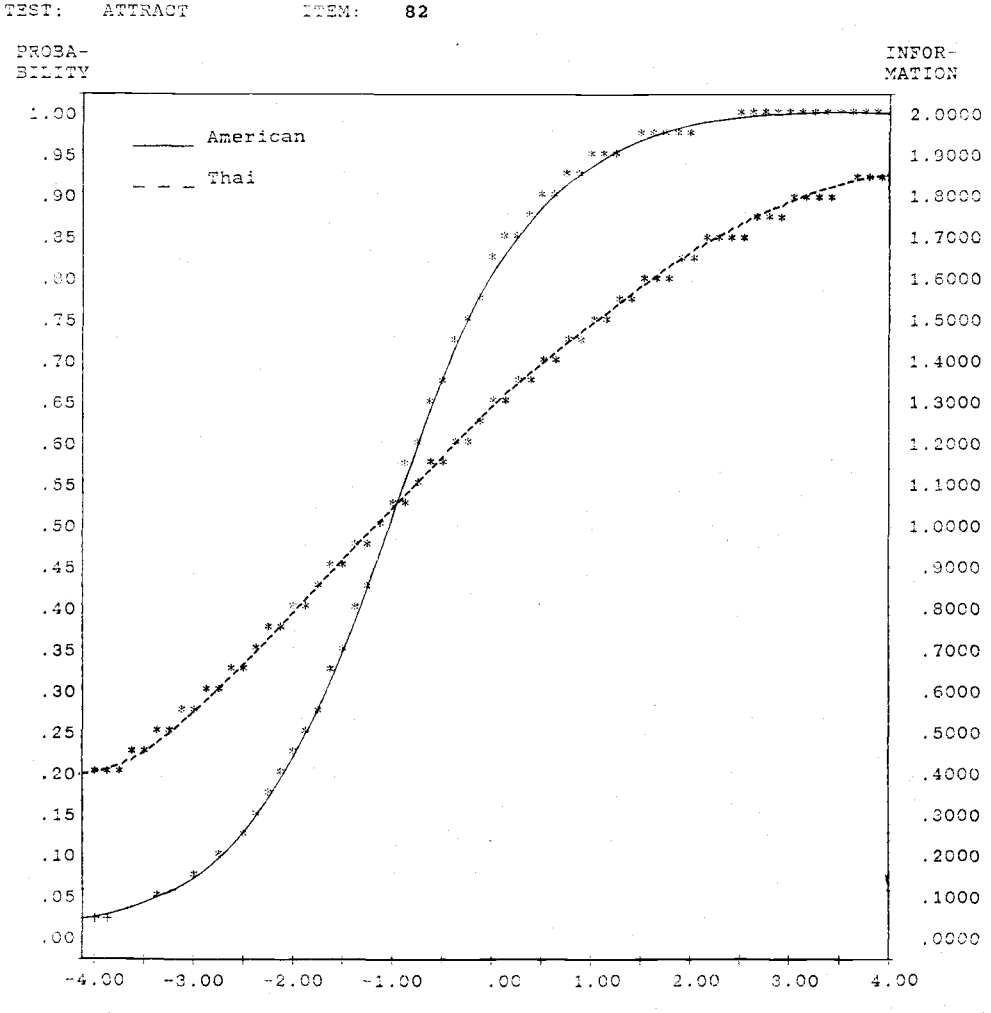

Figure 4.7. ICCs for Attraction Item 82.

Twenty nine of the 54 attraction items and 19 of the 33 estimation items showed significant differences in both the a and b parameters (see Appendix H). The ICCs for these items also indicate the differences in item discrimination slopes and item difficulty locations (see Appendix I). These items show no item equivalence across cultures and should be deleted from the instrument. Items 91 and 43 are examples of these nonequivalent items:

Estimation Item 91

"I am not very good at most physical skills." The ICCs, shown in Figure 4.8, of both versions show differences in item discrimination and item difficulty.

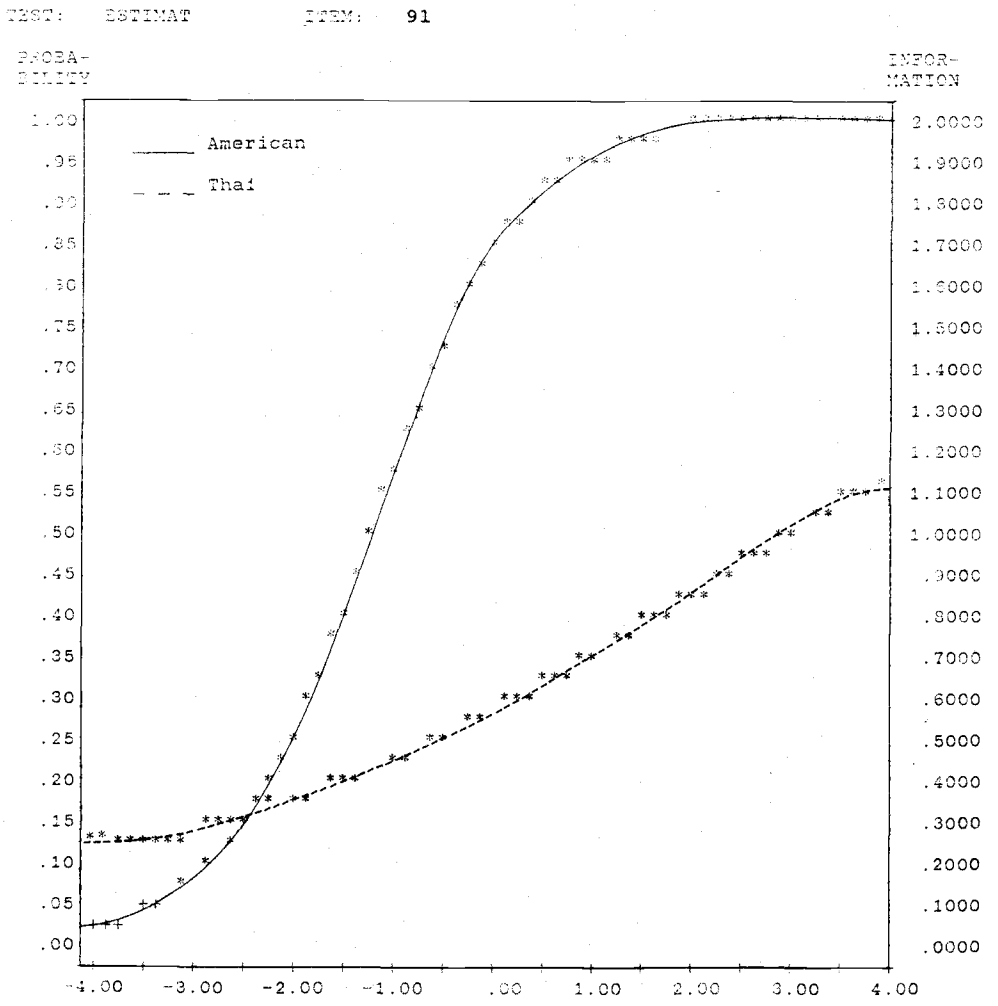

Figure 4.8. ICCs for Estimation Item 91.

Attraction Item 43

"I like the rough and tumble of athletic competition." Figure 4.9 presents the ICCs for Item 43. It is possible that this type of competition is not well-known among Thais and they do not care for it either.

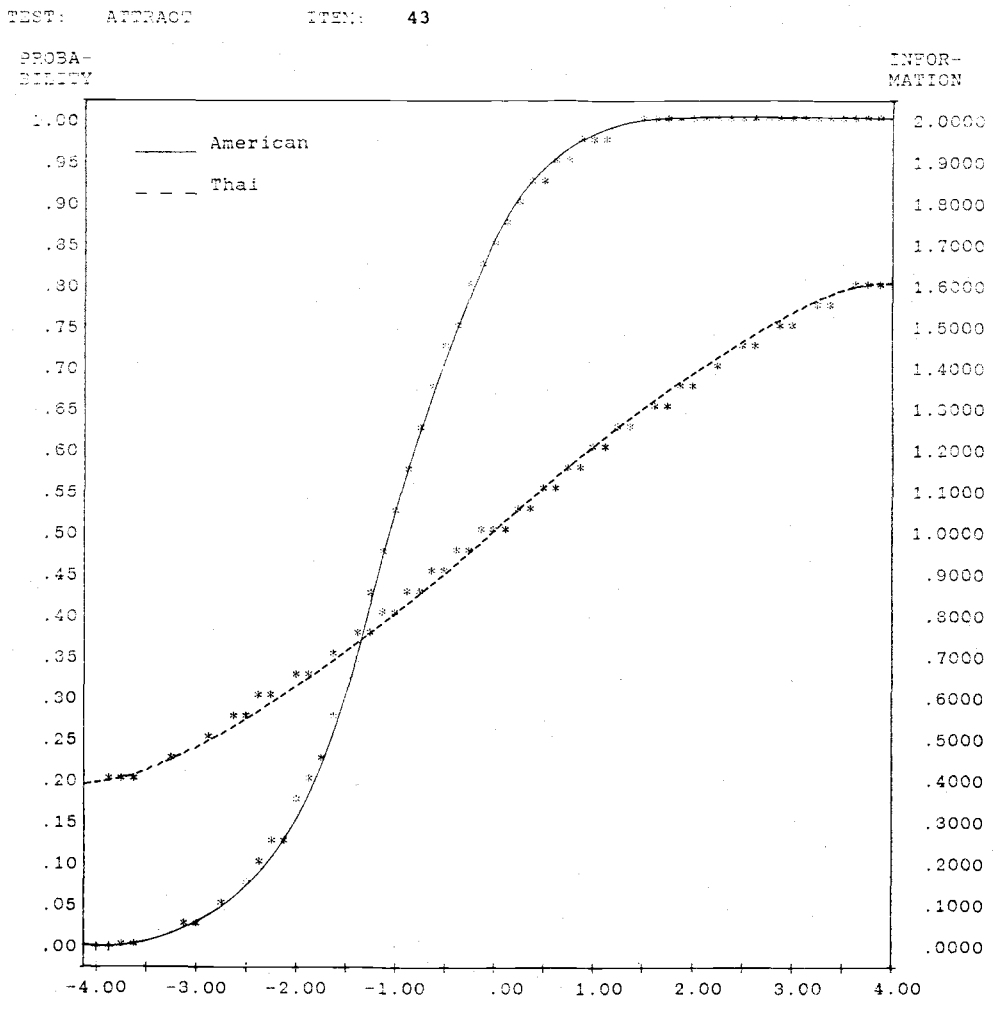

Figure 4.9. ICCs for Attraction Item 43.

Summary of IRT Findings

The summary results of the IRT analysis are the following:

1. Based on traditional item analysis statistics, 49 Thai version items and 17 English version items revealed marginal item discriminatory power. The median item difficulty of the two

versions was similar -- .583 and .665 for the Thai and English versions respectively.

2. Overall, the two-parameter logistic model fit the two instruments well. Using a chi-square goodness-of-fit test at the .05 level five items in the attraction scale and six items in the estimation scale of the PEAS Thai version showed lack of fit. Additionally, five items of the attraction scale and two items of the estimation scale for the PEAS English version exhibited lack of fit.

3. Comparing the estimated IRT parameters across the two versions of the PEAS using a Z-score test at the .0006 level of significance showed that:

    (a) Twelve items of the attraction scale and three items of the estimation scale had nonsignificant differences for both a and b parameters, indicating item equivalence.

    (b) Six attraction items and four estimation items exhibited nonsignificant differences between the a parameters and significant differences between the b parameters. This result provides evidence of

translation inaccuracies such as inappropriate modifiers in the translated instrument.

(c) Seven attraction items and seven estimation items had significant differences between the a parameters and nonsignificant differences between the b parameters. This result indicates items suffering from emic item content or content which has little substantive meaning in the target population.

(d) Twenty-nine attraction items and 19 estimation items with significant differences in both the a and b parameters of the PEAS versions indicating items which have little meaning in common across cultures.

Discussion

It is evident from the results of this study that assessing cross-cultural equivalence of psychological instruments is a lengthy and complex task involving assessment of functional/conceptual equivalence, item equivalence, and construct operationalization. Cross-cultural validity can be viewed as a part of the more global process of construct validity. The aim of both

processes is the determination of the degree to which a test instrument reflects an underlying construct (i.e., latent trait). An added dimension to the cross-validation problem is the comparison of measurement fidelity of an instrument across two or more cultures. The following discussion focuses on two issues: (a) interpreting the results of the cross-validation model and (b) advantages and drawbacks of the model.

Functional/conceptual equivalence.

Translation accuracy (functional/conceptual equivalence) is a necessary but not sufficient condition for equivalence of source and translated instruments across cultures (Hulin & Mayer, 1986; Jensen, 1980; Richard, 1953). Translation accuracy provides evidence of linguistic similarity. However, linguistic similarity does not guarantee that (a) the measurement scale underlying the target and source instruments is similar (i.e., that corresponding items in the target and source instruments invoke the same probability of response from subjects with the same amount of the underlying latent trait (Hulin, 1987)) or (b) that the translated instrument conveys the same concepts across cultures or (c) that concepts in the source instrument have meaning in the target culture. Thus evidence of item (psychometric) equivalence and equivalence of construct operationalization are required along with evidence of

translation accuracy to claim cross-cultural validity of a psychological test instrument.

The drawbacks of relying solely on functional/conceptual equivalent evidence in claiming cross-cultural validity are illustrated dramatically by the results of this investigation. To provide evidence for translation accuracy the PEAS English version was translated into the Thai language using three well-known methods: a modified Delphi technique, back-translation, and a bilingual technique (Hulin & Mayer, 1986). Overall the results indicated the PEAS Thai version to be accurately translated, although a number of translated items evidenced marginal translation accuracy. The presence of marginally accurate items is not uncommon as pointed out by Candell and Hulin (1987) who stated that the translated version need not be equivalent with the original version in every item.

It would be tempting to claim cross-validity of the instruments at this point. However, as noted above, translation accuracy does not guarantee psychometric equivalence. Moreover, the translation accuracy methods are not failsafe. For example, Hulin (1987) noted that accurate back translations from poorly translated target instruments can be made through "insightful guesses and assumptions", while bilingual translators may develop translations which have little meaning for target

monolinguals. Responses to items depend on the backgrounds, experiences, and cultures of the respondents. Diaz, Rodriguez, and Ruiz (1986) noted that a translated test is appropriate only when the cultural aspects of subjects are considered.

Item equivalence.

Traditional item analysis statistics and IRT parameters generated by the PC-BILOG program provided evidence that the source and target versions of the PEAS were not psychometrically equivalent. Of more import, however, were the differences shown between the traditional and IRT analyses. According to the traditional analysis, 49 Thai version items and 17 English version items revealed marginal item discriminatory power, while 14 Thai and 12 English items had unacceptable ID values. A major weakness of this analysis is its inability to directly compare ID and r_b values for each item across translations because the distribution of the underlying latent trait in each population is unknown. The analysis fails to show if the instruments are truly psychometrically equivalent since it is not known for example if the 14 Thai items with unacceptable ID values are the same items as the English items with unacceptable ID values. A perusal of Tables 4.1 and 4.2 shows that many of the Thai items with poor ID values are not the same items in the English version.

In contrast the invariance of IRT parameters allows statistical comparison of the a and b values for each item across instruments. The test of the difference between a pair of IRT parameters was analyzed by using a univariate Z-score statistic outlined by Lord (1980). It should be noted that Lord suggested using a more powerful multivariate test of the parameters. The multivariate test requires computation of the variance/covariance matrix of the item parameters, a feature not included in the most recent version of PC-BILOG. To minimize the probability of Type I error in the univariate analysis, the experimentwise error was set at .05 for testing each parameter and using a Bonferroni approach the comparisonwise error was set at a conservative .05/87 = .0006. The IRT analysis indicated that 15 items were item equivalent (i.e., no differences in either the a or b parameters), 10 items were different in the location parameter only and could be improved by reviewing the translation for inaccuracies, and 62 items were not item equivalent. These results clearly show that despite a claim for functional/conceptual equivalence the Thai version of the PEAS is not psychometrically equivalent to the source version. For most of the items on the PEAS, the probability of Thai adolescent boys responding positively to those items for given levels of the

underlying latent trait is different than the probability of English speaking adolescent boys with the same amount of the underlying trait.

Analysis of Construct Operationalization

Item or psychometric equivalence focuses on the cross-cultural equivalence of the scale used to reflect the underlying latent trait of interest. Item equivalence only indirectly addresses questions related to similarity of the nature or meaning of the latent trait across cultures. This latter concern is the realm of construct operationalization. The term construct operationalization is not to be confused with the term construct representation defined by Embretson-Whitely (1983) as "the theoretical mechanisms that underlie task performance" (p. 180). Construct representation refers to the underlying meaning of the source instrument, while construct operationalization refers to the comparison of the construct representation of the source and target language instruments.

For the purposes of the present investigation, the strategy for assessing construct operationalization of the PEAS across English and Thai versions of the instrument involved comparison of the factor structure of the English version with the factor structure of the Thai version via confirmatory factor analysis procedures. Specifically in Stage 1 of the analysis, the factor

structure loadings and between factor correlations of the English version were to be determined via R-type exploratory factor analysis using the SPSSX subprogram Factor (SPSS, 1986). To determine the best simple structure for the data, three extraction methods (principal axis, maximum likelihood, and generalized least squares) each followed by an orthogonal rotation method (varimax rotation) and an oblique rotation (oblimin) were planned. Using a common rule of thumb, structure loadings $\geq$ .5 would be considered for subsequent stages of the analysis. In Stage 2 of the analysis, the factor structure loadings and between factor correlations computed from Stage 1, were to be input along with the Thai version item intercorrelation matrix to the LISREL 6 computer program (Jöreskog & Sörbom, 1986) for confirmatory factor analysis.

Several problems encountered in Stage 1 of the analysis prohibited completion of the analysis. Of primary concern was the presence of an ill-conditioned correlation matrix in the analysis of the English version data. Many multivariate statistical procedures require that the matrices being analyzed have nonzero determinants (i.e., that the matrix has an inverse). Matrices with no inverse are called singular matrices. Singular matrices pose a problem in multivariate analyses since many multivariate procedures, including factor

analysis, require the computation of the inverse matrix. While singular matrices make the solution to the multivariate equations impossible, a potentially more disastrous situation may occur from so-called "ill-conditioned" matrices. These latter matrices are ones in which the determinant is near zero, permitting a solution to the multivariate equations, but one which may not be accurate.

A primary cause of ill-conditioned matrices is linear dependency (collinearity or near collinearity) among the variables analyzed. Thus dependent variables which are highly correlated should not be included in a multivariate analysis (Marascuilo & Levin, 1983; Thorndike, 1978). A possible factor contributing to the ill-conditioned matrices in the present investigation is collinearity among several of the items in the English PEAS. A perusal of the ID statistics in Table 4.2 reveals extreme values ranging as high as >.94 (Item 18) with many values exceeding .80 and as low as .180. A high ID value indicates that a majority of respondents answered positively (i.e., responded with a score of 1) to that item while a low ID indicates that most respondents answered negatively (i.e., answered with a score of 0), resulting in high item intercorrelations in some cases. However, if extreme ID values were causing collinearity in the data, high positive item correlations

would be expected between items both of which have high or low ID values, while high negative correlations would be expected between item pairs, one of which has a high ID value and one with a low ID value. Inspection of the item intercorrelation matrix analyzed by the SPSSX program reveals for example that English Item 18 (ID = .940) and Item 8 (ID = .860) correlate .187, Items 50 (ID = .180) and 49 (ID = .222) correlate .037, while Items 18 and 50 correlate .247, all unexpected results. Accuracy of tetrachoric correlation coefficients input to SPSSX were also double-checked along with the accuracy of the raw data input. The accuracy of the raw data and computed coefficients was confirmed.

Because the English PEAS data could not be factor analyzed a confirmatory factor analysis using LISREL could not be completed. Therefore, the Thai data was factor analyzed to provide some evidence of the factor structure of the translated instrument which could be compared to previous studies concerning the factor structure of the PEAS for English adolescent boys (e.g., Sonstroem, 1974). However, factor analysis of the Thai data revealed the same problem with ill-conditioned matrices as the English data, thus nullifying the alternative analysis.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

The purposes of this study were to (a) outline a three-stage methodology combining functional/conceptual equivalence, item equivalence, and equivalence in construct operationalization in order to investigate the cross-cultural equivalence of affective test instruments, and (b) examine the cross-cultural equivalence of the PEAS for English-speaking and Thai adolescent boys.

A literature review indicated that the PEAS has been widely used to measure attitude toward participation in physical activity for English-speaking adolescence boys aged 14 - 19 years and less widely used for English-speaking adults. No published studies have investigated the use of the PEAS cross-culturally. Moreover, methods for assessing the cross-cultural equivalence of psychological instruments, particularly the assessment of item or psychometric equivalence and equivalence of construct operationalization have received no attention in the physical education literature.

The present study offered a three-stage model patterned after methods outlined by Hulin (1987) and others for assessing the cross-cultural equivalence of psychological instruments. Assessment of the cross-cultural equivalence of the PEAS for Thai and English adolescent boys was used to exemplify the model.

Functional/conceptual equivalence or translation accuracy was assessed in the first stage using four well-known translation methods: pragmatic translation, a modified Delphi technique, back translation, and a bilingual method. For the bilingual method 34 Oregon State University bilingual Thai students were administered both the Thai and English versions of the instrument in a counterbalanced repeated measures design. Results revealed that there were no significant differences of mean scores of both the English version and the Thai version ($p \geq .05$, $df = 33$). Agreement indices for each item separately using the contingency coefficient (C) ranged from 1.00 to 0.64 with a median value of .79. Based on the results of the four translation methods, the Thai version of the PEAS was judged to have adequate functional/conceptual equivalence.

In the second stage the item equivalence of PEAS items across cultures was analyzed via item response theory. The subjects consisted of 499 boys aged 14-19 years in the United States and 1009 boys aged 14 - 19 in Thailand. The subjects in the United States were a convenience sample selected from public schools in the cities of Corvallis and Albany in the State of Oregon. The subjects in Thailand were randomly selected from the government schools in Bangkok province. To assess the item equivalence of the instruments a two-parameter

logistic IRT model was fit to the PEAS data for each instrument separately using the PC-BILOG computer program. Employing methodology proposed by Hulin (1987) IRT difficulty and discrimination parameters were statistically compared for each item separately across instruments using a Z-score method offered by Lord (1980). The experimentwise Type I error was limited to .05 by using a Bonferroni approach which set the comparisonwise error rate to .0006. The following findings were reported:

1. Items 24, 27, 29, 30, 34, 50, 55, 74, 78, 80, 96, and 99 in the attraction scale and items 10, 64, and 67 in the estimation scale showed evidence of item equivalence across cultures. The ICCs for these items over versions of the PEAS are given in Appendix I.

2. Items 4, 44, 52, 53, 76, and 97 in the attraction scale and items 6, 26, 68, and 77 in the estimation scale showed no significant differences in the item discrimination parameter (a) but significant differences between item difficulty parameters (b). These items were judged to contain translation inaccuracies which could possibly be revised to make the items more acceptable. The ICCs for these items are presented in Appendix I.

3. Items 17, 18, 23, 25, 71, 82, and 89 in the attraction scale and items 5, 19, 35, 39, 59, 62, and 69 in the estimation scale indicated significant differences between item discrimination parameters (a) and no significant differences between item difficulty parameters (b). These items showed possible differences in meaning of items across cultures. The ICCs in Appendix I graphically illustrate the differences between the discrimination parameters of these items.
4. There were 29 items of the attraction scale and 19 items of the estimation scale indicating significant differences for both item discrimination parameters (a) and item difficulty parameters (b). These items are considered nonequivalent items or items which are inaccurately translated and which tap unique concepts in each culture. Appendix I gives the ICCs for these items.

Stage three of the model assesses the equivalence in construct operationalization of the translated instrument. That is, the nature of the latent trait(s) measured by the two instruments is analyzed and compared. One method for providing evidence for equivalence in construct operationalization is comparison of the

underlying factor structures measured by each instrument via confirmatory factor analytic techniques. The presence of ill-conditioned interitem correlation matrices in both the English and Thai data sets prohibited such an analysis in the present study.

Conclusions

Based on the findings of this study, the following conclusions are warranted:

1. Functional/conceptual equivalence (translation accuracy) is a necessary but not sufficient condition for claiming cross-cultural equivalence of psychological instruments. Evidence of item equivalence and evidence of equivalence of construct operationalization must also be provided to claim cross-cultural equivalence.
2. Although the functional/conceptual equivalence of the Thai version of the PEAS was judged to be acceptable, use of the Thai version is not recommended since only 15 items were judged to be item equivalent, 10 items revealed translation inaccuracy, and 62 items were judged to have differences in meaning.

Recommendations

The analyses presented in this investigation represent the beginning of formal assessment of cross-cultural equivalence of psychological instruments in the field of physical education. The following areas of study can originate from this study:

1. Fitting alternative IRT models to the PEAS data in order to discover the model of best fit and the effect of different models on assessing item equivalence.
2. Exploration of more powerful multivariate tests of the difference between IRT parameters across cultures.
3. Constructing a new attitude instrument for Thai students and assessing the validity and reliability of the new instrument.
4. Application of the model to psychological instruments previously used in other cultures to assess the validity of published results.
5. Adaptation of the model for validating the use of a single instrument with various subpopulations of a given culture (e.g., the validity of using the PEAS English-version with English-speaking adults and/or females).

Applications

The concept of the "international community" is fast becoming a reality. Education, like other institutions in our society, must eventually encompass research extending across our borders into other cultures. Comparisons of measurable characteristics across cultures necessitates the need for measurement instruments which validly measure similar concepts on similar scales. This study presents a model for the cross-cultural validation of psychological measurement instruments -- a model that will assist physical educators who are interested in cross-cultural research to make valid comparisons across cultures.

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APPENDICES

Appendix A

APPLICATION FOR EXEMPTION COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS

APPLICATION FOR EXEMPTION

COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS

Principal Investigator* Terry M. Wood, Ph.D. Phone x3718

Student's Name (if any) Kongsak Charoenruk Phone x3222

Department Physical Education

Source of Funding Student

Project Title "The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimation and Attraction Scale."

Certain categories of research are exempt from human subjects review. These categories are reproduced for your information on the back of this form. Feel free to call the Research Office, 754-3437, if you have questions.

The following information should be attached to this form and two copies of the complete Application for Exemption should be submitted to the Research Office, AdS A312:

1. A copy of any questionnaire, survey, testing instrument, etc. to be used in this project.

2. A copy of the informed consent document, survey cover letter, or other informed consent information, and a description of the methods by which informed consent will be obtained from the subjects.

3. A brief description of the methods and procedures to be used during this research project, including:

   (a) A short paragraph describing the objectives of this research,

   (b) A description of the methods by which anonymity of the subjects will be maintained,

   (c) A description of the subject population, and

   (d) Information regarding any other approvals which have been or will be obtained (e.g., school districts, hospitals, cooperating institutions).

Signed Signature redacted for privacy. Date May 6, 1988
Principal Investigator*

*Note: Student projects should be submitted by the Major Professor as Principal Investigator.

7-87

INFORMED CONSENT

Information regarding the purpose of the study, confidentiality of responses, and the volunteer nature of the study will be provided to respondents via verbal instructions from the test administrator.

Test administrators will be asked to read the following instructions to all respondents prior to administering the instrument:

You are being asked to volunteer 20 minutes of your time to complete a 100 question survey of your attitude toward physical activity. Results of the survey will be compared with the results of a similar survey with foreign students. There are no right or wrong answers to these questions and the results of the survey will not be used for grading purposes. You will not be required to write your name on the answer sheet. Since your name will not appear anywhere on your answer sheet, all of your responses will be anonymous; however, the summary results for various groups of respondents will be published. Are there any questions before we begin?

METHODS AND PROCEDURES

Titled "The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimation and Attraction Scale", the project seeks to validate the use of the PEAS with students in another culture (i.e., Thai boys aged 14-19). The project is being conducted under my supervision by Mr. Kongsak Charoenruk as his doctoral dissertation.

The design of the research is relatively simple. After validating in a pilot study the accuracy of a Thai translation of the PEAS, the Thai version of the instrument was administered to 1000 boys aged 14-19 years in Bangkok, Thailand. These data were collected before we discovered that survey research proposals must also be approved by the OSU Research Office. The next stage is to administer the English version of the instrument to approximately 1000 boys aged 14-19 years in Oregon public schools (i.e., Corvallis, Eugene, and Albany). We will then judge the equivalence of the English and Thai versions of the PEAS on an item by item basis using item response theory. We will also compare via confirmatory factor analysis the factor structures of the two versions of the PEAS.

This project has been approved by Mr. Charoenruk's dissertation committee (see attached document Doctoral Prospectus Approval Form). We have also received permission to administer the English version of the PEAS to boys aged 14-19 in the Corvallis school district (see attached memo from Shirley Woods, Assistant Superintendent, Corvallis School District). Permission from the Greater Albany Public School District and the Eugene School District is currently being sought. The PEAS will be administered by classroom teachers on a "mass testing" basis as part of the regular PE class. Alternatively, each school will be informed that Mr. Charoenruk could administer the inventory to students. We have found that approximately 20-25 minutes is required for students to answer the inventory.

As you can see, the PEAS asks no questions that would be considered as too personal or sensitive. Moreover, the only demographic characteristics we are interested in are the student's age, grade, and school. The student's name will not be recorded. In any event we are interested only in total group results, therefore, individual scores will not be reported in any publication or presentation resulting from the research.

If you have any further questions regarding this project, please feel free to call Terry Wood at 754-3718/19.

Vice President for
Research, Graduate Studies,
and International Programs

Oregon State University

Corvallis, Oregon 97331-2135 (503) 754-3437

May 11, 1988

Principal Investigator:

It has been determined that the following project is exempt from review by Oregon State University's Committee for the Protection of Human Subjects under guidelines from the U.S. Department of Health and Human Services:

Principal Investigator: Terry M. Wood

Student's Name (if any): Kongsak Charoenruk

Department: Physical Education

Source of Funding:

Project Title: The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimation and Attraction Scale

Comments: The English version only is approved.

A copy of this information will be provided to the Chair of the Committee for the Protection of Human Subjects. If questions arise, you may be contacted further.

Signature redacted for privacy.

Mary E. Perkins
Research Development Officer

cc: CPHS Chair
7-87

Appendix B

REQUEST LETTER TO GET PERMISSION

FOR DATA COLLECTION IN THE UNITED STATES

The Department of
Physical Education

Oregon State University

Corvallis, Oregon 97331-3302

April 22, 1988

Dr. Shirley Woods
Assistant Superintendent Instruction
Corvallis School District No. 509J
1555 SW 35th St.
Corvallis, OR 97333

Dear Shirley:

Pursuant to our telephone conversation on April 21 regarding the possibility of administering an attitude inventory in the Corvallis School District, please find attached a copy of the Physical Estimation and Attraction Scale (PEAS), the PEAS answer sheet, and a publication describing the nature and development of the PEAS.

Instead of forwarding the rather lengthy proposal I thought it would be more efficient to outline the project in this letter. Titled "The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimation and Attraction Scale", the project seeks to validate the use of the PEAS with students in another culture (i.e., Thai boys aged 14-19). The project is being conducted under my supervision by Mr. Kongsak Charoenruk as his doctoral dissertation.

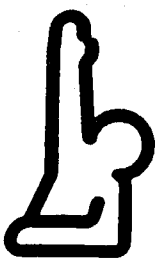
The design of the research is relatively simple. After validating in a pilot study the accuracy of a Thai translation of the PEAS, the Thai version of the instrument was administered to 1000 boys aged 14-19 years in Bangkok, Thailand. The next stage is to administer the English version of the instrument to approximately 1000 boys aged 14-19 years in Oregon public schools (i.e., Corvallis, Eugene, and Salem). We will then judge the equivalence of the English and Thai versions of the PEAS on an item by item basis using item response theory. We will also compare via confirmatory factor analysis the factor structures of the two versions of the PEAS.

We are therefore requesting permission to administer the English version of the PEAS to boys aged 14-19 in the Corvallis school district. The PEAS can be administered by classroom teachers on a "mass testing" basis such as in a PE class. Alternatively, Mr. Charoenruk could administer the inventory to students. We have found that approximately 20-25 minutes is required for students to answer the inventory. As you can see, the PEAS asks no questions that would be considered as too personal or sensitive. Moreover, the only demographic characteristics we are interested in are the student's age, grade, and school. All responses would be kept confidential, unless the individual schools would care to record the results as part of the student's file. In any event we are interested only in total group results, therefore, individual scores or school summary statistics would not be reported in any publication or presentation resulting from the research.

If you have any further questions regarding this project, please feel free to call me at 754-3718/19. Otherwise, I am looking forward to meeting with you on May 6.

Regards,

Terry, M. Wood, Ph.D.
Assistant Professor
College of Health and Physical Education



CORVALLIS
SCHOOL
DISTRICT
509J

Excellence in
Education

May 6, 1988

MEMO TO: Middle and High School Principals

FROM: Shirley Woods SW

Permission has been given for Dr. Terry Wood to contact you about the possibility of administering an attitude inventory titled, "The Application of Item Response Theory in the Cross-Cultural Validation of the Physical Estimate and Attraction Scale."

swl0:05/06/88
pb

Appendix C

LISTS OF THAI DELPHI COMMITTEE AND THAI TRANSLATORS

รายชื่อผู้เชี่ยวชาญและผู้แปล

ผู้เชี่ยวชาญ

ดร.จรวยพร ธรณินทร์

กองส่งเสริมพลศึกษาและสุขภาพ

กรมพลศึกษา

กระทรวงศึกษาธิการ

ศาสตราจารย์ ดร.ดวงเดือน พันธุมนาวิน

สถาบันวิจัยพฤติกรรมศาสตร์

มหาวิทยาลัยศรีนครินทรวิโรฒ

รองศาสตราจารย์ ดร.ลมุล รัตตากร

คณะมนุษยศาสตร์

มหาวิทยาลัยศรีนครินทรวิโรฒ

ผู้ช่วยศาสตราจารย์ ดร.สวนา พรพัฒน์กุล

คณะมนุษยศาสตร์

มหาวิทยาลัยศรีนครินทรวิโรฒ

ดร.สุนทร แก้วลาย

สำนักบริการคอมพิวเตอร์

อาคารหอสมุดกลาง ชั้น 4

มหาวิทยาลัยศรีนครินทรวิโรฒ ประสานมิตร

รองศาสตราจารย์ เสาวนี อินทรภักดี

คณะมนุษยศาสตร์

มหาวิทยาลัยศรีนครินทรวิโรฒ

ผู้แปล

พลโท ประวัติ โกมลมาลย์

6/37 ซอยพรรณี ถนนวิภาวดี

ลาดยาว บางเขน

กรุงเทพฯ 10900

สุทัศนี โรจนสุนทร

126/7 ซอยกาญจนาคม

ถ. พหลโยธิน พญาไท

กทม 10400

THAI DELPHI COMMITTEE

Dr. Charuaypon Torranin
Physical Education Senior Specialist
Department of Physical Education
Ministry of Education, Patumwan
Bangkok 10500, THAILAND

Pro. Dr. Duangduen Bhanthumnavin
Behavioral Science Research Institute
Srinakharinwirot University
Sukumvit 23, Bangkok 10110
THAILAND

Ass. Pro. Dr. Lamoon Rattakorn
Department of Library Science
Faculty of Humanities
Srinakharinwirot University
Patumwan, Bangkok 10500
THAILAND

Asso. Pro. Saowanee Indrabhakti
Department of Western Languages
Faculty of Humanities
Srinakharinwirot University
Sukumvit 23, Bangkok 10110
THAILAND

Dr. Soonthorn Kaewlai
Computer Center
Srinakharinwirot University
Sukumvit 23, Bangkok 10110
THAILAND

Ass. Pro. Dr. Swana Pornputtkul
Department of Psychology
Faculty of Humanities
Srinakharinwirot University
Sukumvit 23, Bangkok 10110
THAILAND

THAI TRANSLATORS

Lt. Gen. Pravati Komolmalya
6/37 Soi Pannee, Vipavadee Road
Lardyaw, Bangkhen
Bangkok 10900
THAILAND

Sutasnee Rojanasoonthon
126/7 Soi Karnjanakorm
Phaholyothin Road
Phayathai, Bangkok 10400
THAILAND

Appendix D

PEAS QUESTIONNAIRE (ENGLISH VERSION)

PHYSICAL ESTIMATION AND ATTRACTION SCALE (PEAS)

The statements below reflect certain attitudes and interests of persons. Read each statement and decide whether it is true or false as applied to you. Indicate your answer by marking an "X" over the true (T) or false (F) beside the question number on the separate answer sheet. DO NOT MARK ON THIS SHEET. In some cases you may have difficulty deciding which response is best, but please make some decision and answer every statement. Please do not make an attempt to be consistent in your answers, but respond to each statement individually. Even if an statement asks about things you have not experienced, answer it as best you can on the basis of what you have heard, seen, or read. There are no right or wrong answers on this questionnaire. It is not a test and will not effect your grade in any way.

True or False:

1. I would rather see a play than a movie.
2. I prefer exercising to reading.
3. I generally prefer talking with friends to playing a family table game such as Monopoly.
4. I would much rather play softball than go for a ride in a car.
5. Most of my friends work harder than I do.
6. My body is strong and muscular compared to other boys my age.
7. I would be interested in learning to play a musical instrument.
8. Most sports require too much time and energy to be worthwhile.
9. I would have made a good accountant.
10. I am in better physical condition than most boys my age.
11. The mechanical properties of motors interest me a great deal.
12. On a Sunday afternoon, I would prefer to go to a movie rather than to go on a picnic.
13. I am quite limber and agile compared to others my age.
14. I often stick up for my own point of view even when no one agrees with me.
15. I enjoy people who talk a great deal.
16. I prefer team sports to individual sports because of the experience of playing with different people.
17. I like to be in sports that do not require a great amount of running.

18. I know that my health improves when I exercise.
19. I just do not have the coordination necessary to look like a graceful skier.
20. I prefer woodworking to tinkering with a motor.
21. One of my favorite interests is listening to music.
22. I would enjoy participating in activities such as cross-country skiing, and channel swimming.
23. Music, art, or intellectual pursuits are more refreshing to me than physical activity.
24. I would rather visit an amusement park than watch a tennis match.
25. I like the social opportunities afforded by physical activity programs.
26. I am better coordinated than most people I know.
27. I would enjoy difficult mountain climbing.
28. I love to go to jazz or rock concerts.
29. I do not think that I'd enjoy participating in a judo program.
30. I enjoy the feeling of physical well-being one gets after a day's tramp in the woods.
31. I would rather watch a good movie than a hockey match.
32. I would like to belong to some type of exercise group.
33. I am a good deal stronger than most of my friends.
34. I would rather play poker than softball.
35. Compared to other people I am somewhat clumsy.
36. I enjoy hard physical work.
37. I like to engage in recreational exercise rather than in organized, competitive athletics.
38. I am stronger than a good many of my friends.
39. Most people I know think I have very good physical skills.
40. My friends seem to be more physically active than I am.
41. I would rather walk than run through an open meadow or field.
42. Sports provide me with a welcome escape from the pressures of present-day life.
43. I like the rough and tumble of athletic competition.
44. I prefer to watch an exciting basketball game to playing it myself.
45. I rather enjoy the physical risk involved when I play football.
46. I would enjoy participating in a vigorous weight-lifting program.

47. Long-distance running would seem to be an enjoyable activity.
48. I doubt that I could ever get into good physical condition.
49. My legs have as much spring as those of champion high jumpers.
50. I do not enjoy doing things that get me sweaty and dirty.
51. I prefer not to participate in physical activities that involve risk of injury.
52. I would enjoy belonging to a whitewater canoe club.
53. When tensions are high, I prefer to lie down and rest rather than to absorb myself in physical activity.
54. If I wanted to, I could become an excellent tennis player.
55. I enjoy performing gymnastic stunts because of the coordinated movements involved.
56. It makes no difference to me how strong or fit I am.
57. I would like to meet more people by engaging in various types of physical activities.
58. After a day at school, I prefer to take it easy instead of participating in vigorous sport activities.
59. It is difficult for me to catch a thrown ball.
60. With a fair amount of practice I could maintain a high bowling average.
61. I enjoy the discipline of long and strenuous physical training.
62. I can run faster than most of my friends.
63. Watching an athletic contest provides a welcome relief from the cares of life.
64. With practice I could become a very good golfer.
65. I have more important things to do than to spend time on developing and maintaining physical fitness.
66. I would rather run in a track meet than play badminton.
67. I could do better at long-distance hiking than the average boy of my age.
68. I exhibit a fair amount of leadership in a sports situation.
69. I lack confidence in performing physical activities.
70. Even with practice I doubt that I could learn to do a handstand well.
71. Playing tennis appeals to me more than does golfing.

72. I can run for longer distances than most boys of my age.
73. I am a natural athlete.
74. The thought of getting sweaty and dirty often keeps me from exercising.
75. I love to run.
76. Getting into good physical shape takes too much effort to be really worth it.
77. I have a strong throwing arm for baseball or softball.
78. Karate competition must be fun.
79. It would be very difficult for me to learn to do a back dive.
80. I would prefer to listen to a concert than to watch a gymnastics match.
81. I am well equipped to excel at physical activities.
82. Being strong and highly fit is not really that important to me.
83. Absorbing myself in a good sport activity provides an escape from the routine of a school day.
84. Even with practice I doubt that I could ever learn to do a cartwheel well.
85. Exercise relieves me of emotional strain.
86. I would play sports more often if I did not get so tired.
87. Probably I could get into good physical condition faster than most fellows my age.
88. I often doubt my physical abilities.
89. I would rather play touch football than go to an amusement park.
90. Participation in physical activity improves me as a social person.
91. I am not very good at most physical skills.
92. I enjoy the exhilarated feeling one gets after doing calisthenics.
93. I am not able to meet many worthwhile people through participation in sports.
94. Poor timing handicaps me in certain physical activities.
95. I am a natural leader in sport activities.
96. I would rather play active sports like soccer and basketball than participate in activities like badminton and softball.
97. I believe it is important that a person belongs to a group that participates in sport activities together.
98. I would rather watch either a baseball or basketball game than visit a museum or art gallery.

99. Target archery appeals to me more as an activity than does tennis.
100. I believe one of the greatest values of physical activity is the thrill of competition.

PEAS ANSWER SHEET

Age: _____ years Grade _____ School _____

Mark an "X" over True (T) or False (F)

1.	T	F	26.	T	F	51.	T	F	76.	T	F
2.	T	F	27.	T	F	52.	T	F	77.	T	F
3.	T	F	28.	T	F	53.	T	F	78.	T	F
4.	T	F	29.	T	F	54.	T	F	79.	T	F
5.	T	F	30.	T	F	55.	T	F	80.	T	F
6.	T	F	31.	T	F	56.	T	F	81.	T	F
7.	T	F	32.	T	F	57.	T	F	82.	T	F
8.	T	F	33.	T	F	58.	T	F	83.	T	F
9.	T	F	34.	T	F	59.	T	F	84.	T	F
10.	T	F	35.	T	F	60.	T	F	85.	T	F
11.	T	F	36.	T	F	61.	T	F	86.	T	F
12.	T	F	37.	T	F	62.	T	F	87.	T	F
13.	T	F	38.	T	F	63.	T	F	88.	T	F
14.	T	F	39.	T	F	64.	T	F	89.	T	F
15.	T	F	40.	T	F	65.	T	F	90.	T	F
16.	T	F	41.	T	F	66.	T	F	91.	T	F
17.	T	F	42.	T	F	67.	T	F	92.	T	F
18.	T	F	43.	T	F	68.	T	F	93.	T	F
19.	T	F	44.	T	F	69.	T	F	94.	T	F
20.	T	F	45.	T	F	70.	T	F	95.	T	F
21.	T	F	46.	T	F	71.	T	F	96.	T	F
22.	T	F	47.	T	F	72.	T	F	97.	T	F
23.	T	F	48.	T	F	73.	T	F	98.	T	F
24.	T	F	49.	T	F	74.	T	F	99.	T	F
25.	T	F	50.	T	F	75.	T	F	100.	T	F

ANSWER KEY

Item	Keyed Response	Item	Keyed Response	Item	Keyed Response
		Attraction Scale			
2	T	41	F	66	T
4	T	42	T	71	T
8	F	43	T	74	F
16	T	44	F	75	T
17	F	45	T	76	F
18	T	46	T	78	T
22	T	47	T	80	F
23	F	50	T	82	F
24	F	51	F	83	T
25	T	52	T	85	T
27	T	53	F	86	F
29	F	55	T	89	T
30	T	56	F	92	T
31	F	57	T	96	T
32	T	58	F	97	T
34	F	61	T	98	T
36	T	63	T	99	F
37	F	65	F	100	T
		Estimation Scale			
5	F	48	F	72	T
6	T	49	T	73	T
10	T	54	T	77	T
13	T	59	F	79	F
19	F	60	T	81	T
26	T	62	T	84	F
33	T	64	T	87	T
35	F	67	T	88	F
38	T	68	T	91	F
39	T	69	F	94	F
40	F	70	F	95	T

Appendix E

PEAS QUESTIONNAIRE (THAI VERSION)

แบบทดสอบเจตคติเรื่องการคาดคะเนและความชอบด้านกิจกรรมทางร่างกาย

ข้อความในแบบทดสอบนี้เป็นการสะท้อนให้เห็นเจตคติและความสนใจของแต่ละคนที่มีต่อกิจกรรมทางร่างกาย โปรดอ่านแต่ละข้อและตัดสินใจว่าข้อความนั้น "ถูก" หรือ "ผิด" เมื่อนำมาใช้กับตัวท่านเอง แล้วทำเครื่องหมาย " ✓ " ลงในกระดาษคำตอบในช่องที่ท่านเลือก ข้อความบางข้ออาจตัดสินใจยาก ก็ขอให้ท่านตัดสินใจและตอบให้ครบทุกข้อ การตอบไม่ต้องคำนึงว่าได้ตอบข้ออื่น ๆ ไปแล้วอย่างไร แต่ขอให้ตอบแต่ละข้อโดยอิสระแก่กัน บางข้อความท่านอาจจะไม่เคยมีประสบการณ์มาก่อน ก็ขอให้ท่านตัดสินใจโดยอาศัยการที่ท่านเคยได้ยิน เคยเห็น หรือเคยอ่านมา "แบบทดสอบนี้จะไม่มีผลต่อเกรดของท่านแต่อย่างใด"

แบบทดสอบเจตคติเรื่องการคาดคะเนและความชอบด้านกิจกรรมทางร่างกาย

1. ฉันอยากดูละครมากกว่าภาพยนตร์
2. ฉันชอบออกกำลังกายมากกว่าอ่านหนังสือ
3. โดยปกติฉันชอบคุยกับเพื่อน ๆ มากกว่าที่จะใช้เวลาเล่นเกมกับสมาชิกครอบครัว เช่น เกมเศรษฐี
4. ฉันอยากจะเล่นซอฟท์บอลมากกว่านั่งรถเที่ยว
5. เพื่อน ๆ ของฉันส่วนใหญ่ทำงานหนักมากกว่าฉัน
6. ร่างกายของฉันแข็งแรงและล่ำสันเมื่อเทียบกับเด็กชายอื่น ๆ ในวัยเดียวกัน
7. ฉันสนใจอยากฝึกเล่นเครื่องดนตรีสักชนิดหนึ่ง
8. กีฬาส่วนใหญ่ต้องใช้เวลาและพลังงานมากจึงจะให้ผลคุ้มค่า
9. ฉันน่าจะเป็นนักบัญชีที่ดีได้คนหนึ่ง
10. ฉันมีสภาพร่างกายดีกว่าเด็กชายคนอื่น ๆ ในวัยเดียวกัน
11. ลักษณะกลไกของเครื่องยนต์ทำให้ฉันเกิดความสนใจเป็นอันมาก
12. ในตอนบ่ายวันอาทิตย์ ฉันอยากจะไปดูภาพยนตร์มากกว่าไปเที่ยวนอกบ้าน (ปิคนิค)
13. ฉันเป็นคนที่ว่องไวและกระฉับกระเฉงมากทีเดียว เมื่อเปรียบเทียบกับคนอื่น ๆ ในวัยเดียวกัน
14. ฉันมักจะยึดมั่นอยู่กับความคิดเห็นของตัวเองเสมอ ถึงแม้ว่าจะไม่มีใครเห็นด้วยกับฉันก็ตาม
15. ฉันชอบคนที่พูดเก่ง
16. ฉันชอบเล่นกีฬาประเภททีมมากกว่าประเภทบุคคล เพราะทำให้ได้ประสบการณ์ในการเล่นกับคนหลายประเภท
17. ฉันชอบกีฬาชนิดที่ไม่ต้องวิ่งมาก
18. ฉันทราบดีว่าสุขภาพของฉันดีขึ้นเมื่อฉันออกกำลังกาย
19. ฉันเพียงแต่ไม่มีร่างกายที่ประสานกันอย่างดีจนดูคล้ายกับนักยิมนาสติกส์ที่สง่างาม
20. ฉันชอบทำงานช่างไม้มากกว่าการแก้เครื่องยนต์
21. สิ่งที่ฉันสนใจเป็นพิเศษอย่างหนึ่งคือการฟังดนตรี
22. ฉันควรจะสนุกถ้าได้เข้าร่วมกิจกรรมต่าง ๆ เช่น การวิ่งมาราธอน และการว่ายน้ำระยะทางไกล

23. ดนตรี ศิลปะ หรือกิจกรรมที่ต้องใช้ปัญญา ทำให้ฉันกระปรี้กระเปร่ามากกว่ากิจกรรมที่ใช้กำลังกาย

24. ฉันอยากไปเที่ยวสวนสนุกมากกว่าไปดูการแข่งขันเทนนิส

25. ฉันชอบโอกาสทางสังคมต่าง ๆ ที่ได้รับจากการเข้าร่วมโครงการกิจกรรมด้านออกกำลังกาย

26. ฉันเป็นคนที่มีร่างกายประสานกันดีกว่าคนอื่น ๆ ที่ฉันรู้จัก

27. ฉันมักจะชอบการปีนเขาที่ยากลำบาก

28. ฉันไปรดปรานที่จะไปชมการแสดงดนตรีประเภทแจ๊สหรือร็อคมาก

29. ฉันไม่คิดว่าฉันจะสนุกกับการเข้าร่วมในการฝึกยูโด

30. ฉันชอบความรู้สึกสบายกายหลังจากเดินเที่ยวป่าหนึ่งวัน

31. ฉันอยากดูภาพยนตร์ดี ๆ สักเรื่องหนึ่งมากกว่าไปดูการแข่งขันฟุตบอล

32. ฉันอยากเป็นสมาชิกในกลุ่มออกกำลังกายกลุ่มใดกลุ่มหนึ่ง

33. ฉันมีร่างกายแข็งแรงกว่าบรรดาเพื่อน ๆ ของฉันส่วนใหญ่

34. ฉันอยากเล่นไพ่มากกว่าเล่นซอฟท์บอล

35. เปรียบเทียบกับคนอื่น ๆ แล้ว ฉันเป็นคนที่ค่อนข้างจะงุ่มง่าม

36. ฉันชอบงานที่ใช้แรงกายมาก ๆ

37. ฉันชอบการออกกำลังกายเพื่อนันทนาการมากกว่าการเล่นกีฬาที่จัดขึ้นเพื่อการแข่งขัน

38. ฉันมีร่างกายแข็งแรงกว่าเพื่อนของฉันหลาย ๆ คน

39. คนส่วนใหญ่ที่ฉันรู้จักคิดว่าฉันมีทักษะด้านร่างกายดีมากคนหนึ่ง

40. เพื่อนฉันหลายคนดูเหมือนจะมีร่างกายว่องไวกระฉับกระเฉงกว่าฉัน

41. ฉันมักจะเดินข้ามทุ่งหญ้าหรือทุ่งนามากกว่าที่จะวิ่งข้ามไป

42. กีฬาช่วยให้ฉันพ้นจากสภาพความเครียดในการดำรงชีวิตประจำวันปัจจุบัน

43. ฉันชอบการแข่งขันกีฬาที่เล่นรุนแรงและผาดโผน

44. ฉันชอบดูการแข่งขันบาสเกตบอลที่ตื่นเต้นมากกว่าที่จะลงไปเล่นด้วยตนเอง

45. เมื่อฉันเล่นรักบี้ฟุตบอล ฉันรู้สึกสนุกที่จะเอาร่างกายเข้าเสี่ยงกับอันตราย

46. ฉันคงจะสนุกถ้าได้เข้าร่วมในการฝึกยกน้ำหนักที่ต้องใช้ความแข็งแรง

47. การวิ่งระยะไกลน่าจะเป็นกิจกรรมที่สนุกสนานกิจกรรมหนึ่ง

48. ฉันไม่แน่ใจว่าฉันจะสามารถปรับให้สภาพร่างกายแข็งแรงขึ้นได้หรือไม่

49. ขาของฉันมีแรงยืดหยุ่นมากพอ ๆ กับพวกแชม เปี้ยนกระโดดสูง

50. ฉันไม่สนุกกับกิจกรรมที่ทำให้เหงื่อออกและสกปรก

51. ฉันไม่ชอบ เข้าร่วมกิจกรรมทางร่างกายที่อาจ เสี่ยงต่อการบาดเจ็บ

52. ฉันอยาก เป็นสมาชิกชมรมกระดานโต้คลื่น

53. เวลาที่ฉันรู้สึก เครียดมาก ๆ ฉันชอบนอนพักผ่อนมากกว่าที่จะให้ตัว เองต้องออกแรงฝึกกิจกรรมที่ใช้กำลังกาย

54. ฉันสามารถที่จะ เป็นนัก เทนนิสชั้น เยี่ยมได้คนหนึ่งถ้าฉันต้องการ

55. ฉันสนุกกับการ เล่นท่าผาดโผนในกีฬายิมนาสติกส์ เพราะได้ใช้ท่า เคลื่อนไหวที่ประสานสอดคล้องกันในการ เล่น

56. ฉันไม่รู้สึกว่าจะแตกต่างกันตรงไหนกับการที่ฉันจะแข็งแรงหรือสมบูรณ์แค่ไหน

57. ฉันอยากพบปะผู้คนมากขึ้นด้วยการ เข้าร่วมในกิจกรรมทางร่างกายหลาย ๆ ประ เภท

58. หลังจาก เรียนมาทั้งวันที่โรง เรียน ฉันชอบปล่อยตัวตามสบายมากกว่าที่จะร่วม เล่นกีฬาซึ่งต้องใช้กำลังมาก

59. การรับลูกบอลที่ขว้างมานั้น เป็น เรื่องยากสำหรับฉัน

60. เพราะฉันได้ฝึกฝนมาพอสมควร ฉันจึงสามารถรักษาระดับคะแนน เฉลี่ยการ เล่นโบว์ลิ่งไว้ได้ในระดับสูง

61. ฉันชอบความมีวินัยที่ได้จากการฝึกทางร่างกายที่ยาวนานและหนักหน่วง

62. ฉันสามารถวิ่งได้ เร็วกว่า เพื่อนของฉันส่วนใหญ่

63. การดู เกมแข่งขันกรีฑาช่วยผ่อนคลายภาวะความวิตกกังวลในชีวิตได้อย่างหนึ่ง

64. ถ้าได้ฝึกซ้อมฉันสามารถ เป็นนักกอล์ฟที่ดี เยี่ยมได้คนหนึ่ง เหมือนกัน

65. ฉันมีสิ่งอื่นที่สำคัญมากกว่าอีกหลายอย่างที่จะต้องทำ แทนที่จะใช้เวลาไปกับการ เสริมสร้างและรักษาไว้ซึ่งสมรรถภาพทางกาย

66. ฉันอยากวิ่งในลู่มากกว่า เล่นแบดมินตัน

67. ฉันสามารถ เดินทางไกลได้ดีกว่า เด็กชายทั่ว ๆ ไปในวัย เดียวกัน

68. ฉันแสดงความ เป็นผู้นำได้ดี เมื่อ เล่นกีฬา

69. ฉันขาดความมั่นใจในการทำกิจกรรมทางร่างกาย

70. แม้ว่าฉันจะฝึกซ้อมแล้วก็ตาม ฉันก็ไม่แน่ใจว่าฉันสามารถที่จะเรียนรู้การทำท่าหกสูงได้ดีหรือไม่

71. การเล่น เทนนิส เป็นที่น่าสนใจต่อฉันมากกว่าการ เล่นกอล์ฟ

72. ฉันสามารถวิ่งได้ระยะทางไกลกว่า เด็กชายคนอื่น ๆ ในวัย เดียวกัน

73. ฉัน เป็นนักกีฬาโดยกำ เนิด

74. เพราะฉันคิดว่าร่างกายต้องสกปรกและมี เหงื่อ จึงทำให้ฉัน เลี่ยงการออกกำลังกายอยู่ เสมอ

75. ฉันชอบวิ่ง

76. เพื่อให้มีรูปร่างดีต้องใช้ความอุตสาหะมาก เกินไปจนทำให้รู้สึกไม่คุ้มค่า

77. ฉันมีแขนที่แข็งแรง เหมาะที่จะใช้ขว้างลูกซอฟท์บอล

78. การแข่งขันคาราเต้ ต้องสนุกแน่

79. มันคงจะ เป็นการยากสำหรับฉันอย่างมากที่จะ เรียนรู้การกระโดดน้ำแบบตีลังกากลับหลัง

80. ฉันชอบฟังดนตรีมากกว่าดูการแข่งขันยิมนาสติกส์

81. ฉันฝึกฝนมาอย่างดีพอที่จะทำให้ตน เอง เป็น เลิศในกิจกรรมทางร่างกาย

82. การที่จะมีร่างกายแข็งแรงสมบูรณ์ ไม่ใช่ เรื่องสำคัญมากนักสำหรับฉัน

83. การที่ฉัน เข้าร่วมในกิจกรรมกีฬาที่สนุก ๆ ทำให้ฉันพ้นจากสภาพความจำ เจที่โรง เรียน

84. แม้ว่าฉันจะฝึกซ้อมแล้วก็ตาม ฉันก็ไม่แน่ใจว่าฉันสามารถที่จะแสดงท่าล้อ เกวียนได้ดีหรือไม่

85. การออกกำลังกายช่วยให้ฉันผ่อนคลายความตึง เครียดทางอารมณ์

86. ฉันคงจะ เล่นกีฬาได้บ่อยกว่านี้ถ้าฉันไม่ เหนื่อย เกินไป

87. บางทีฉันอาจจะกลับไปมีสภาพร่างกายสมบูรณ์ไวกว่า เพื่อนคนอื่น ๆ ในวัย เดียวกัน

88. ฉันมักจะไม่แน่ใจบ่อย ๆ ในความสามารถทางด้านร่างกายของฉัน

89. ฉันอยาก เล่นวอล เลย์บอลมากกว่าที่จะไป เที่ยวสวนสนุก

90. การมีส่วนร่วมในกิจกรรมทางร่างกาย ช่วยส่ง เสริมให้ฉัน เป็นคน เข้าสังคม เก่ง

91. ฉันไม่ใช่บุคคลที่ดีเลิศในการใช้ทักษะทางร่างกายเกือบทุกประเภท

92. ฉันพอใจกับความรู้สึกที่ร่าเริงภายหลังจากการบริหารร่างกาย

93. ฉันไม่ได้พบบุคคลหลายคนที่ควรค่าแก่การพบจากการเข้าร่วมในกิจกรรมด้านกีฬา

94. การจัดเวลาที่ไม่เหมาะสมเป็นอุปสรรคต่อฉันในการเข้าร่วมกิจกรรมทางร่างกาย

95. ฉันเป็นผู้นำโดยกำเนิดในกิจกรรมทางกีฬา

96. ฉันอยากเล่นกีฬาที่ต้องเคลื่อนไหวรวดเร็ว เช่น ฟุตบอลและบาสเกตบอล มากกว่าที่จะเข้าร่วมในกิจกรรมประเภทแบดมินตันและซอฟท์บอล

97. ฉันเชื่อว่าเป็นสิ่งสำคัญที่แต่ละคนจะเข้าร่วมเป็นสมาชิกในกิจกรรมกีฬา

98. ฉันอยากดูซอฟท์บอลหรือบาสเกตบอลมากกว่าไปชมพิพิธภัณฑ์หรือห้องแสดงศิลปะ

99. กีฬายิงธนูเป็นกิจกรรมอย่างหนึ่งที่ฉันถูกอกถูกใจมากกว่าเล่นเทนนิส

100. ฉันเชื่อว่าคุณค่าสูงสุดประการหนึ่งของกิจกรรมทางร่างกายคือความตื่นเต้นที่ได้รับจากการแข่งขัน

กระดาษคำตอบ

แบบทดสอบเจตคติเรื่องการตัดสินและความชอบด้านกิจกรรมทางร่างกาย

อายุ.....ปี ชั้น.....โรงเรียน.....

ข้อ	ถูก	ผิด	ข้อ	ถูก	ผิด	ข้อ	ถูก	ผิด	ข้อ	ถูก	ผิด
1.	☐	☐	2.	☐	☐	3.	☐	☐	4.	☐	☐
5.	☐	☐	6.	☐	☐	7.	☐	☐	8.	☐	☐
9.	☐	☐	10.	☐	☐	11.	☐	☐	12.	☐	☐
13.	☐	☐	14.	☐	☐	15.	☐	☐	16.	☐	☐
17.	☐	☐	18.	☐	☐	19.	☐	☐	20.	☐	☐
21.	☐	☐	22.	☐	☐	23.	☐	☐	24.	☐	☐
25.	☐	☐	26.	☐	☐	27.	☐	☐	28.	☐	☐
29.	☐	☐	30.	☐	☐	31.	☐	☐	32.	☐	☐
33.	☐	☐	34.	☐	☐	35.	☐	☐	36.	☐	☐
37.	☐	☐	38.	☐	☐	39.	☐	☐	40.	☐	☐
41.	☐	☐	42.	☐	☐	43.	☐	☐	44.	☐	☐
45.	☐	☐	46.	☐	☐	47.	☐	☐	48.	☐	☐
49.	☐	☐	50.	☐	☐	51.	☐	☐	52.	☐	☐
53.	☐	☐	54.	☐	☐	55.	☐	☐	56.	☐	☐
57.	☐	☐	58.	☐	☐	59.	☐	☐	60.	☐	☐
61.	☐	☐	62.	☐	☐	63.	☐	☐	64.	☐	☐
65.	☐	☐	66.	☐	☐	67.	☐	☐	68.	☐	☐
69.	☐	☐	70.	☐	☐	71.	☐	☐	72.	☐	☐
73.	☐	☐	74.	☐	☐	75.	☐	☐	76.	☐	☐
77.	☐	☐	78.	☐	☐	79.	☐	☐	80.	☐	☐
81.	☐	☐	82.	☐	☐	83.	☐	☐	84.	☐	☐
85.	☐	☐	86.	☐	☐	87.	☐	☐	88.	☐	☐
89.	☐	☐	90.	☐	☐	91.	☐	☐	92.	☐	☐
93.	☐	☐	94.	☐	☐	95.	☐	☐	96.	☐	☐
97.	☐	☐	98.	☐	☐	99.	☐	☐	100.	☐	☐

Appendix F

PROCEDURES FOR ADMINISTERING THE PEAS

PROCEDURES FOR ADMINISTERING THE PEAS

The Physical Estimation and Attraction Scale (PEAS) is to be administered to boys aged 14 - 19 years. Before administering the instrument, please identify students who have filled out the questionnaire in another class. Do not administer the instrument to these students.

1. Please read the following instructions to all respondents (boys aged 14 - 19 years only) prior to administering the instrument:

   "You are being asked to volunteer 20 minutes of your time to complete a 100 question survey of your attitude toward physical activity. Results of the survey will be compared with the results of a similar survey with foreign students. There are no right or wrong answers to these questions and the results of the survey will not be used for grading purposes. You will not be required to write your name on the answer sheet. Since your name will not appear anywhere on your answer sheet, all of your responses will be anonymous; however, the summary results for various groups of respondents will be published. Are there any questions before we begin?"

2. Handout the one-page PEAS answer sheet to each student, instructing them to write their name, grade, and school in the appropriate space at the top of the form.

3. Instruct the students to mark on the answer sheet only, so that the questionnaire can be used again.

4. Distribute copies of the PEAS questionnaire to each respondent, instructing them to wait for instructions before filling in the answer sheet.

5. Read out loud the instructions at the top of the PEAS, emphasizing that the students should respond to each question with their first impression.

6. Collect answer sheets and questionnaires in separate piles, and place a paper clip over the answer sheets.

THANKYOU VERY MUCH FOR TAKING TIME TO HELP US
IN THIS WORTHWHILE PROJECT!

Appendix G

CHI-SQUARE GOODNESS-OF-FIT VALUES FOR ITEM PARAMETER ESTIMATES OF THE PEAS THAI AND ENGLISH VERSIONS

ATTRACTION SCALE

Item	Thai			English		
	a (S.E.)	b (S.E.)	X^2 (PROB)	a (S.E.)	b (S.E.)	X^2 (PROB)
2	.632	-2.306	25.6	1.100	-1.379	12.9
	(.042)	(.160)	(.043)	(.062)	(.090)	(.228)
4	.451	1.282	16.6	.555	.360	9.9
	(.036)	(.121)	(.552)	(.049)	(.081)	(.828)
8	.127	9.819	32.6	1.675	-1.514	1.5
	(.026)	(2.050)	(.013)	(.068)	(.068)	(.909)
16	.785	-2.059	18.1	.527	-1.117	22.5
	(.045)	(.124)	(.200)	(.049)	(.131)	(.128)
17	1.292	-.813	12.0	.779	-1.069	7.4
	(.051)	(.040)	(.607)	(.053)	(.091)	(.920)
18	1.356	-2.309	3.3	.985	-3.159	2.6
	(.059)	(.102)	(.768)	(.087)	(.280)	(.464)
22	.967	-.772	12.1	.396	.811	20.6
	(.046)	(.048)	(.676)	(.044)	(.137)	(.246)
23	.530	-.984	9.3	1.340	-1.160	9.1
	(.036)	(.087)	(.951)	(.069)	(.069)	(.524)
24	.274	4.724	19.3	.277	4.500	17.8
	(.035)	(.613)	(.314)	(.045)	(.750)	(.163)
25	.886	-.873	14.8	1.481	-.854	6.3
	(.043)	(.054)	(.540)	(.070)	(.051)	(.850)
27	.458	-1.053	23.1	.441	-1.477	15.2
	(.036)	(.104)	(.185)	(.047)	(.184)	(.581)
29	.513	-.698	17.6	.505	-1.070	14.9
	(.037)	(.075)	(.485)	(.050)	(.132)	(.529)
30	.509	-2.161	9.7	.531	-2.056	8.7
	(.040)	(.180)	(.880)	(.053)	(.221)	(.730)
31	.857	-.140	22.1	.454	1.078	20.0
	(.042)	(.036)	(.227)	(.048)	(.145)	(.218)
32	1.394	-1.173	11.9	.871	-.212	13.5
	(.052)	(.048)	(.533)	(.059)	(.052)	(.488)
34	.730	-.825	14.9	.650	-.648	9.0
	(.040)	(.061)	(.602)	(.052)	(.083)	(.878)
36	.427	1.043	26.2	1.090	-1.086	7.7
	(.036)	(.110)	(.096)	(.064)	(.075)	(.806)
37	.404	1.046	17.0	1.091	-.264	8.4
	(.034)	(.114)	(.522)	(.062)	(.044)	(.871)
41	.300	2.677	13.4	.592	.077	16.6
	(.034)	(.315)	(.768)	(.050)	(.070)	(.483)
42	1.289	-2.088	10.4	2.066	-.868	6.7
	(.054)	(.090)	(.321)	(.084)	(.042)	(.575)

Appendix G (Continued)

43	.369	.007	7.5	1.715	-1.049	7.4
	(.034)	(.077)	(.985)	(.076)	(.054)	(.691)
44	.537	.560	29.1	.653	-1.766	6.9
	(.036)	(.066)	(.047)	(.053)	(.158)	(.863)
45	.330	.330	23.9	.729	-.653	10.4
	(.033)	(.092)	(.157)	(.054)	(.075)	(.794)
46	.422	.327	15.5	1.076	-.662	6.9
	(.034)	(.073)	(.630)	(.061)	(.055)	(.907)
47	1.306	-.902	6.4	.385	1.769	29.8
	(.047)	(.040)	(.972)	(.045)	(.235)	(.019)
50	.080	13.867	70.3	.135	11.287	32.6
	(.018)	(3.217)	(.000)	(.031)	(2.628)	(.000)
51	.572	-.120	21.3	.880	-1.333	11.1
	(.037)	(.052)	(.265)	(.058)	(.099)	(.600)
52	.403	-.351	11.3	.517	-1.065	23.5
	(.035)	(.077)	(.880)	(.050)	(.129)	(.101)
53	.867	-.055	13.9	.916	-1.205	12.7
	(.043)	(.035)	(.737)	(.057)	(.088)	(.470)
55	.412	.831	13.9	.308	1.753	9.0
	(.034)	(.099)	(.733)	(.043)	(.280)	(.915)
56	.479	-.787	17.1	.947	-1.816	15.9
	(.036)	(.085)	(.516)	(.058)	(.120)	(.043)
57	1.043	-1.384	14.8	1.720	-.950	15.2
	(.047)	(.068)	(.390)	(.076)	(.050)	(.085)
58	.800	-.280	20.8	1.467	-.654	5.0
	(.410)	(.040)	(.290)	(.074)	(.046)	(.956)
61	1.021	-.944	9.7	1.472	-.524	17.8
	(.047)	(.052)	(.882)	(.075)	(.041)	(.120)
63	.868	-1.449	7.0	1.220	-.495	9.0
	(.046)	(.083)	(.935)	(.069)	(.046)	(.774)
65	.663	-.364	11.9	1.588	-1.140	6.4
	(.040)	(.049)	(.851)	(.069)	(.057)	(.700)
66	.365	1.002	30.5	.785	.255	11.6
	(.034)	(.122)	(.303)	(.056)	(.058)	(.712)
71	.565	-2.090	17.2	.313	-1.258	13.7
	(.042)	(.162)	(.370)	(.043)	(.215)	(.747)
74	.785	-1.517	11.6	.870	-2.041	5.3
	(.044)	(.092)	(.771)	(.065)	(.159)	(.723)
75	1.177	-.997	8.9	.702	.421	8.3
	(.048)	(.048)	(.838)	(.054)	(.069)	(.873)
76	.723	-1.016	19.7	.927	-1.766	19.2
	(.041)	(.070)	(.236)	(.060)	(.121)	(.008)
78	.687	-1.374	19.6	.673	-1.031	8.5
	(.041)	(.092)	(.239)	(.055)	(.104)	(.860)
80	.372	1.816	12.9	.264	3.104	11.3
	(.033)	(.182)	(.797)	(.042)	(.521)	(.730)
82	.503	-1.145	20.3	1.383	-1.068	19.6
	(.037)	(.101)	(.317)	(.062)	(.057)	(.020)
83	.825	-1.918	11.3	1.664	-1.001	2.6
	(.046)	(.112)	(.735)	(.074)	(.052)	(.958)

Appendix G (Continued)

85	1.066	-1.892	13.5	1.478	-1.009	12.9
	(.051)	(.094)	(.259)	(.069)	(.056)	(.226)
86	.256	2.325	19.3	.585	-1.066	21.7
	(.032)	(.312)	(.373)	(.050)	(.115)	(.152)
89	.396	-.056	25.8	.748	.014	18.6
	(.035)	(.072)	(.103)	(.054)	(.057)	(.233)
92	1.012	-1.901	8.7	.720	-.121	20.4
	(.048)	(.094)	(.794)	(.055)	(.059)	(.203)
96	1.123	-1.105	15.0	1.033	-1.081	10.0
	(.046)	(.053)	(.453)	(.062)	(.077)	(.696)
97	1.147	-1.39	14.4	1.079	-.880	12.0
	(.049)	(.065)	(.277)	(.064)	(.066)	(.530)
98	.452	-.511	11.5	.784	-1.089	12.2
	(.036)	(.075)	(.872)	(.056)	(.095)	(.667)
99	.237	.273	17.3	.391	.284	11.5
	(.031)	(.124)	(.502)	(.044)	(.108)	(.830)
100	.602	-2.592	12.3	1.265	-1.213	13.6
	(.043)	(.192)	(.660)	(.062)	(.069)	(.191)

Appendix G (Continued)

ESTIMATION SCALE

Item	Thai			English		
	a (S.E.)	b (S.E.)	X^2 (PROB)	a (S.E.)	b (S.E.)	X^2 (PROB)
5	.215	-2.625	3.8	.711	-2.074	15.0
	(.031)	(.396)	(.925)	(.055)	(.170)	(.036)
6	1.077	-.060	8.7	1.067	.131	19.0
	(.049)	(.030)	(.470)	(.065)	(.043)	(.015)
10	1.441	-.440	16.7	1.421	-.554	1.6
	(.055)	(.028)	(.054)	(.070)	(.042)	(.977)
13	1.032	-.610	6.9	.770	-.297	12.1
	(.047)	(.041)	(.649)	(.055)	(.059)	(.145)
19	.231	-.821	9.1	1.052	-1.398	11.5
	(.029)	(.174)	(.430)	(.060)	(.090)	(.117)
26	1.133	-.089	13.1	1.050	-.812	2.7
	(.051)	(.029)	(.157)	(.060)	(.062)	(.908)
33	1.534	-.056	20.6	.989	.130	2.3
	(.061)	(.023)	(.015)	(.060)	(.046)	(.985)
35	.680	-1.504	17.0	1.197	-1.528	10.6
	(.042)	(.102)	(.049)	(.066)	(.091)	(.101)
38	1.538	-.512	12.9	1.151	-.161	6.3
	(.060)	(.029)	(.116)	(.067)	(.041)	(.611)
39	1.053	-.906	10.2	1.584	-.920	4.4
	(.044)	(.048)	(.334)	(.070)	(.050)	(.625)
40	.700	.470	16.8	1.466	-1.119	4.6
	(.040)	(.050)	(.052)	(.065)	(.058)	(.593)
48	.424	-1.706	12.9	.938	-2.540	5.9
	(.037)	(.162)	(.160)	(.068)	(.188)	(.319)
49	.673	1.265	21.1	.358	3.595	10.0
	(.042)	(.089)	(.012)	(.048)	(.499)	(.353)
54	.502	-.267	11.7	.784	-1.013	2.2
	(.036)	(.061)	(.228)	(.057)	(.091)	(.950)
59	.321	-4.406	16.0	.935	-2.434	3.8
	(.043)	(.599)	(.042)	(.067)	(.179)	(.583)
60	.419	.644	16.5	.723	-2.293	8.8
	(.035)	(.087)	(.056)	(.058)	(.192)	(.265)
62	1.213	-.417	9.8	.955	-.370	2.8
	(.052)	(.032)	(.368)	(.059)	(.051)	(.946)
64	.491	-.826	10.2	.603	-1.111	4.6
	(.037)	(.086)	(.333)	(.050)	(.115)	(.804)
67	.905	-1.052	9.2	.801	-1.011	9.3
	(.044)	(.061)	(.324)	(.054)	(.085)	(.233)
68	1.123	-.300	7.6	1.126	-.660	4.5
	(.048)	(.031)	(.574)	(.063)	(.054)	(.722)

Appendix G (Continued)

69	.566	-1.124	7.4	1.387	-.930	5.0
	(.038)	(.091)	(.594)	(.069)	(.056)	(.663)
70	.464	-.295	21.5	.882	-1.419	7.8
	(.036)	(.066)	(.011)	(.058)	(.104)	(.348)
72	1.278	-.387	8.5	.857	.071	11.6
	(.055)	(.030)	(.486)	(.056)	(.051)	(.233)
73	.697	1.519	12.0	1.330	-.200	8.8
	(.042)	(.100)	(.215)	(.073)	(.037)	(.267)
77	1.049	-.356	4.8	.844	-.887	5.8
	(.047)	(.034)	(.854)	(.056)	(.077)	(.565)
79	.343	-.092	7.3	.665	-1.140	2.9
	(.033)	(.083)	(.605)	(.051)	(.108)	(.896)
81	.939	-.279	5.9	2.272	-.806	8.8
	(.047)	(.036)	(.747)	(.089)	(.038)	(.116)
84	.405	-.303	8.8	.983	-1.374	12.1
	(.034)	(.075)	(.452)	(.060)	(.093)	(.097)
87	.317	-4.265	14.6	1.254	-.811	2.2
	(.038)	(.517)	(.103)	(.065)	(.055)	(.946)
88	.696	-.071	9.8	1.212	-.479	12.7
	(.039)	(.043)	(.364)	(.066)	(.045)	(.079)
91	.306	2.966	5.5	1.372	-1.235	3.9
	(.034)	(.343)	(.793)	(.069)	(.070)	(.686)
94	.180	3.992	14.9	.934	-.948	10.2
	(.029)	(.675)	(.093)	(.058)	(.074)	(.179)
95	.472	1.936	15.1	.838	.106	11.4
	(.038)	(.167)	(.087)	(.056)	(.052)	(.249)

Appendix H

Z-SCORE VALUES FOR ITEM PARAMETER COMPARISONS BETWEEN THE PEAS THAI AND ENGLISH VERSIONS

ATTRACTION SCALE

ITEM	a_T	a_E	S.E.$_{aT}$	S.E.$_{aE}$	Z	b_T	b_E	S.E.$_{bT}$	S.E.$_{bE}$	Z
2	0.632	1.1	0.042	0.064	-6.1136	-2.306	-1.379	0.16	0.09	-5.0497
4	0.451	0.555	0.036	0.049	-1.7104	1.282	0.36	0.121	0.081	6.3320
8	0.127	1.675	0.026	0.068	-21.2634	9.819	-1.514	2.05	0.068	5.5253
16	0.785	0.527	0.045	0.049	3.8781	-2.059	-1.117	0.124	0.131	-5.2223
17	1.292	0.779	0.051	0.053	6.9746	-0.813	-1.069	0.04	0.091	2.5754
18	1.356	0.985	0.059	0.087	3.5293	-2.309	-3.159	0.102	0.28	2.8523
22	0.967	0.396	0.046	0.044	8.9702	-0.772	0.811	0.048	0.137	-10.9048
23	0.53	1.34	0.036	0.069	-10.4077	-0.984	-1.16	0.087	0.069	1.5850
24	0.274	0.277	0.035	0.045	-0.0526	4.724	4.5	0.613	0.75	0.2313
25	0.886	1.481	0.043	0.07	-7.2426	-0.873	-0.854	0.054	0.051	-0.2558
27	0.458	0.441	0.036	0.047	0.2871	-1.053	-1.477	0.104	0.184	2.0061
29	0.513	0.505	0.037	0.05	0.1286	-0.698	-1.07	0.075	0.132	2.4503
30	0.509	0.531	0.04	0.053	-0.3313	-2.161	-2.056	0.18	0.221	-0.3684
31	0.857	0.454	0.042	0.048	6.3185	-0.14	1.078	0.036	0.145	-8.1525
32	1.394	0.871	0.052	0.059	6.6502	-1.173	-0.212	0.048	0.052	-13.5797
34	0.73	0.65	0.04	0.052	1.2194	-0.825	-0.648	0.061	0.083	-1.7184
36	0.427	1.09	0.036	0.064	-9.0290	1.043	-1.086	0.11	0.075	15.9913
37	0.404	1.091	0.034	0.062	-9.7156	1.046	-0.264	0.114	0.044	10.7204
41	0.3	0.592	0.034	0.05	-4.8293	2.677	0.077	0.315	0.07	8.0574
42	1.289	2.066	0.054	0.084	-7.7809	-2.088	-0.868	0.09	0.042	-12.2838
43	0.369	1.715	0.034	0.076	-16.1665	0.007	-1.049	0.077	0.054	11.2283
44	0.537	0.653	0.036	0.053	-1.8105	0.56	-1.766	0.066	0.158	13.5840
45	0.33	0.729	0.033	0.054	-6.3048	0.33	-0.653	0.092	0.075	8.2816
46	0.422	1.076	0.034	0.061	-9.3649	0.327	-0.662	0.073	0.055	10.8205
47	1.306	0.385	0.047	0.045	14.1542	-0.902	1.769	0.04	0.235	-11.2048
50	0.08	0.135	0.018	0.031	-1.5343	13.867	11.287	3.217	2.628	0.6211
51	0.572	0.88	0.037	0.058	-4.4770	-0.12	-1.333	0.052	0.099	10.8472
52	0.403	0.517	0.035	0.05	-1.8678	-0.351	-1.065	0.077	0.129	4.7526
53	0.867	0.916	0.043	0.057	-0.6863	-0.055	-1.205	0.035	0.088	12.1430
55	0.412	0.308	0.034	0.043	1.8972	0.831	1.753	0.099	0.28	-3.1045
56	0.479	0.947	0.036	0.058	-6.8557	-0.787	-1.816	0.085	0.12	6.9974
57	1.043	1.72	0.047	0.076	-7.5762	-1.384	-0.95	0.068	0.05	-5.1419
58	0.8	1.467	0.041	0.074	-7.8842	-0.28	-0.654	0.04	0.046	6.1353
61	1.021	1.472	0.047	0.075	-5.0955	-0.944	-0.524	0.052	0.041	-6.3426
63	0.868	1.22	0.046	0.069	-4.2447	-1.449	-0.495	0.083	0.046	-10.0533
65	0.663	1.588	0.04	0.069	-11.5979	-0.364	-1.14	0.049	0.057	10.3238
66	0.365	0.785	0.034	0.056	-6.4109	1.002	0.255	0.122	0.058	5.5298
71	0.565	0.313	0.042	0.043	4.1924	-2.09	-1.258	0.162	0.215	-3.0906
74	0.785	0.87	0.044	0.065	-1.0829	-1.517	-2.041	0.092	0.159	2.8525
75	1.177	0.702	0.048	0.054	6.5744	-0.997	0.421	0.048	0.069	-16.8702
76	0.723	0.927	0.041	0.06	-2.8072	-1.016	-1.766	0.07	0.121	5.3652
78	0.678	0.673	0.041	0.055	0.0729	-1.374	-1.031	0.092	0.104	-2.4702
80	0.372	0.264	0.033	0.042	2.0220	1.816	3.104	0.182	0.521	-2.3339
82	0.503	1.383	0.037	0.062	-12.1882	-1.145	-1.068	0.101	0.057	-0.6639
83	0.825	1.664	0.046	0.074	-9.6291	-1.918	-1.001	0.112	0.052	-7.4261
85	1.066	1.478	0.051	0.069	-4.8017	-1.892	-1.009	0.094	0.056	-8.0701
86	0.256	0.585	0.032	0.05	-5.5421	2.325	-1.066	0.312	0.115	10.1979
89	0.396	0.748	0.035	0.054	-5.4700	-0.056	0.014	0.072	0.057	-0.7623
92	1.012	0.72	0.048	0.055	4.0000	-1.901	-0.121	0.094	0.059	-16.0386
96	1.123	1.033	0.046	0.062	1.1658	-1.105	-1.081	0.053	0.077	-0.2567
97	1.147	1.079	0.049	0.064	0.8436	-1.396	-0.88	0.065	0.066	-5.5703
98	0.452	0.784	0.036	0.056	-4.9870	-0.511	-1.089	0.075	0.095	4.7754
99	0.237	0.391	0.031	0.044	-2.8612	0.273	0.284	0.124	0.108	-0.0669
100	0.602	1.265	0.043	0.062	-8.7870	-2.592	-1.213	0.192	0.069	-6.7591

ESTIMATION SCALE

ITEM	a_T	a_E	S.E.$_{aT}$	S.E.$_{aE}$	Z	b_T	b_E	S.E.$_{bT}$	S.E.$_{bE}$	Z
5	0.215	0.711	0.031	0.055	-7.8562	-2.625	-2.074	0.396	0.17	-1.2786
6	1.077	1.067	0.049	0.065	0.1228	-0.06	0.131	0.03	0.043	-3.6429
10	1.441	1.421	0.055	0.07	0.2247	-0.44	-0.554	0.028	0.042	2.2584
13	1.032	0.77	0.047	0.055	3.6215	-0.61	-0.297	0.041	0.059	-4.3565
19	0.213	1.052	0.029	0.06	-12.5899	-0.821	-1.398	0.174	0.09	2.9454
26	1.133	1.05	0.051	0.06	1.0540	-0.089	-0.812	0.029	0.062	10.5629
33	1.534	0.989	0.061	0.06	6.3696	-0.056	0.13	0.023	0.046	-3.6166
35	0.68	1.197	0.042	0.066	-6.6087	-1.504	-1.528	0.102	0.091	0.1756
38	1.538	1.151	0.06	0.067	4.3029	-0.512	-0.161	0.029	0.041	-6.9833
39	1.053	1.584	0.044	0.07	-6.4223	-0.906	-0.92	0.048	0.05	0.2020
40	0.7	1.466	0.04	0.065	-10.0365	0.47	-1.119	0.05	0.058	20.7504
48	0.424	0.938	0.037	0.068	-6.6396	-1.706	-2.54	0.162	0.188	3.3606
49	0.673	0.358	0.042	0.048	4.9388	1.265	3.595	0.089	0.499	-4.5968
54	0.502	0.784	0.036	0.057	-4.1829	-0.267	-1.013	0.061	0.091	6.8094
59	0.321	0.935	0.043	0.067	-7.7124	-4.406	-2.434	0.599	0.179	-3.1543
60	0.419	0.723	0.035	0.058	-4.4876	0.644	-2.293	0.087	0.192	13.9332
62	1.213	0.955	0.052	0.059	3.2806	-0.417	-0.37	0.032	0.051	-0.7806
64	0.491	0.603	0.037	0.05	-1.8006	-0.826	-1.111	0.086	0.115	1.9847
67	0.905	0.801	0.044	0.054	1.4930	-1.052	-1.011	0.061	0.085	-0.3919
68	1.123	1.126	0.048	0.063	-0.0379	-0.3	-0.66	0.031	0.054	5.7817
69	0.566	1.387	0.038	0.069	-10.4225	-1.124	-0.93	0.031	0.056	-1.8156
70	0.464	0.882	0.036	0.058	-6.1233	-0.295	-1.419	0.066	0.104	9.1253
72	1.278	0.857	0.055	0.056	5.3636	-0.387	0.071	0.03	0.051	-7.7405
73	0.697	1.33	0.042	0.073	-7.5160	1.519	-0.2	0.1	0.037	16.1218
77	1.049	0.844	0.047	0.056	2.8040	-0.356	-0.887	0.034	0.077	6.3085
79	0.343	0.665	0.033	0.051	-5.3008	-0.092	-1.14	0.083	0.108	7.6940
81	0.939	2.272	0.047	0.089	-13.2442	-0.279	-0.806	0.036	0.038	10.0678
84	0.405	0.983	0.034	0.06	-8.3812	-0.303	-1.374	0.075	0.093	8.9643
87	0.317	1.254	0.038	0.065	-12.4448	-4.265	-0.811	0.517	0.055	-6.6434
88	0.696	1.212	0.039	0.066	-6.7309	-0.071	-0.479	0.043	0.045	6.5551
91	0.306	1.372	0.034	0.069	-13.8582	2.966	-1.235	0.343	0.07	12.0005
94	0.18	0.934	0.029	0.058	-11.6276	3.992	-0.948	0.675	0.074	7.2749
95	0.472	0.838	0.038	0.056	-5.4081	1.936	0.106	0.167	0.052	10.4626

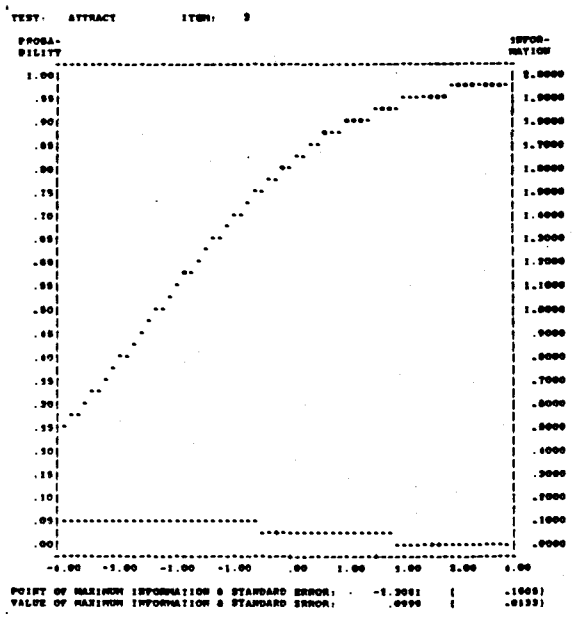
Appendix I

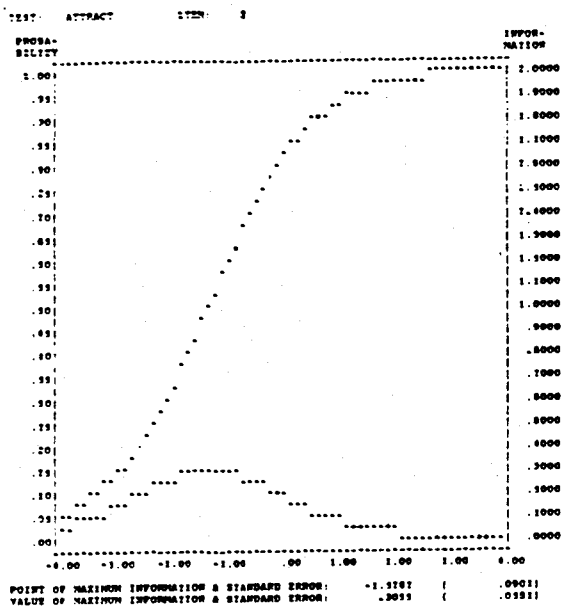
ITEM CHARACTERISTIC CURVES

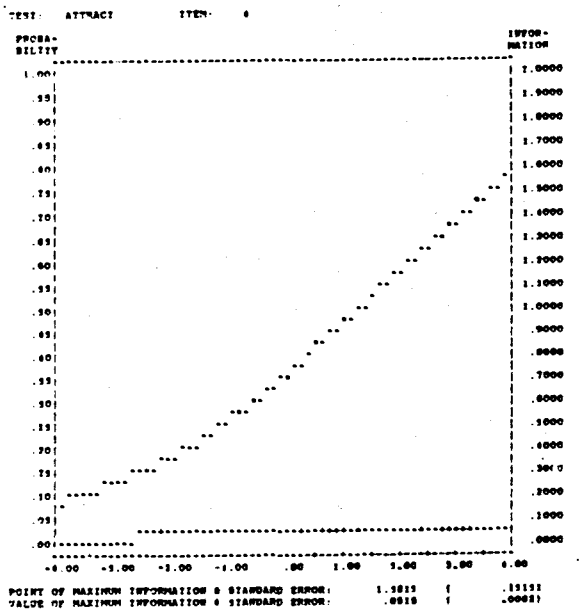
FOR THE PEAS THAI AND ENGLISH VERSIONS

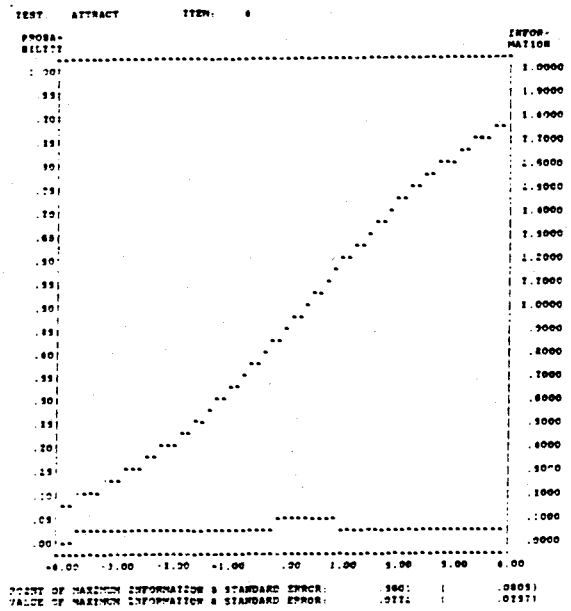
PEAS Thai version **PEAS English version**

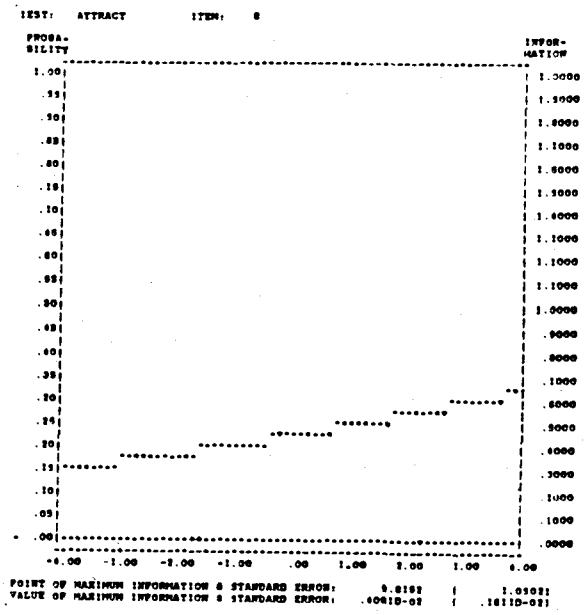
ATTRACTION SCALE







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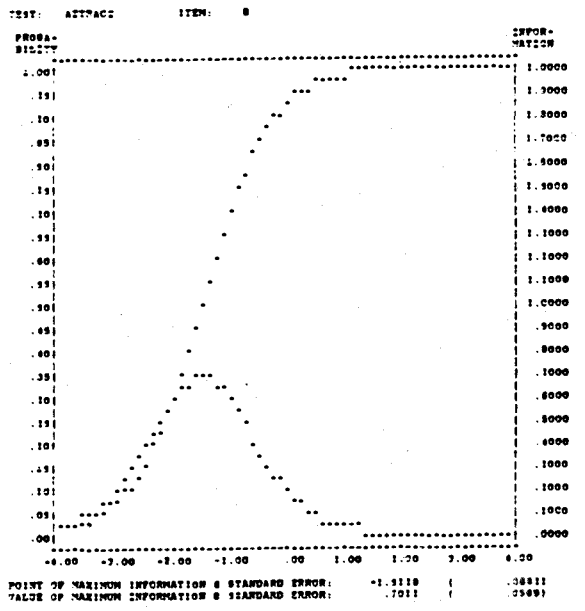
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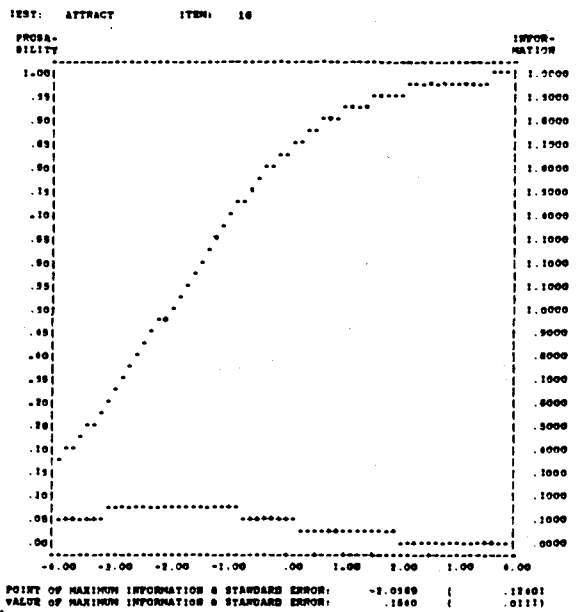
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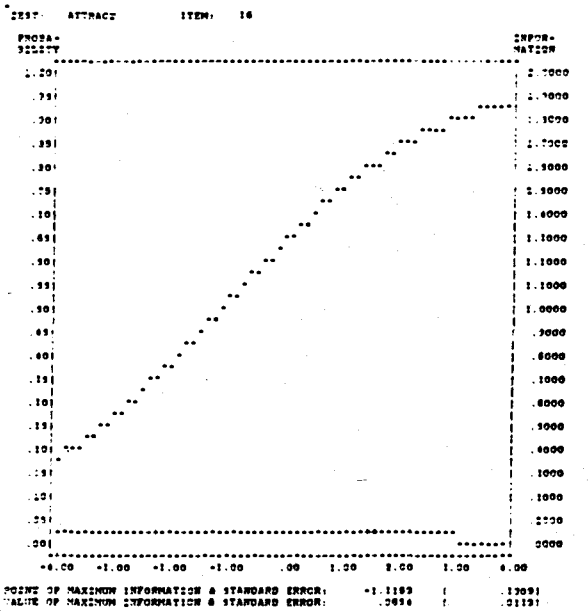
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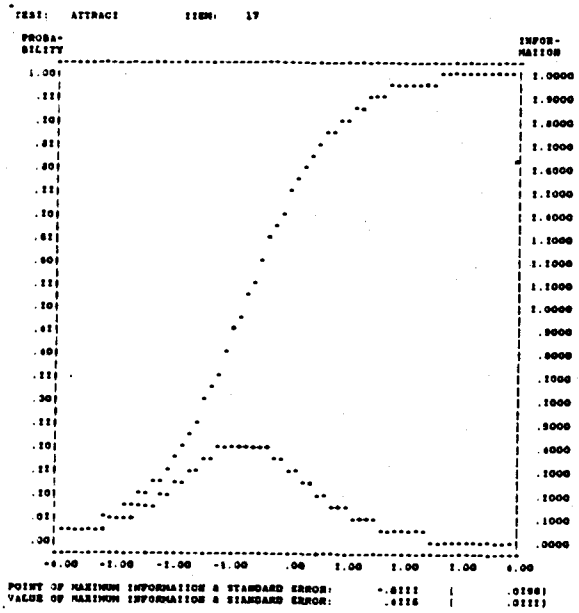
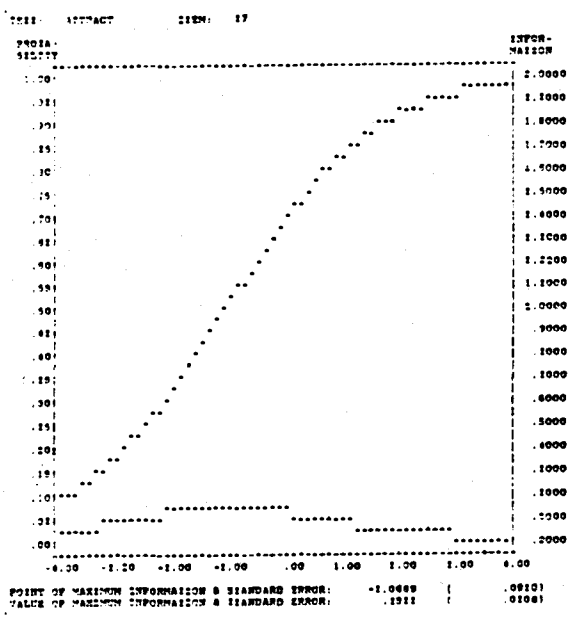
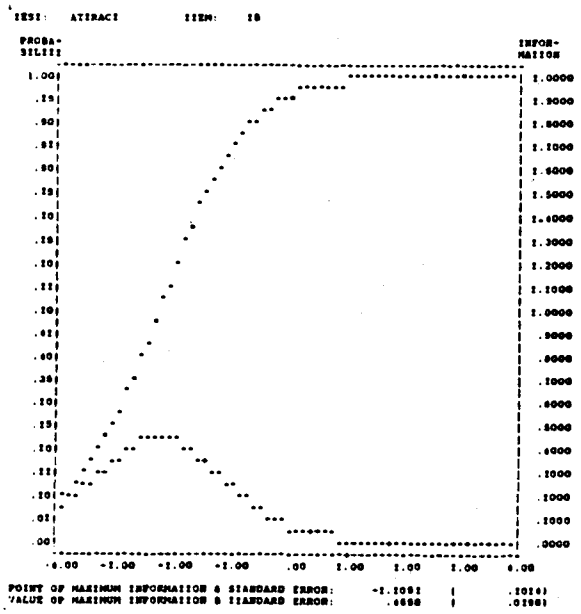
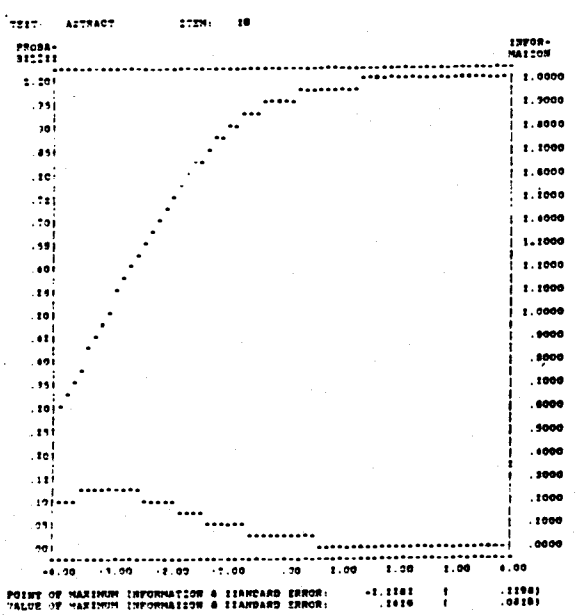
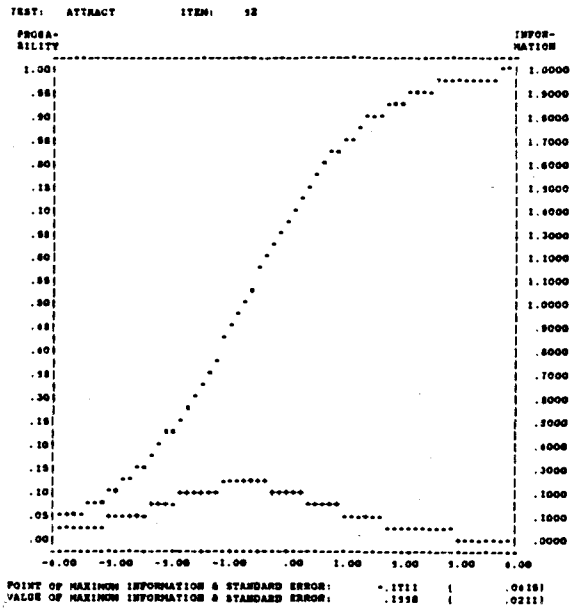
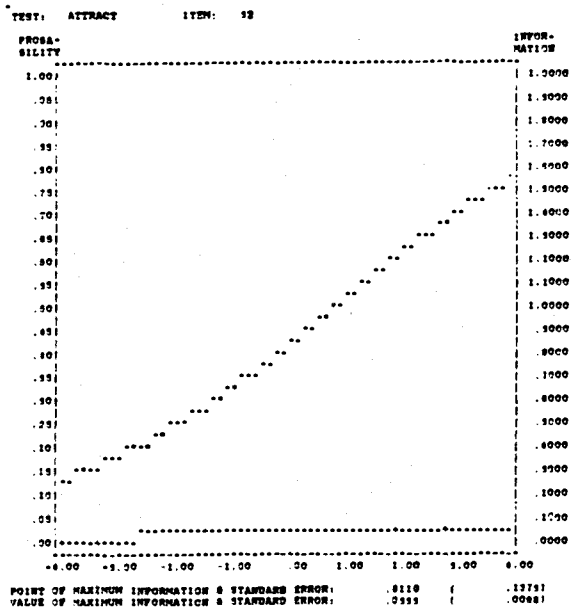

TEST: ATTRACT ITEM: 17
PROBABILITY
INFORMATION
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
.00
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6111 (.0196)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6116 (.0111)

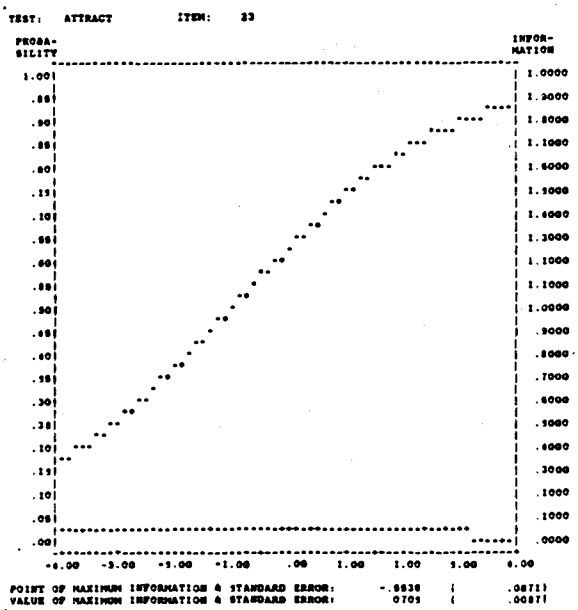

TEST: ATTRACT ITEM: 17
PROBABILITY
INFORMATION
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0669 (.0810)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1911 (.0108)

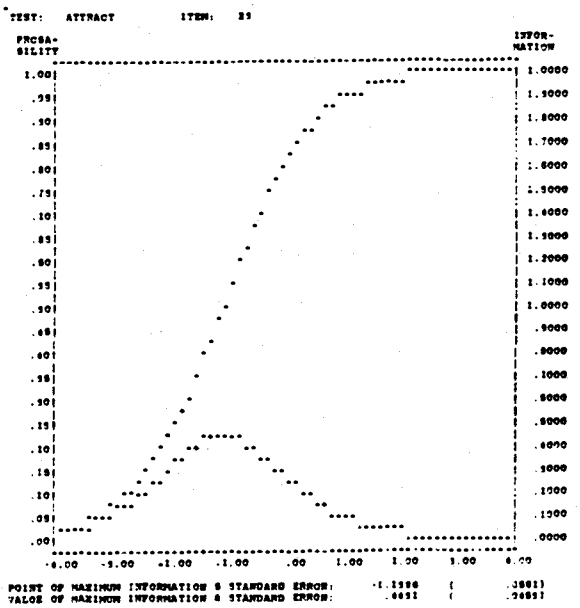

TEST: ATTRACT ITEM: 18
PROBABILITY
INFORMATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1061 (.1014)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6698 (.0198)

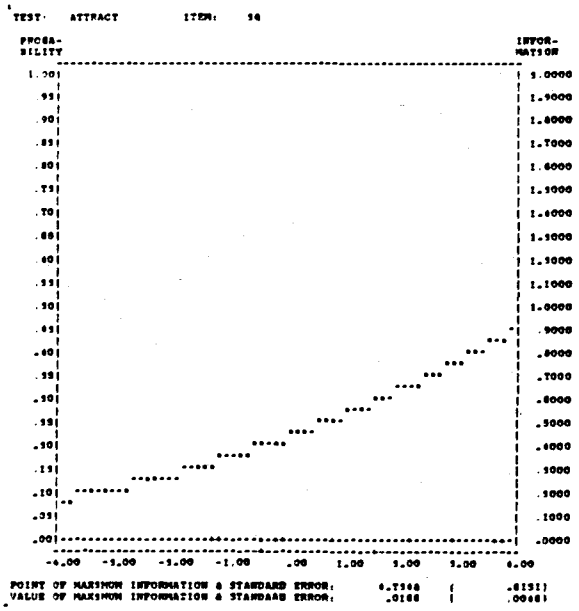

TEST: ATTRACT ITEM: 18
PROBABILITY
INFORMATION
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1161 (.1196)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1616 (.0818)

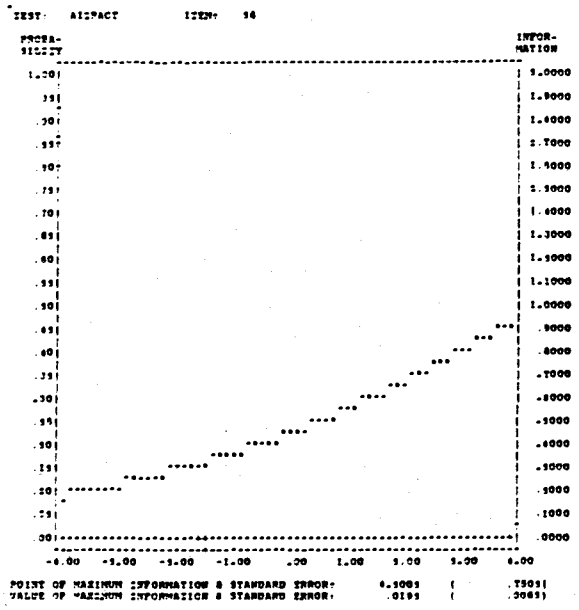

TEST: ATTRACT ITEM: 32
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1711 (.0618)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: 1.1558 (.0211)

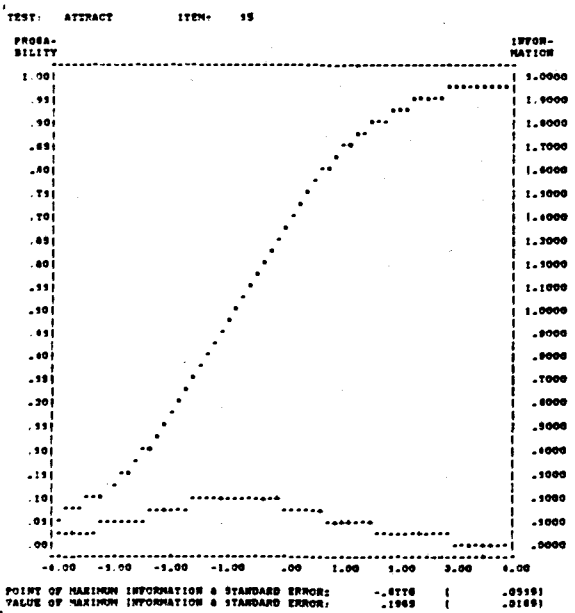

TEST: ATTRACT ITEM: 32
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .8110 (.1375)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: 1.0555 (.0068)

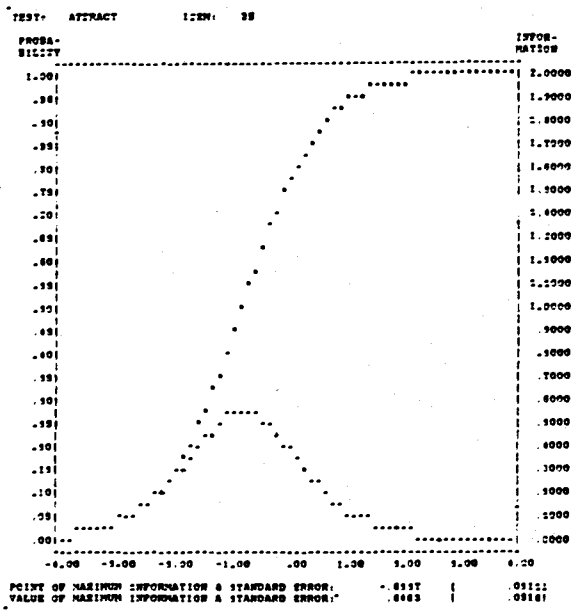

TEST: ATTRACT ITEM: 33
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.8638 (.0871)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: 0705 (.0087)

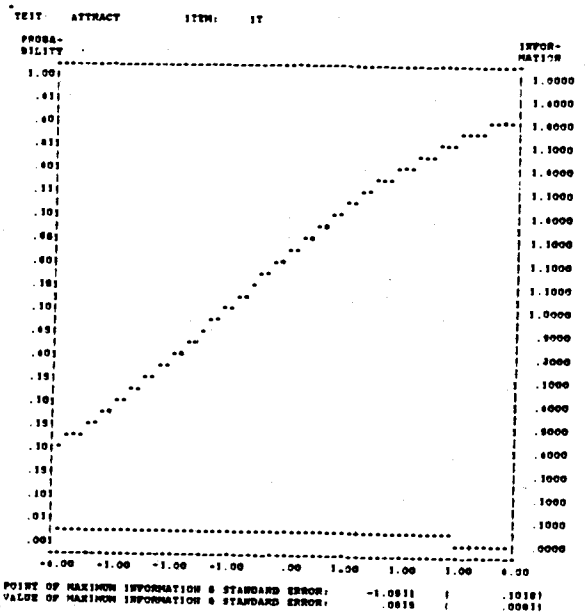

TEST: ATTRACT ITEM: 33
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1356 (.1861)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .4631 (.0683)

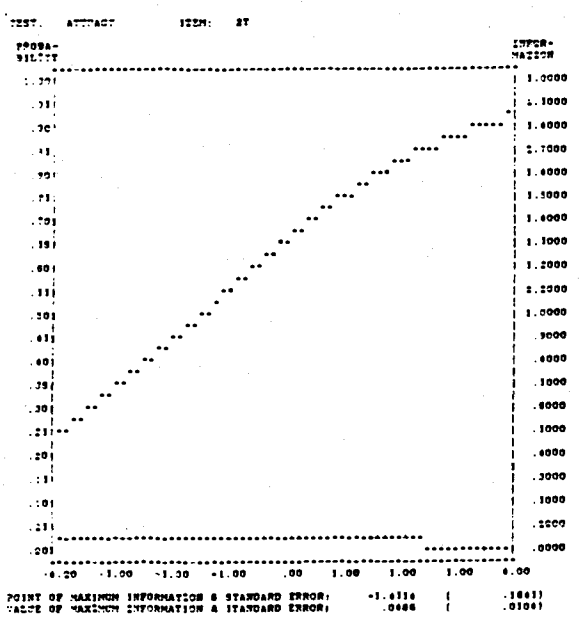

TEST: ATTRACT ITEM: 14
PROBA-BILITY
INFOR-MATION
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6736 (.6131)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0186 (.0068)

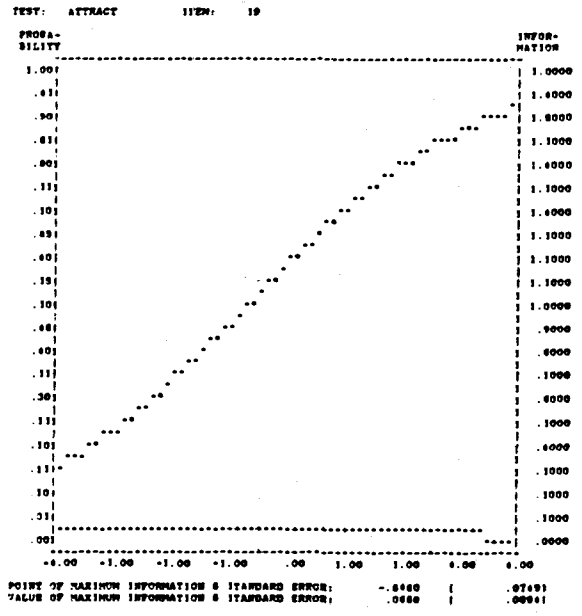

TEST: ATTRACT ITEM: 16
PROBA-BILITY
INFOR-MATION
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6306 (.7501)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0195 (.0065)

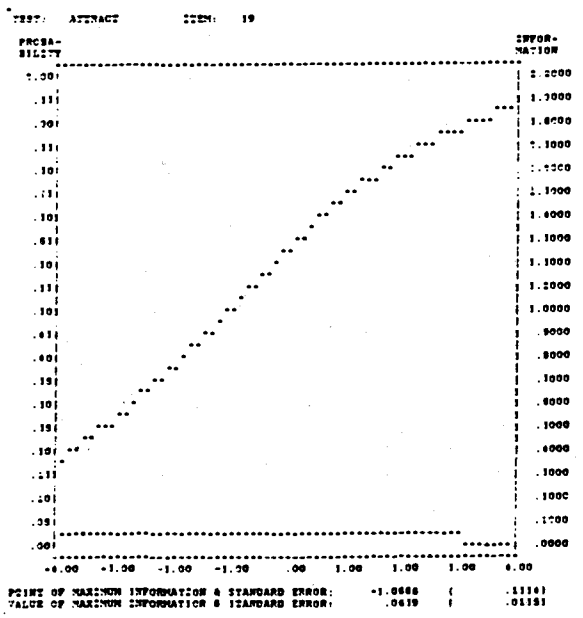

TEST: ATTRACT ITEM: 15
PROBA-BILITY
INFOR-MATION
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6776 (.6510)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1965 (.0169)


TEST: ATTRACT ITEM: 25
PROBA-BILITY
INFOR-MATION
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6137 (.0511)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6463 (.0316)


TEST: ATTRACT ITEM: 17
PROBA-BILITY
INFOR-MATION
1.00
.91
.80
.71
.60
.51
.40
.31
.20
.11
.00
1.0000
1.4000
1.8000
1.1000
1.4000
1.1000
1.4000
1.1000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0811 (.1018)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0815 (.0081)


TEST: ATTRACT ITEM: 27
PROBA-BILITY
INFOR-MATION
1.00
.91
.80
.71
.60
.51
.40
.31
.20
.11
.00
1.0000
1.1000
1.4000
1.7000
1.4000
1.5000
1.4000
1.3000
1.2000
1.2500
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.4114 (.1661)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0488 (.0104)


TEST: ATTRACT ITEM: 18
PROBA-BILITY
INFOR-MATION
1.00
.91
.80
.71
.60
.51
.40
.31
.20
.11
.00
1.0000
1.4000
1.8000
1.1000
1.4000
1.1000
1.4000
1.1000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.8460 (.0769)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0686 (.0084)


TEST: ATTRACT ITEM: 19
PROBA-BILITY
INFOR-MATION
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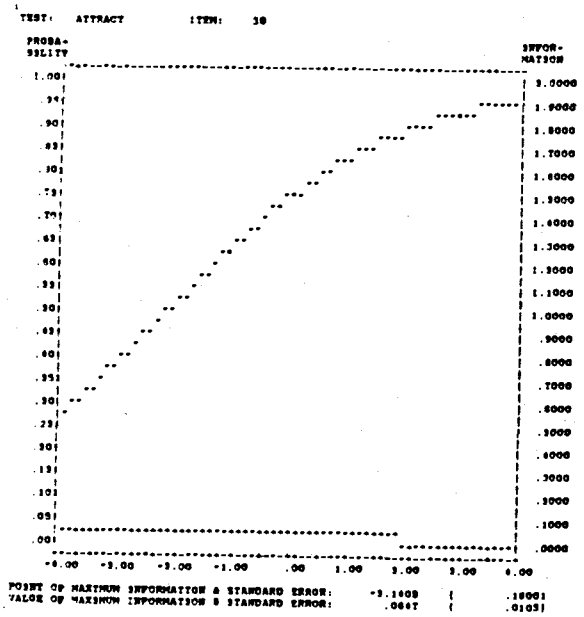
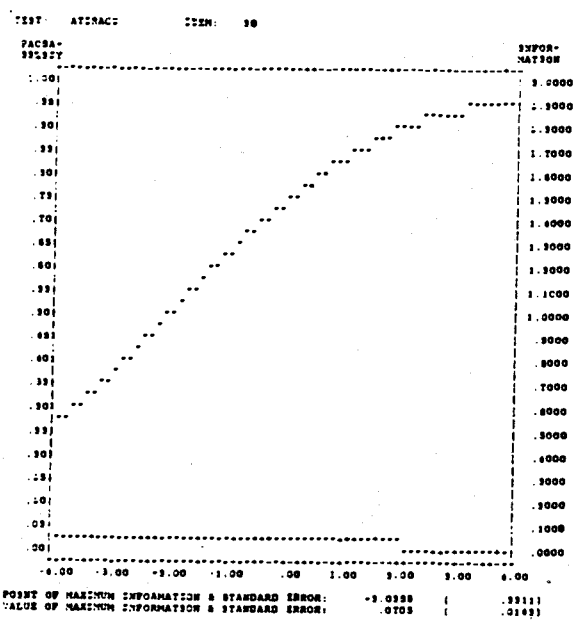
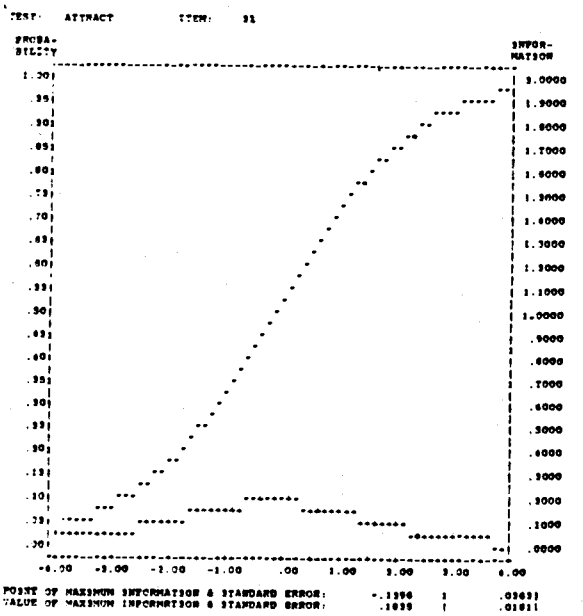
.91
.80
.71
.60
.51
.40
.31
.20
.11
.00
1.0000
1.4000
1.8000
1.1000
1.4000
1.1000
1.4000
1.1000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0668 (.1116)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0619 (.0115)


TEST: ATTRACT ITEM: 30
PROBA-
BILITY
INFOR-
MATION
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -3.1408 (.1800)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0647 (.0103)


TEST: ATTRACT ITEM: 30
PROBA-
BILITY
INFOR-
MATION
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -3.0338 (.3311)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0703 (.0149)


TEST: ATTRACT ITEM: 31
PROBA-
BILITY
INFOR-
MATION
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
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.8000
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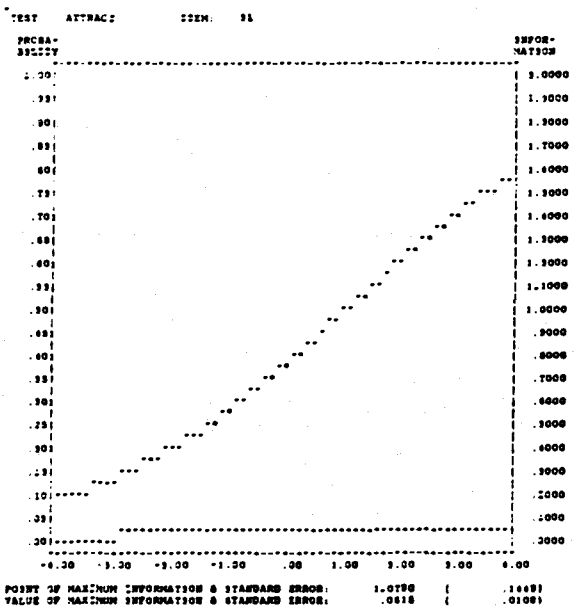
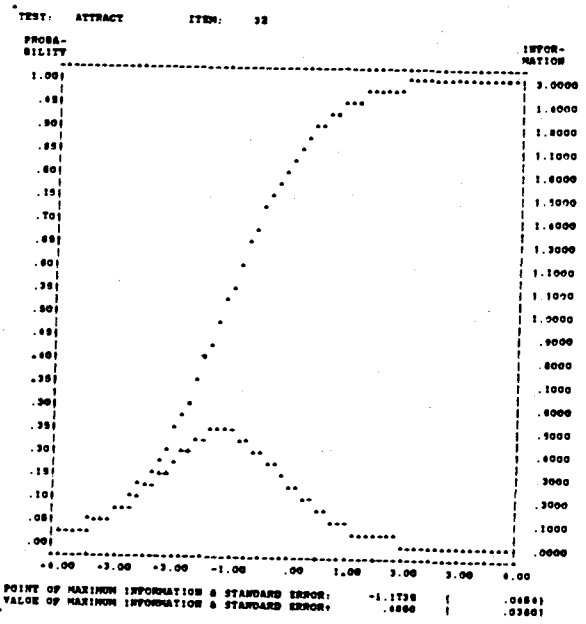
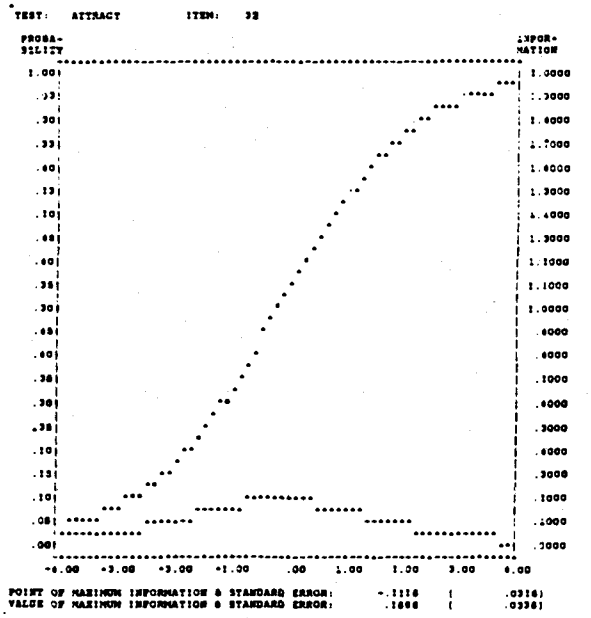
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1396 (.0363)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1039 (.0101)


TEST ATTRACT ITEM: 31
PROBA-
BILITY
INFOR-
MATION
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.0796 (.1669)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0618 (.0108)


TEST: ATTRACT ITEM: 32
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
1.8000
1.8000
1.1000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1738 (.0684)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .4860 (.0360)


TEST: ATTRACT ITEM: 32
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
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.8000
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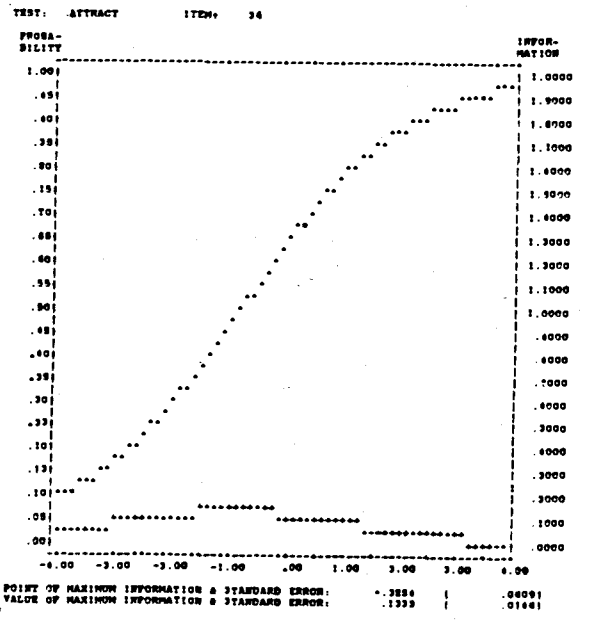
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1116 (.0316)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1666 (.0336)


TEST: ATTRACT ITEM: 34
PROBA-BILITY
INFOR-MATION
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.55
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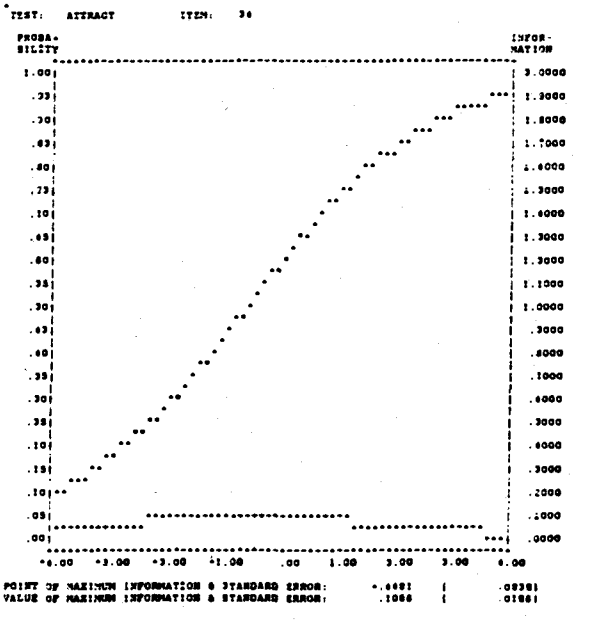
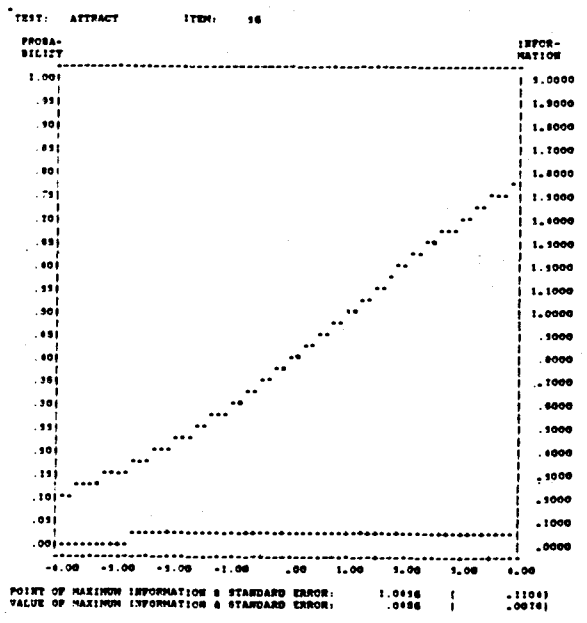
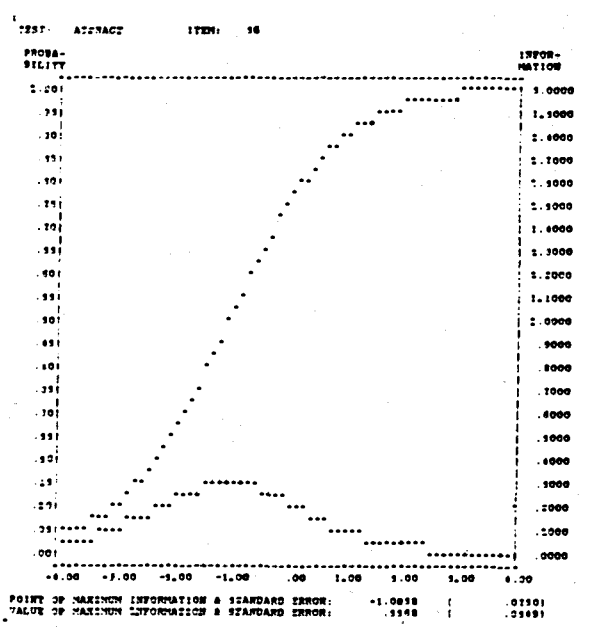
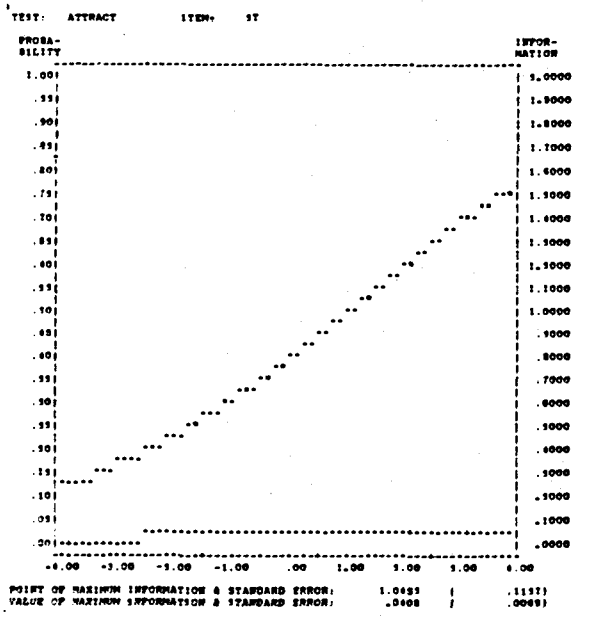
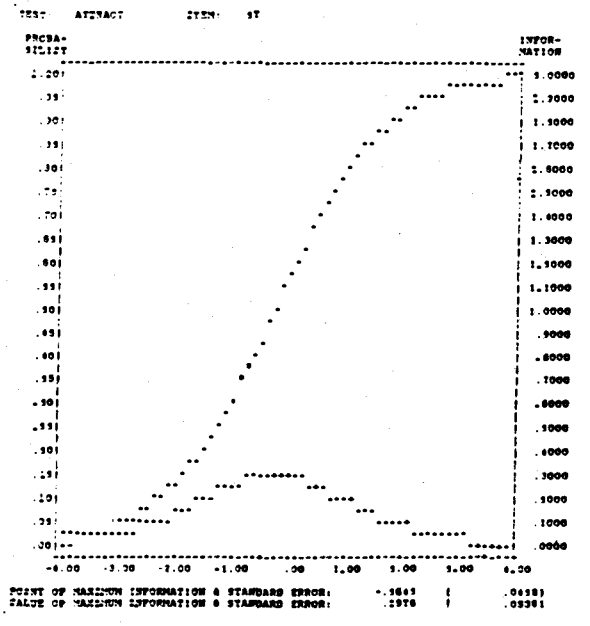
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.3834 (.0609)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1339 (.0166)

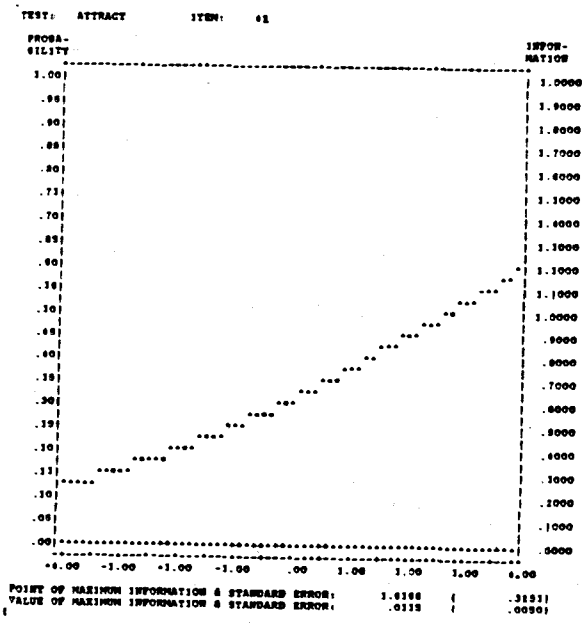

TEST: ATTRACT ITEM: 34
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.4681 (.0336)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1866 (.0186)

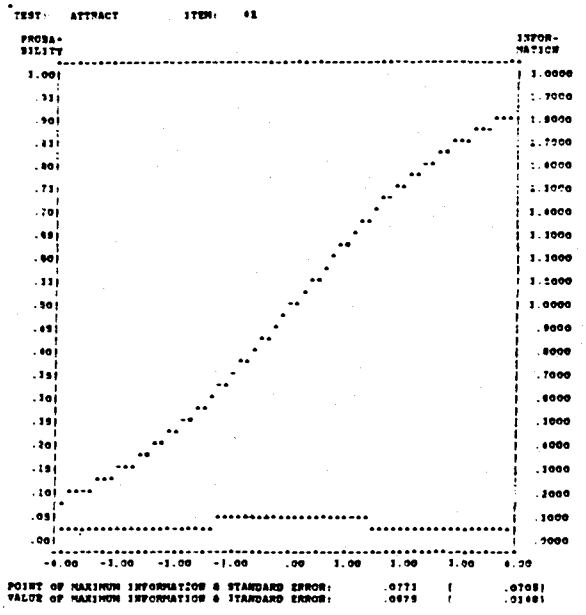

TEST: ATTRACT ITEM: 16
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.0456 (.1104)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0486 (.0076)

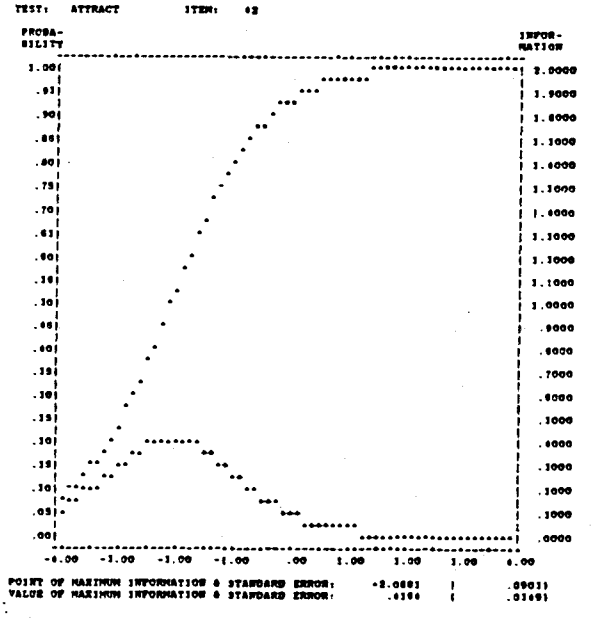

TEST: ATTRACT ITEM: 16
PROBA-BILITY
INFOR-MATION
1.20
1.15
1.10
1.05
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
2.9000
2.8000
2.7000
2.6000
2.5000
2.4000
2.3000
2.2000
2.1000
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0858 (.0750)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .5548 (.0369)

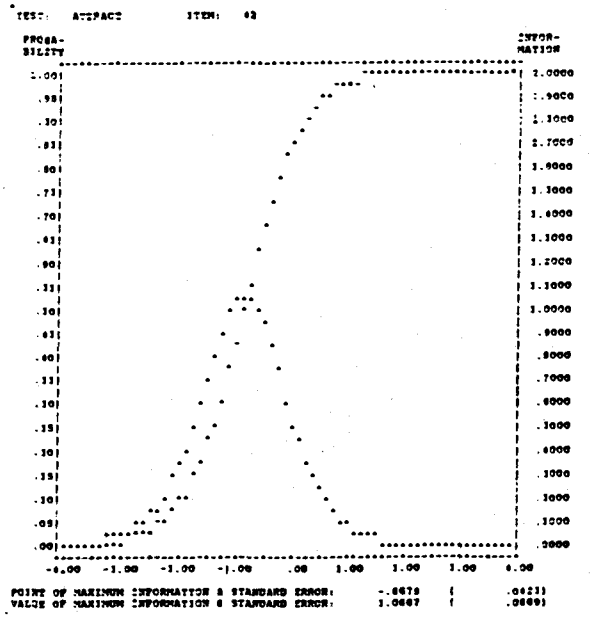

TEST: ATTRACT ITEM: 17
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.0455 (.1151)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0408 (.0069)

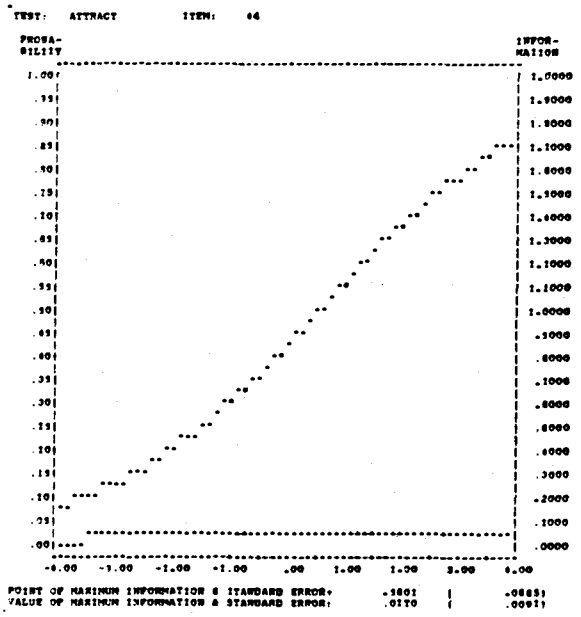

TEST: ATTRACT ITEM: 17
PROBA-BILITY
INFOR-MATION
1.20
1.15
1.10
1.05
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
2.9000
2.8000
2.7000
2.6000
2.5000
2.4000
2.3000
2.2000
2.1000
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1665 (.0638)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1976 (.0238)

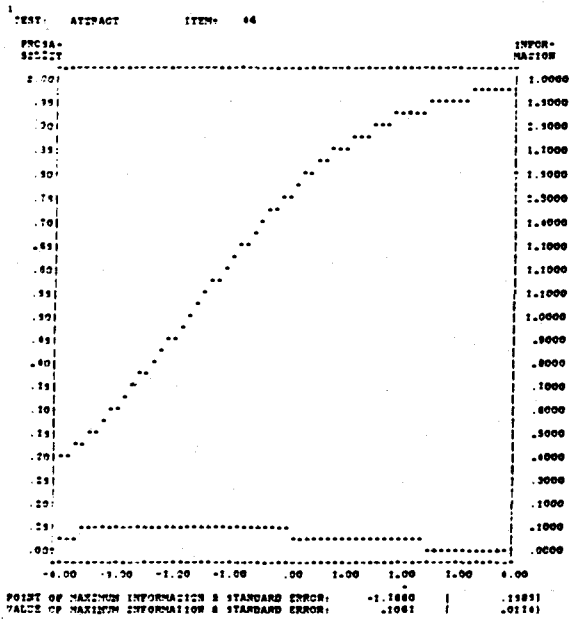

TEST: ATTRACT ITEM: 01
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.6166 (.3193)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6115 (.0650)

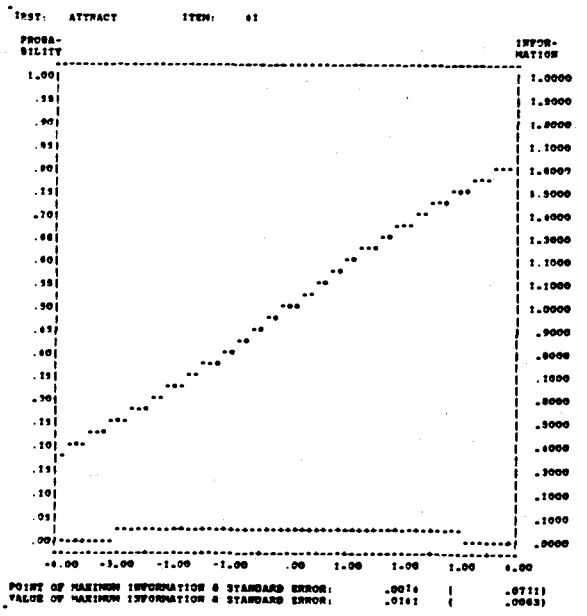

TEST: ATTRACT ITEM: 01
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .0771 (.0705)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0679 (.0148)

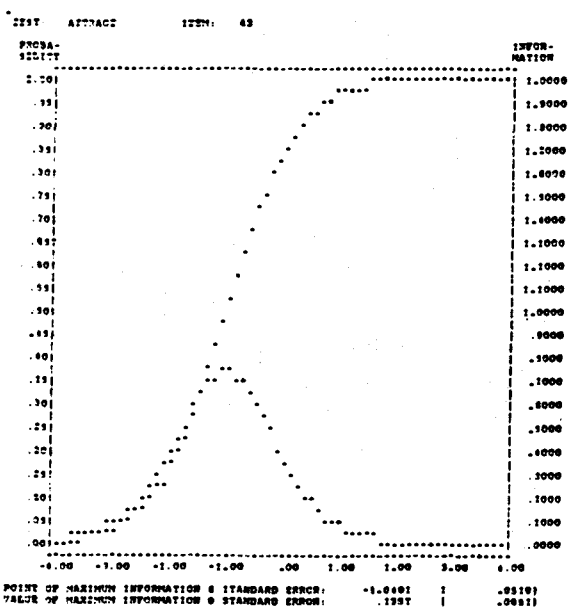

TEST: ATTRACT ITEM: 02
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +2.0681 (.0901)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6166 (.0169)

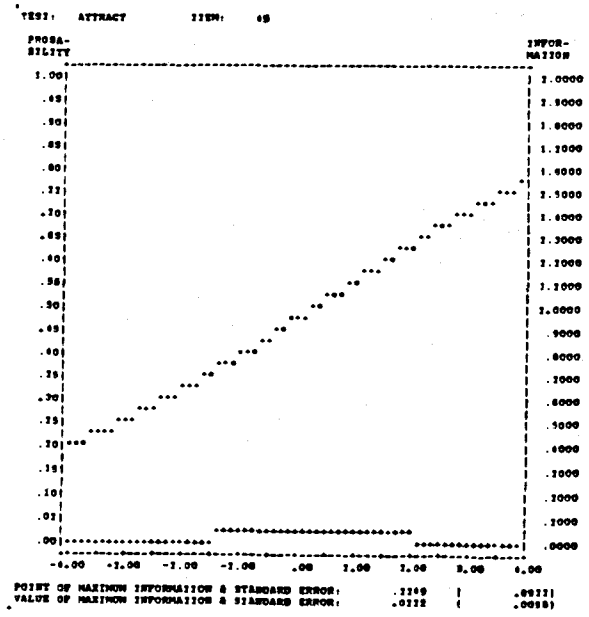

TEST: ATTRACT ITEM: 02
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6675 (.0623)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: 1.0667 (.0869)

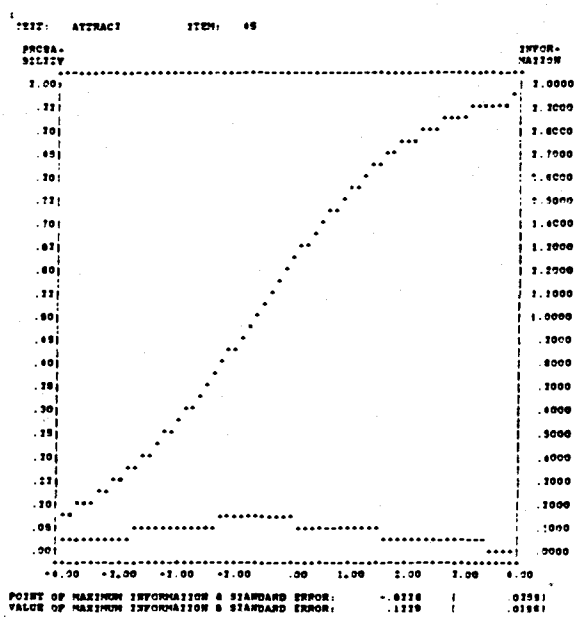

TEST: ATTRACT ITEM: 44
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.3801 | -.0885)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0170 | .0091)

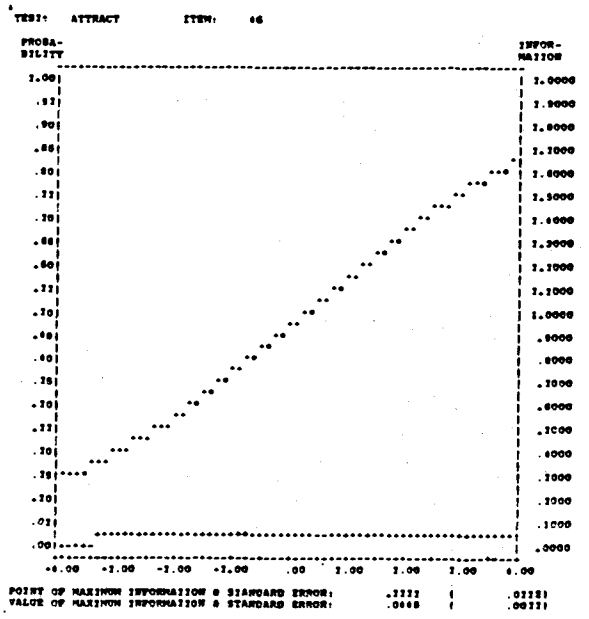

TEST: ATTRACT ITEM: 44
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1660 | .1585)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1061 | .0114)

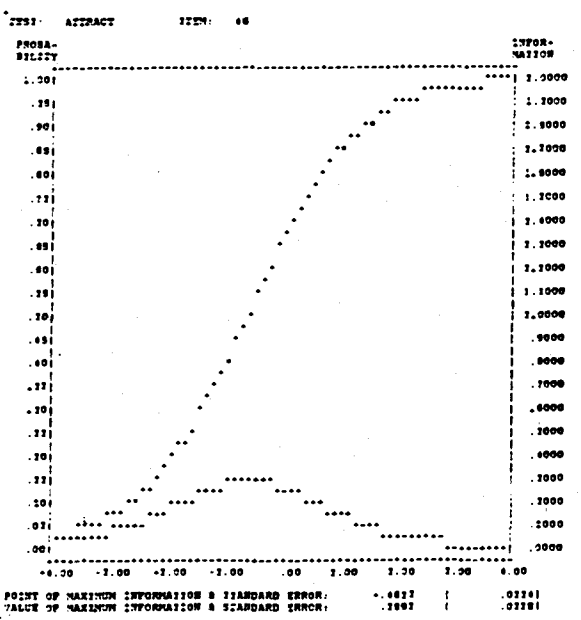

TEST: ATTRACT ITEM: 61
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .0014 | .0711)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0141 | .0063)

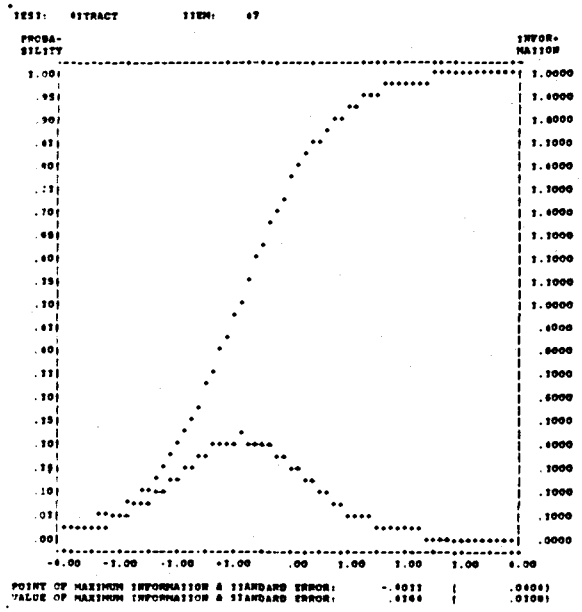

TEST ATTRACT ITEM: 63
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0401 | .0519)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1257 | .0081)

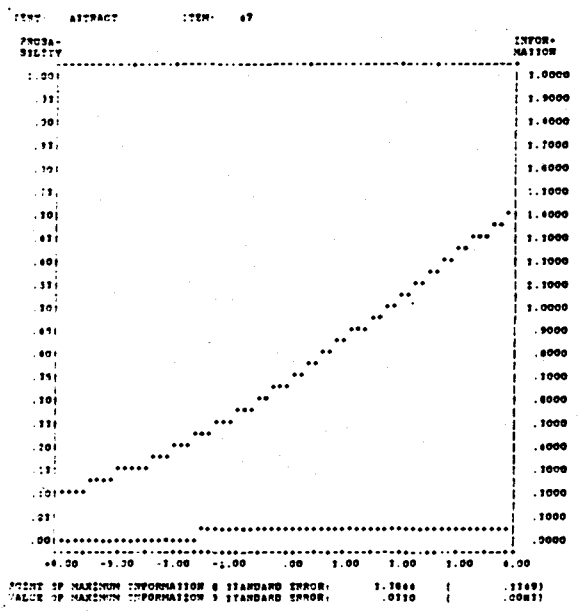

TEST: ATTRACT ITEM: 69
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .2249 | .0933|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0212 | .0098|

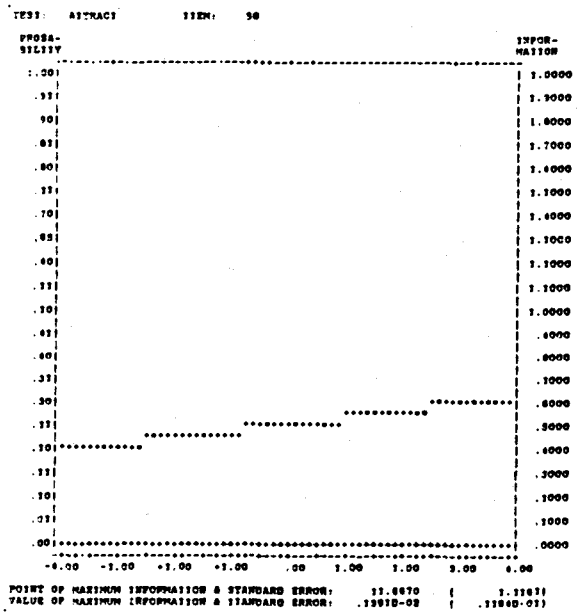

TEST: ATTRACT ITEM: 68
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0216 | .0358|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1219 | .0196|

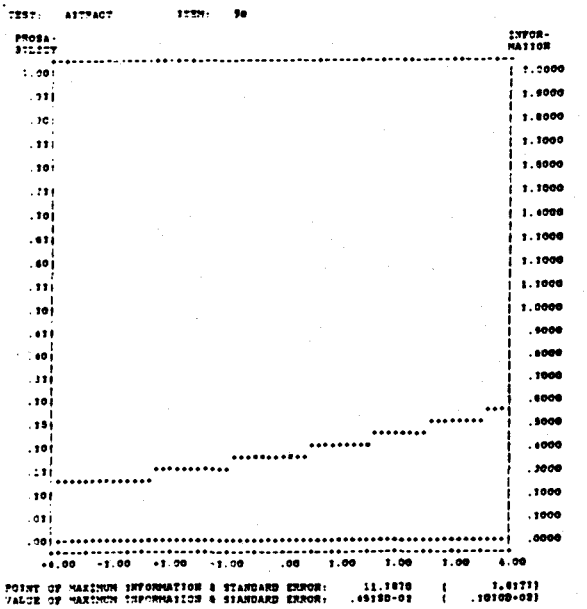

TEST: ATTRACT ITEM: 66
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .2222 | .0228|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0668 | .0033|

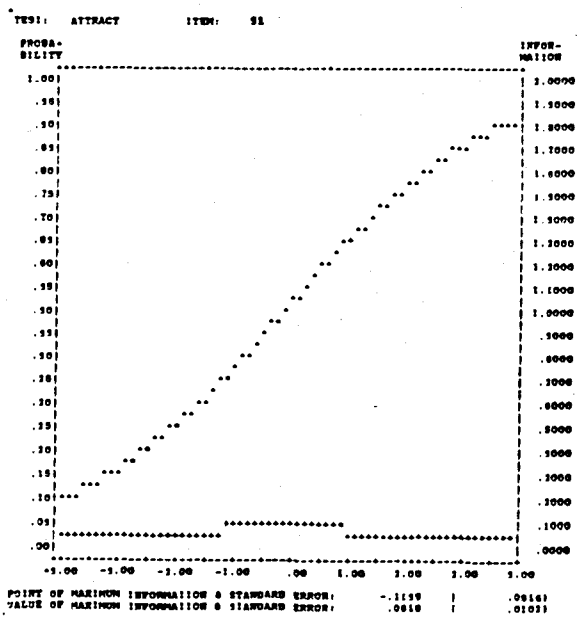

TEST: ATTRACT ITEM: 66
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.4617 | .0276|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .2692 | .0228|

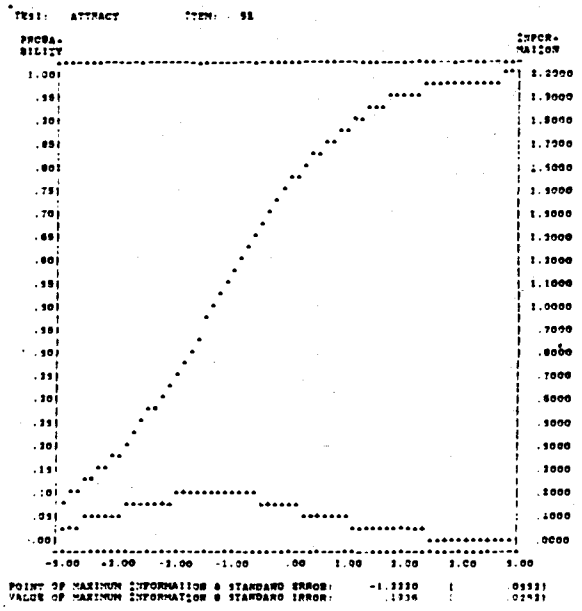

TEST: ATTRACT ITEM: 67
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
1.0000
1.4000
1.8000
1.3000
1.4000
1.3000
1.4000
1.1000
1.1000
1.1000
1.0000
.4000
.6000
.1000
.6000
.1000
.4000
.1000
.1000
.1000
.0000
-4.00 -3.00 -2.00 +1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.4033 (.0606)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6166 (.0108)

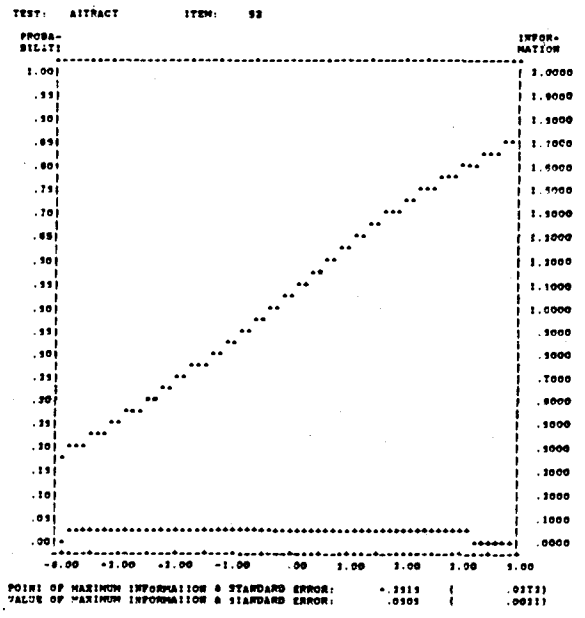

TEST: ATTRACT ITEM: 67
PROBA-BILITY
INFOR-MATION
1.9000
1.4000
1.7000
1.4000
1.1000
1.4000
1.1000
1.1000
1.1000
1.0000
.9000
.8000
.1000
.6000
.1000
.4000
.1000
.1000
.1000
.9000
+0.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.3866 (.1369)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0310 (.0083)

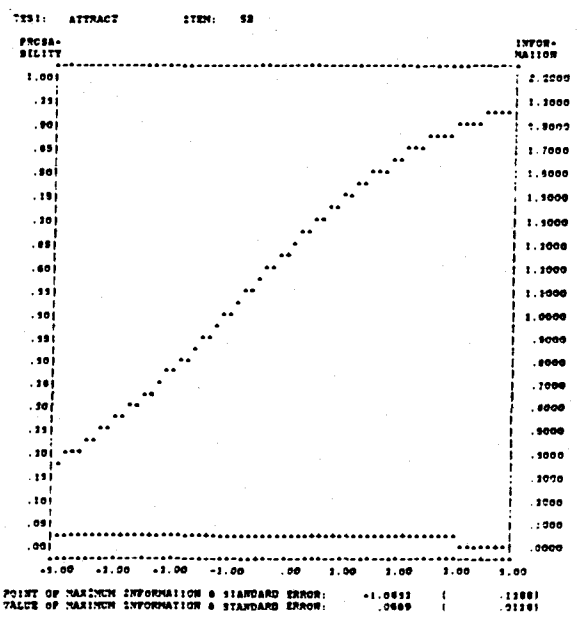

TEST: ATTRACT ITEM: 98
PROBA-BILITY
INFOR-MATION
1.9000
1.8000
1.7000
1.4000
1.1000
1.4000
1.1000
1.1000
1.1000
1.0000
.4000
.8000
.1000
.6000
.5000
.4000
.3000
.1000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 11.8670 (1.3163)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .13918-02 (.13868-01)


TEST: ATTRACT ITEM: 98
PROBA-BILITY
INFOR-MATION
1.9000
1.8000
1.7000
1.4000
1.1000
1.4000
1.1000
1.1000
1.1000
1.0000
.9000
.8000
.1000
.6000
.5000
.4000
.3000
.1000
.1000
.0000
+0.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 11.1870 (1.0177)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6918D-02 (.1010D-02)


TEST: ATTRACT ITEM: 91
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-3.00 -2.00 -1.00 .00 1.00 2.00 3.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1119 (.0816)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0810 (.0103)


TEST: ATTRACT ITEM: 91
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
2.2000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-3.00 -2.00 -1.00 .00 1.00 2.00 3.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.3330 (.0933)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1936 (.0293)


TEST: ATTRACT ITEM: 92
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-3.00 -2.00 -1.00 .00 1.00 2.00 3.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1515 (.0373)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0305 (.0031)


TEST: ATTRACT ITEM: 92
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
2.2000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
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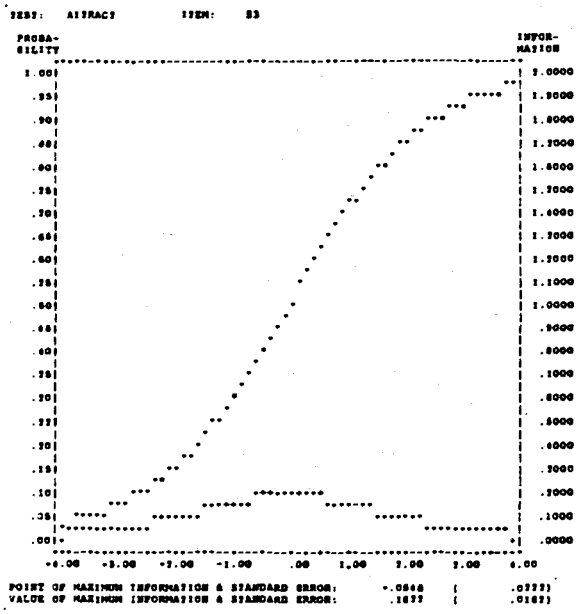
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-3.00 -2.00 -1.00 .00 1.00 2.00 3.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0611 (.1388)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0689 (.0118)


TEST: ATTRACT ITEM: 83
PROBA-BILITY
INFOR-MATION
1.00
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.90
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.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
2.9000
2.8000
2.7000
2.6000
2.5000
2.4000
2.3000
2.2000
2.1000
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
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.8000
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.6000
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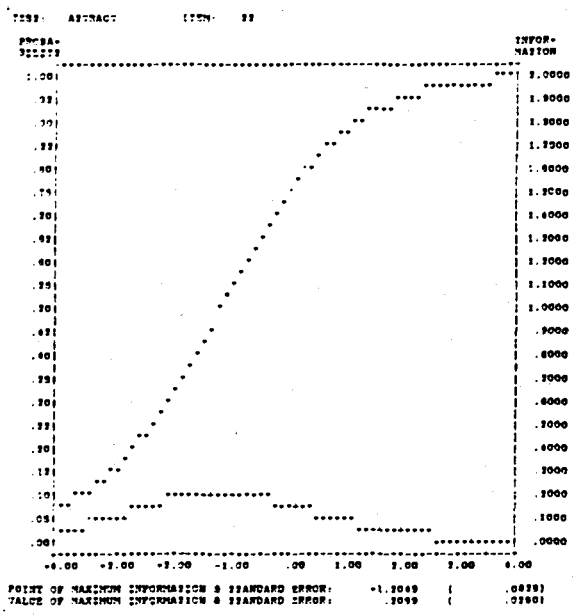
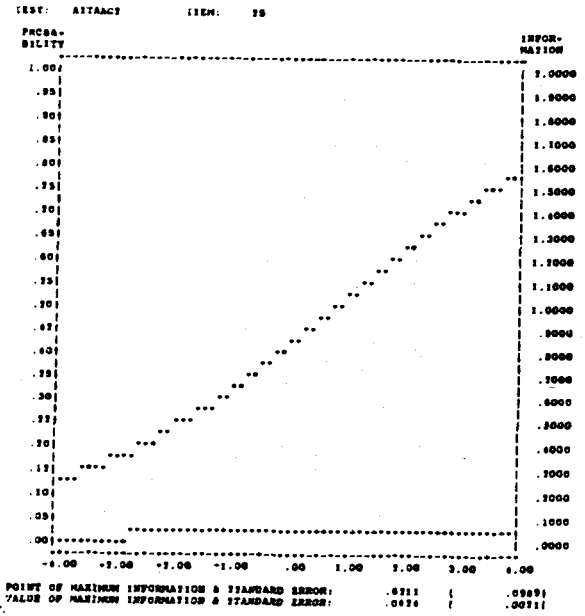
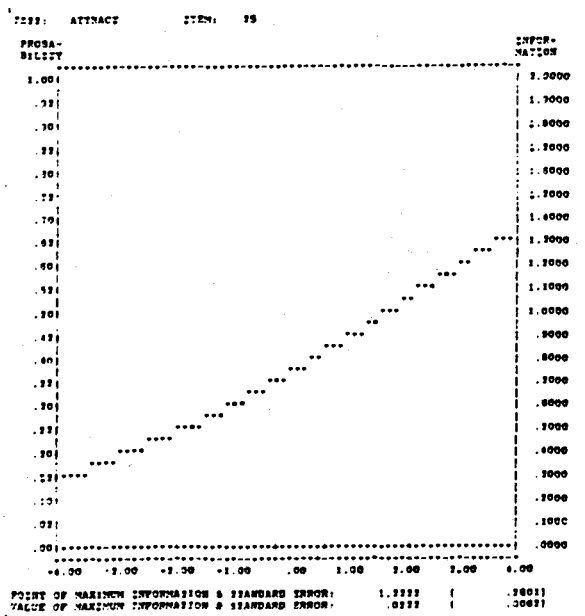
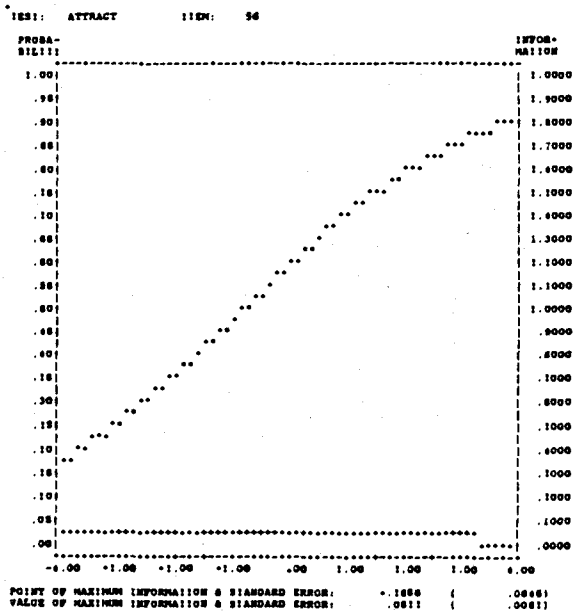
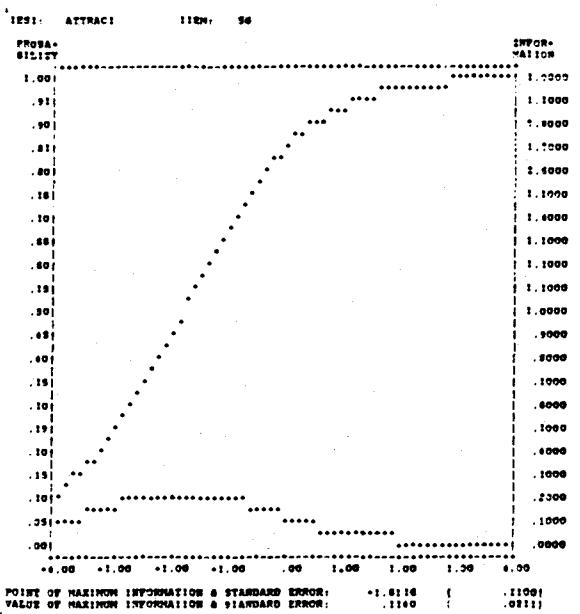
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0848 (.0777)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1877 (.0187)

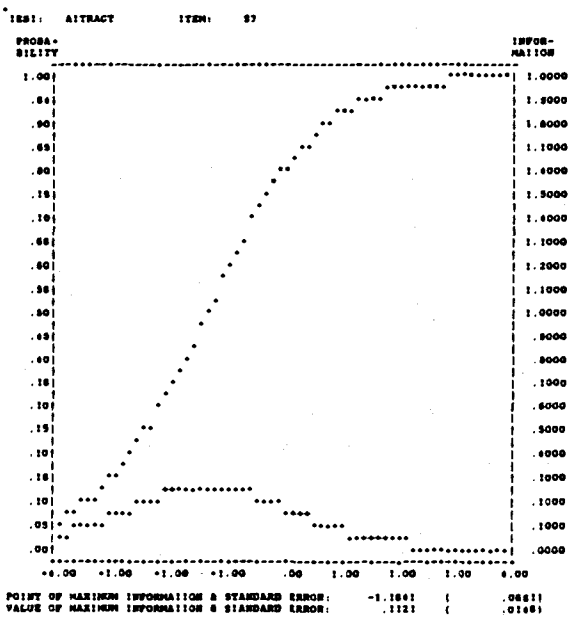

TEST: ATTRACT ITEM: 93
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
2.9000
2.8000
2.7000
2.6000
2.5000
2.4000
2.3000
2.2000
2.1000
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.3049 (.0839)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3049 (.0280)

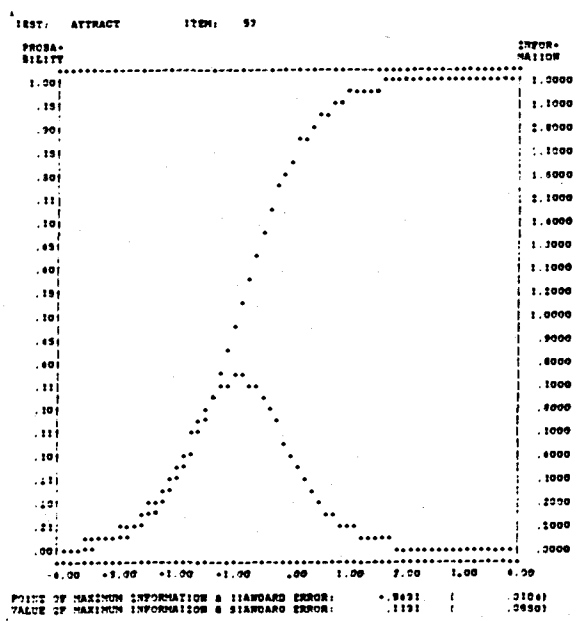

TEST: ATTRACT ITEM: 95
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
2.9000
2.8000
2.7000
2.6000
2.5000
2.4000
2.3000
2.2000
2.1000
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .0311 (.0989)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0836 (.0091)

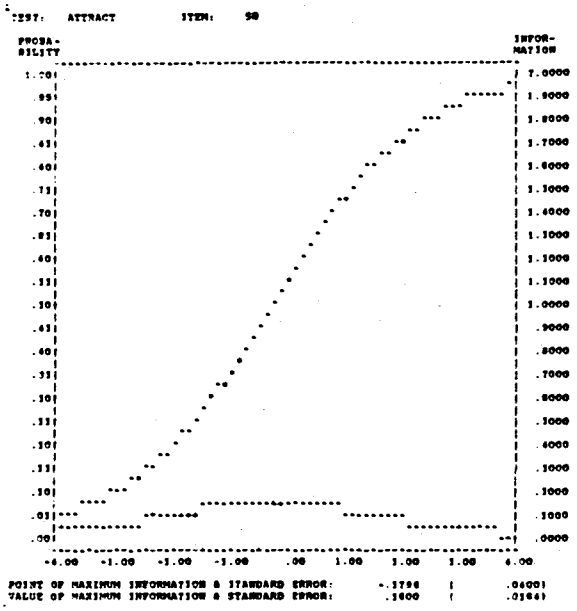

TEST: ATTRACT ITEM: 95
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
2.9000
2.8000
2.7000
2.6000
2.5000
2.4000
2.3000
2.2000
2.1000
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.3333 (.3601)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0333 (.3063)

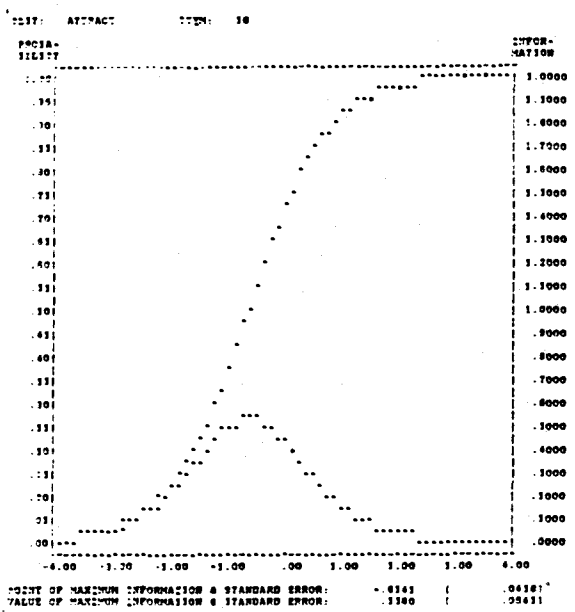

TEST: ATTRACT ITEM: 56
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1656 (.0646)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0611 (.0081)

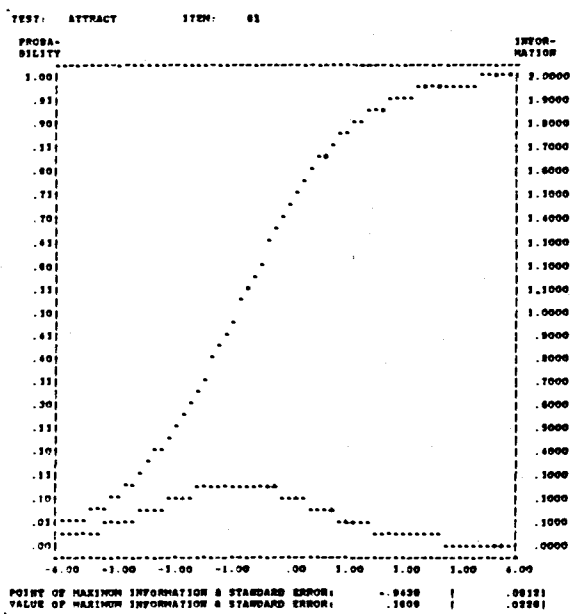

TEST: ATTRACT ITEM: 56
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.8116 (.1100)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1140 (.0311)

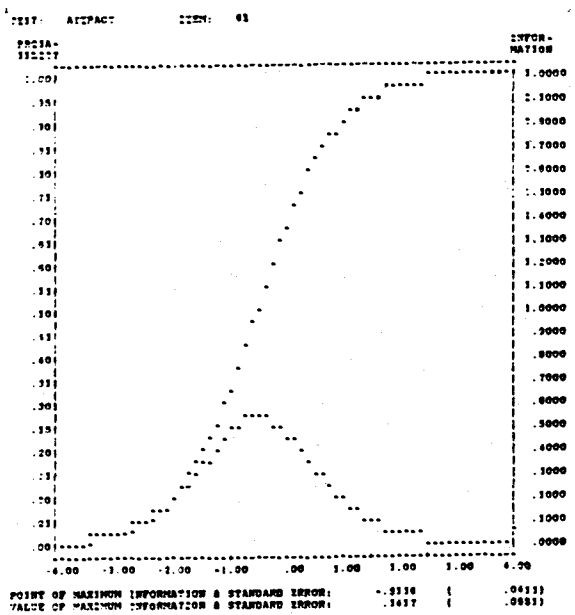

TEST: ATTRACT ITEM: 57
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1641 (.0611)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1121 (.0168)

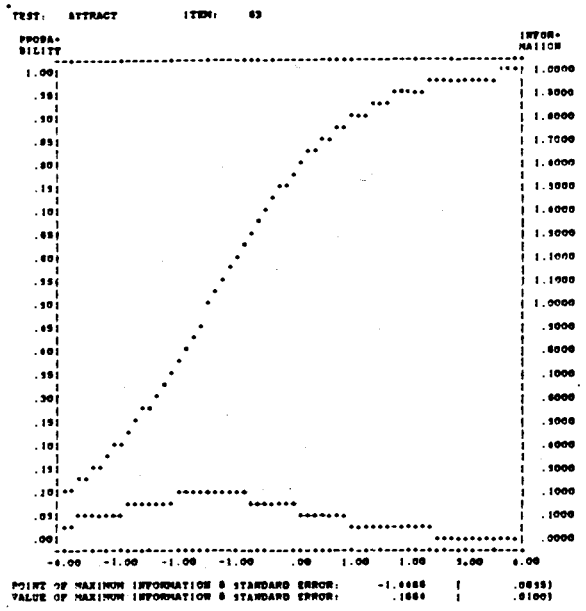

TEST: ATTRACT ITEM: 57
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +.9631 (.2104)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1131 (.0950)

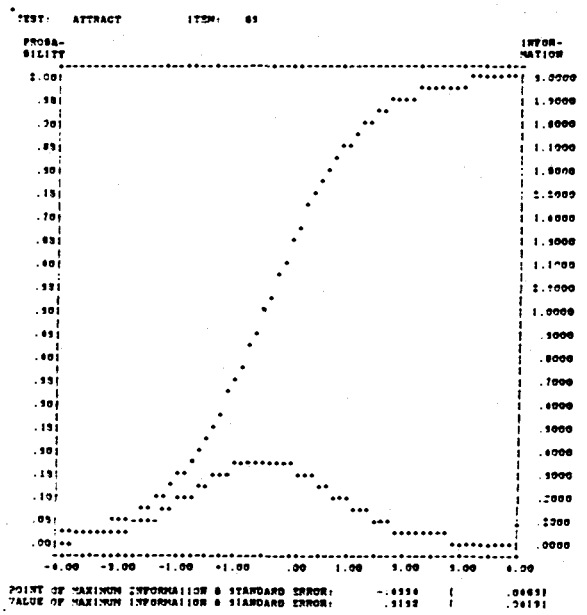

TEST: ATTRACT ITEM: 58
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1796 (.0400)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1600 (.0364)

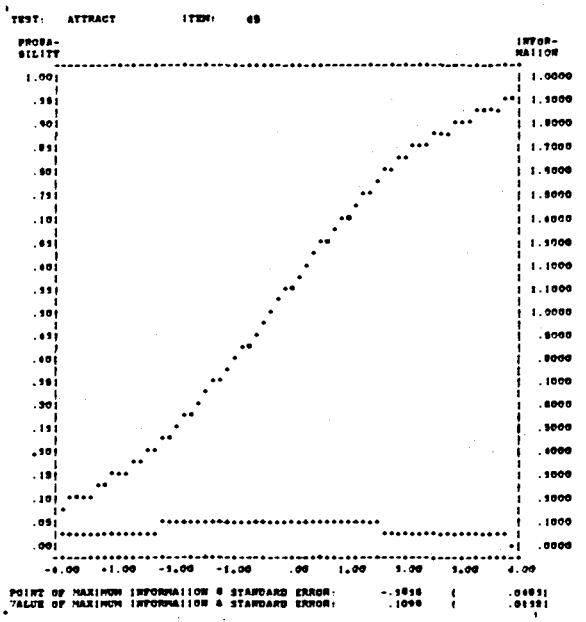

TEST: ATTRACT ITEM: 58
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0161 (.0416)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1360 (.0543)

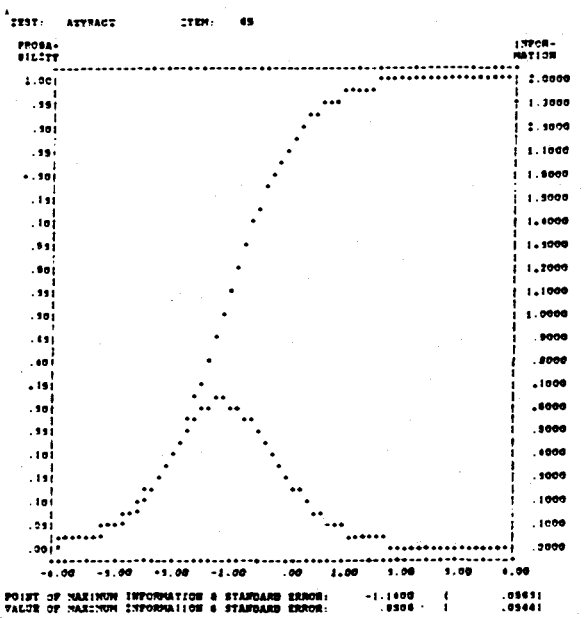

TEST: ATTRACT ITEM: 61
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.9430 (.0813)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1600 (.0226)

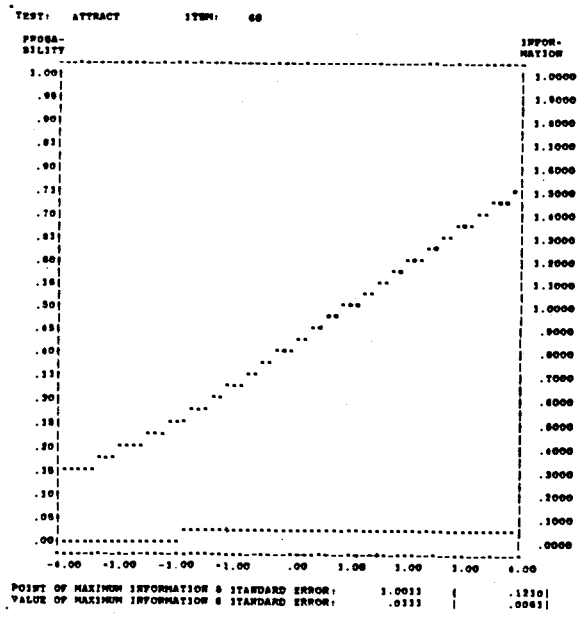

TEST: ATTRACT ITEM: 61
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0116 (.0411)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1617 (.0583)

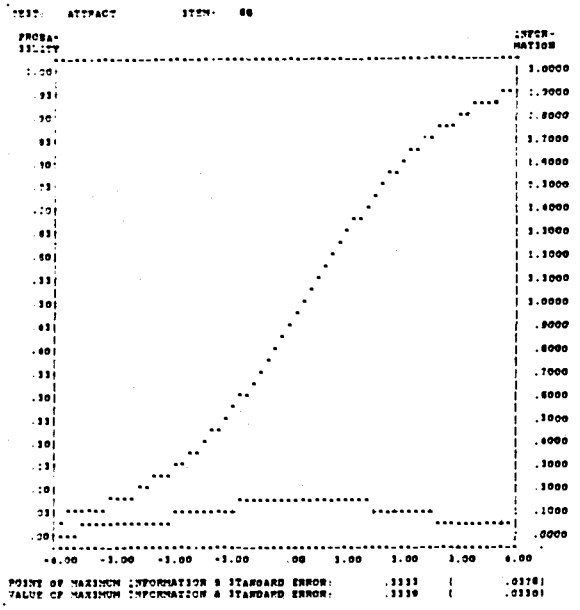

TEST: ATTRACT ITEM: 63
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.4486 (.0835)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1884 (.0100)

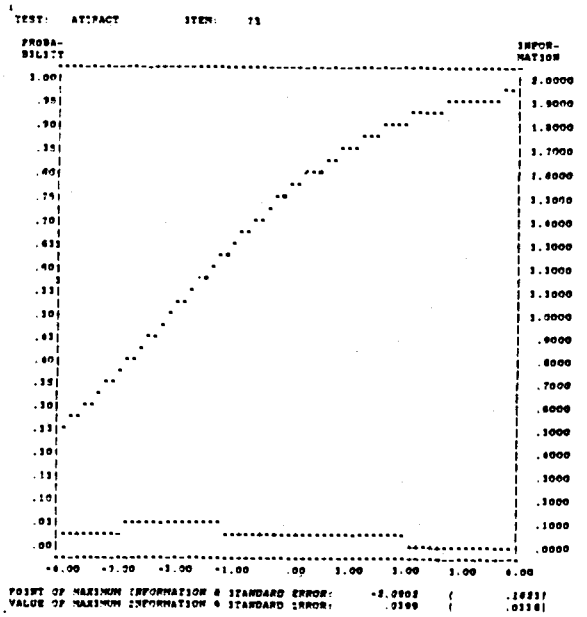

TEST: ATTRACT ITEM: 64
PROBA-BILITY
INFOR-MATION

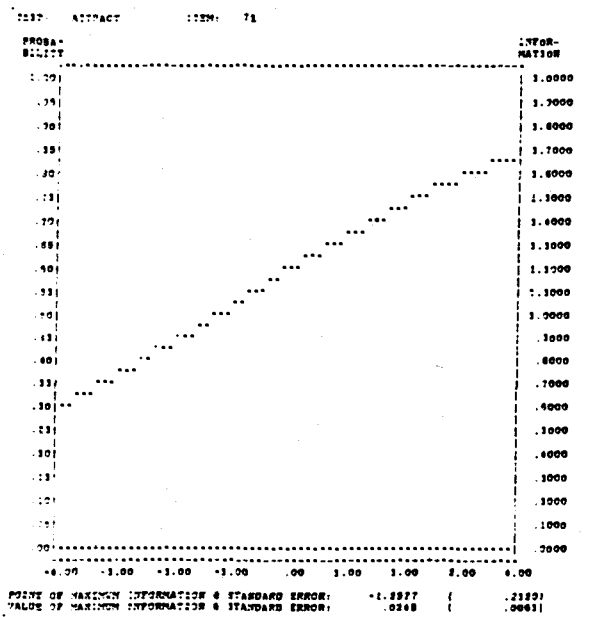

TEST: ATTRACT ITEM: 65
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.5816 (.0693)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1098 (.0132)

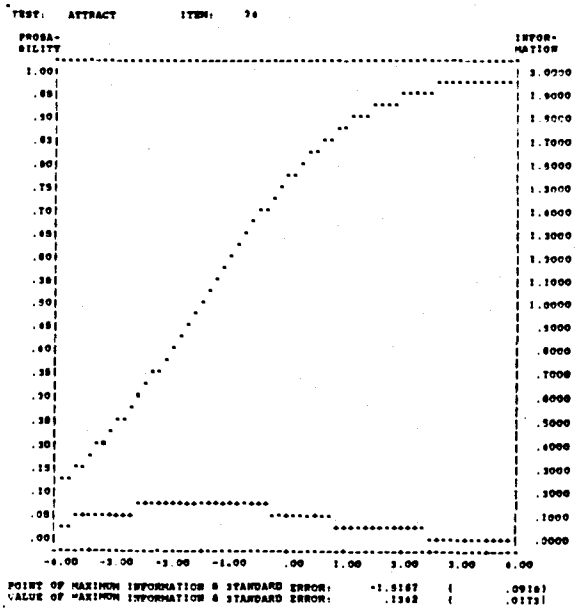

TEST: ATTRACT ITEM: 66
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1408 (.0865)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .8306 (.0944)

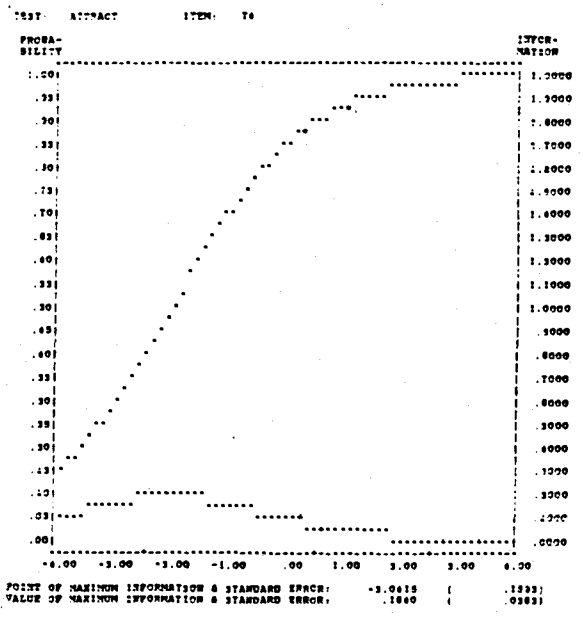

TEST: ATTRACT ITEM: 68
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.0011 (.1210)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0333 (.0063)


TEST: ATTRACT ITEM: 68
PROBABILITY
INFORMATION


TEST: ATTRACT ITEM: 71
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -8.0002 (.1633)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0100 (.0116)


TEST: ATTRACT ITEM: 71
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.8977 (.2139)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0268 (.0063)


TEST: ATTRACT ITEM: T6
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00 5.00 6.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.5167 (.0916)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1362 (.0173)


TEST: ATTRACT ITEM: T6
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
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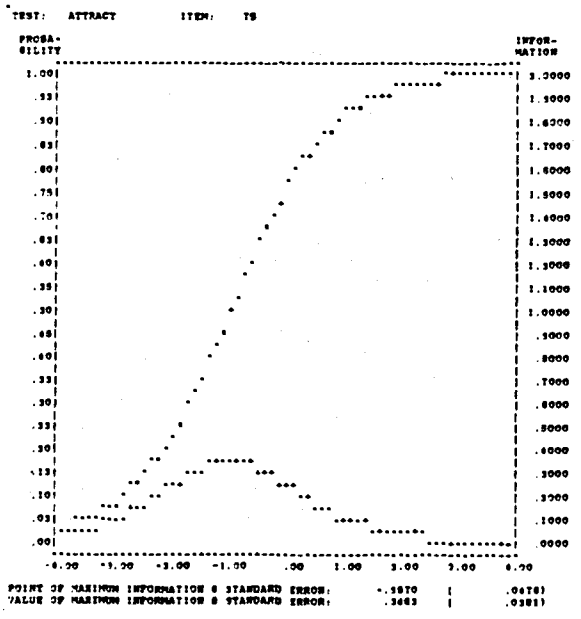
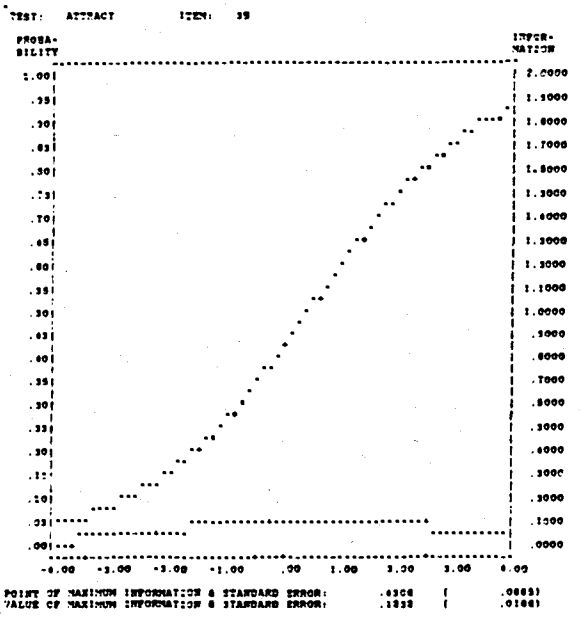
.00
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00 5.00 6.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -3.0615 (.1333)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1060 (.0383)


TEST: ATTRACT ITEM: T8
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
3.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
1.1000
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00 5.00 6.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.5870 (.0678)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3663 (.0381)


TEST: ATTRACT ITEM: T9
PROBA-BILITY
INFOR-MATION
1.00
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
.00
2.0000
1.9000
1.8000
1.7000
1.6000
1.5000
1.4000
1.3000
1.2000
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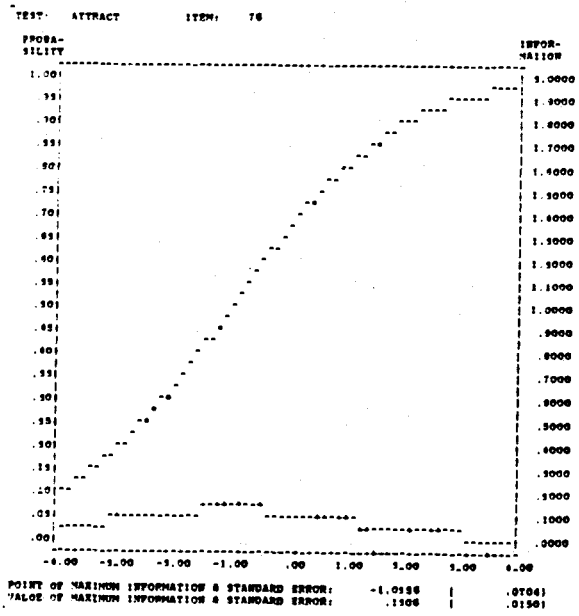
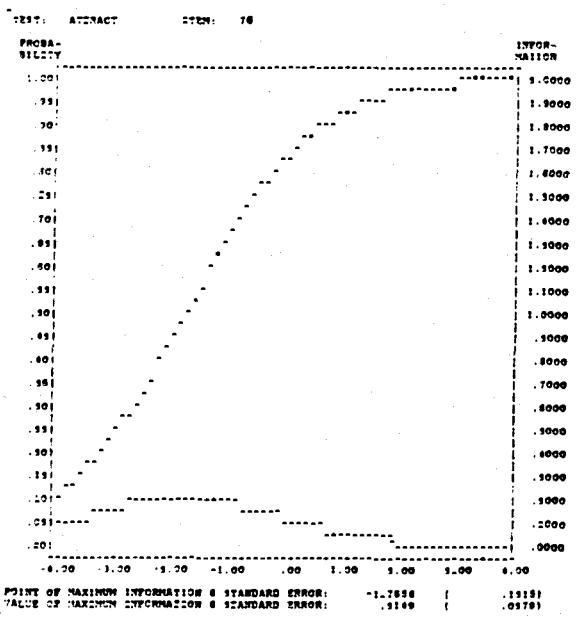
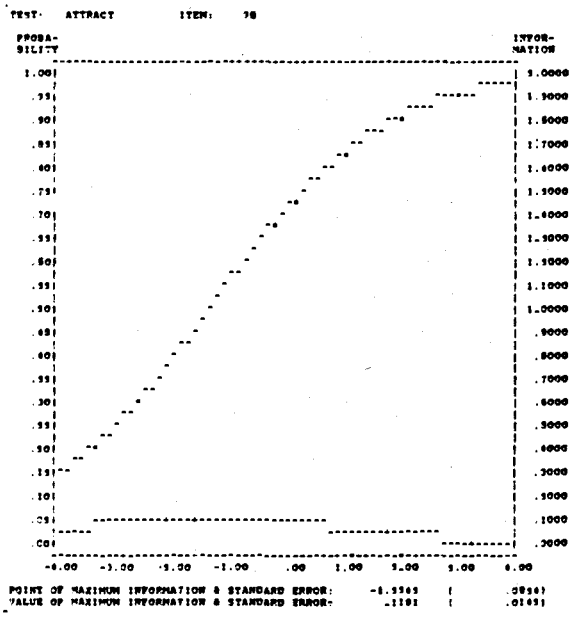
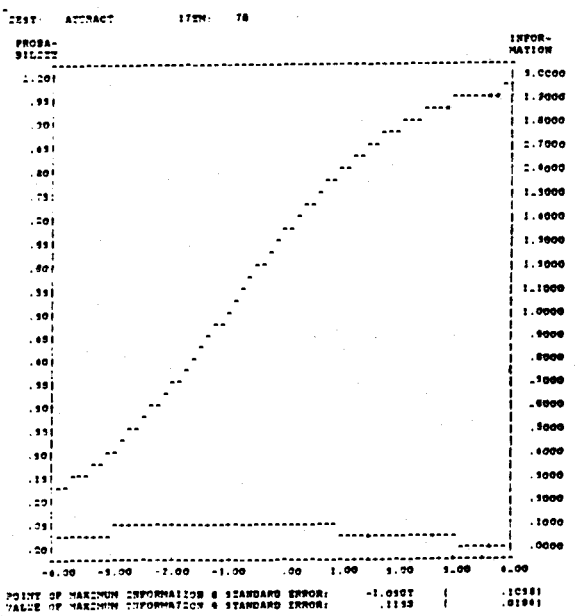
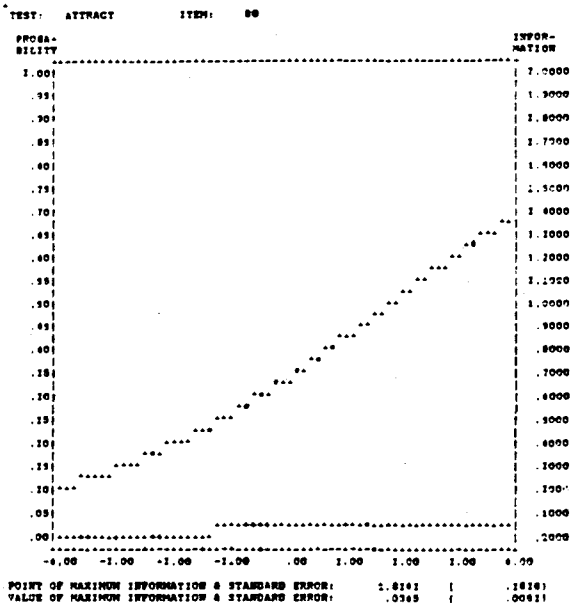
1.0000
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00 5.00 6.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .6306 (.0883)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1838 (.0186)

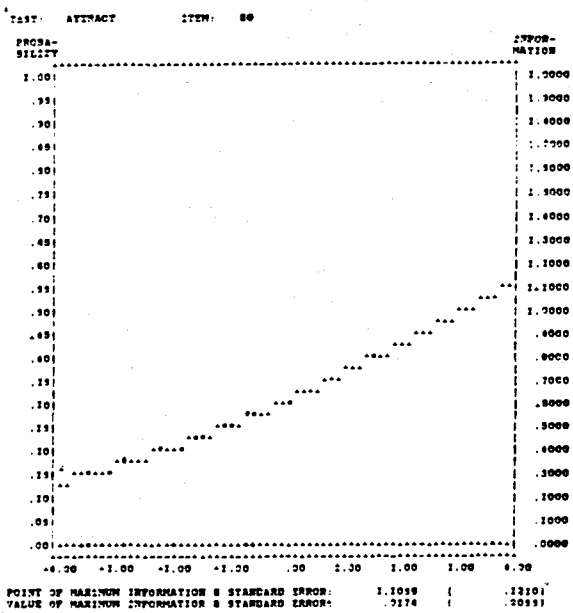

TEST: ATTRACT ITEM: 76
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0156 (.0706)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1506 (.0150)

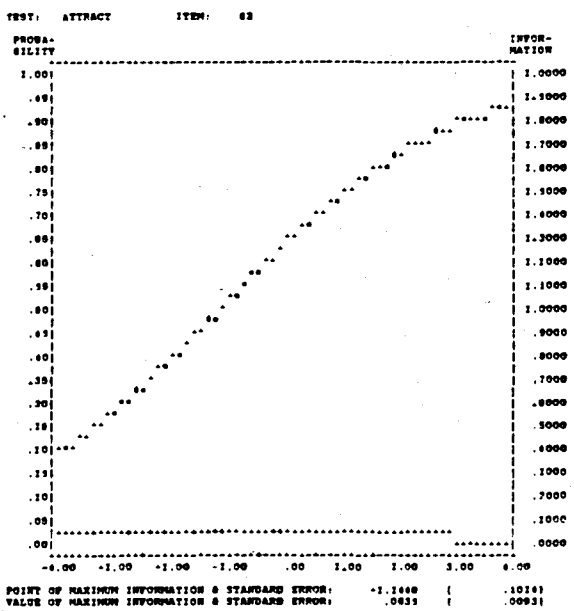

TEST: ATTRACT ITEM: 76
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.7856 (.1918)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .9169 (.0979)

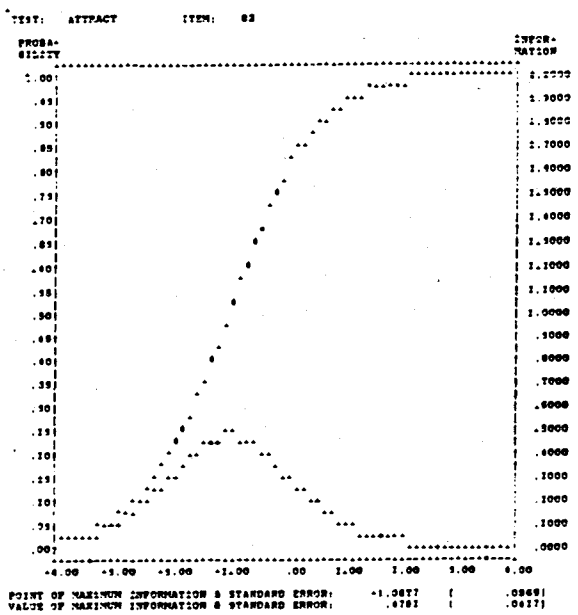

TEST: ATTRACT ITEM: 78
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.5565 (.0946)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1191 (.0149)

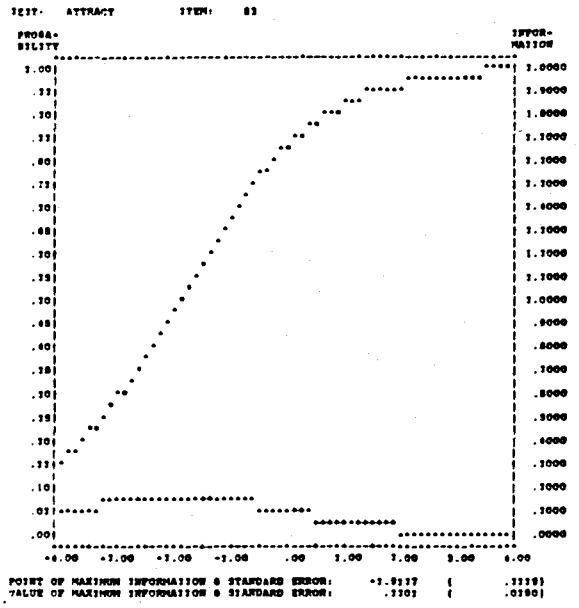

TEST: ATTRACT ITEM: 78
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0407 (.1058)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1193 (.0186)

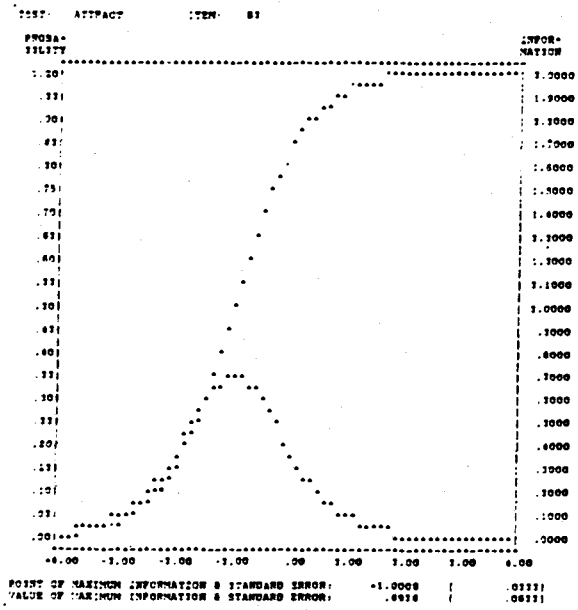

TEST: ATTRACT ITEM: 80
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.8141 (.1816)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0365 (.0061)

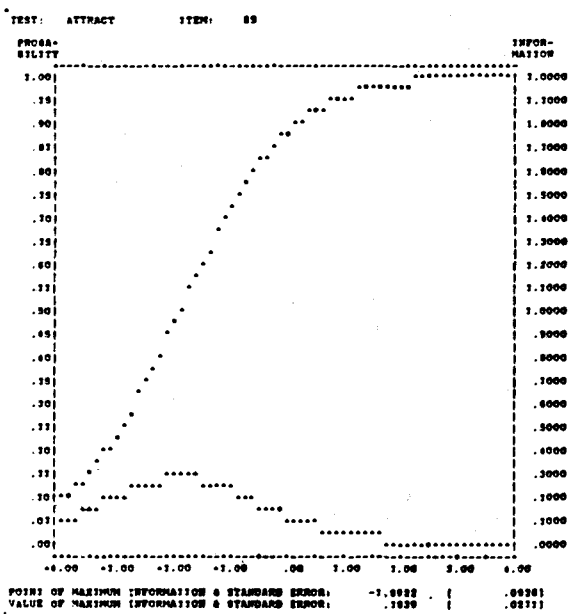

TEST: ATTRACT ITEM: 80
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.1059 (.1210)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .7174 (.2051)

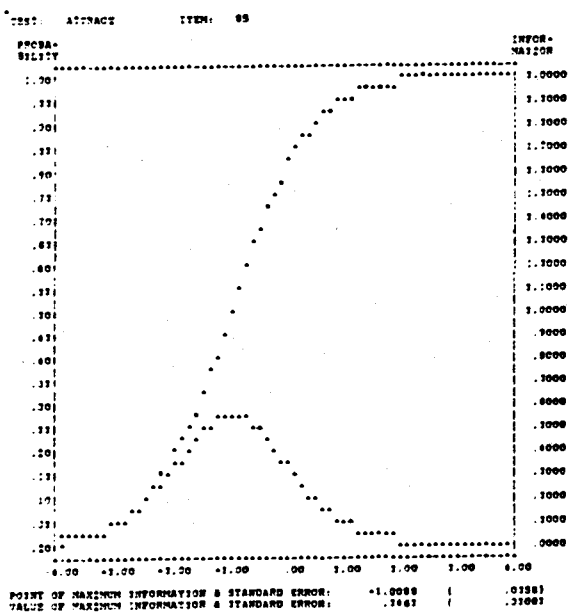

TEST: ATTRACT ITEM: 82
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1460 (.1016)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0635 (.0093)

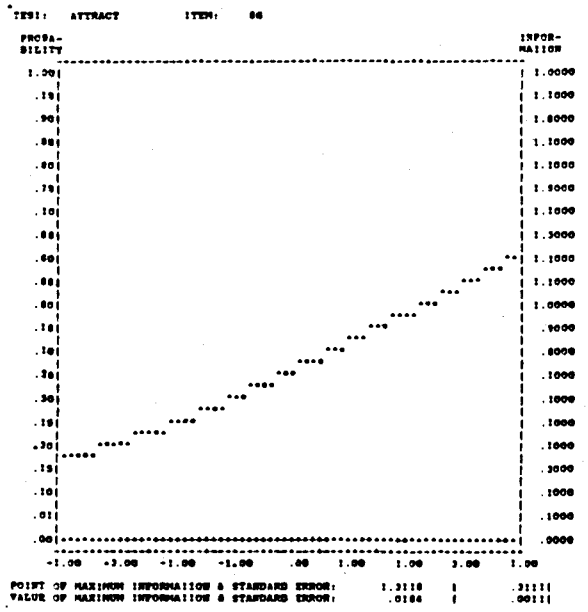

TEST: ATTRACT ITEM: 82
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0677 (.0869)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .6781 (.0617)

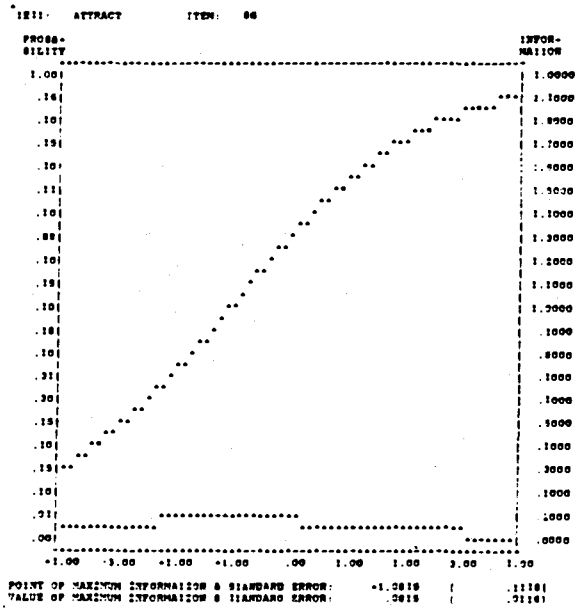

TEST: ATTRACT ITEM: 83
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.9117 (.3119)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3301 (.0190)

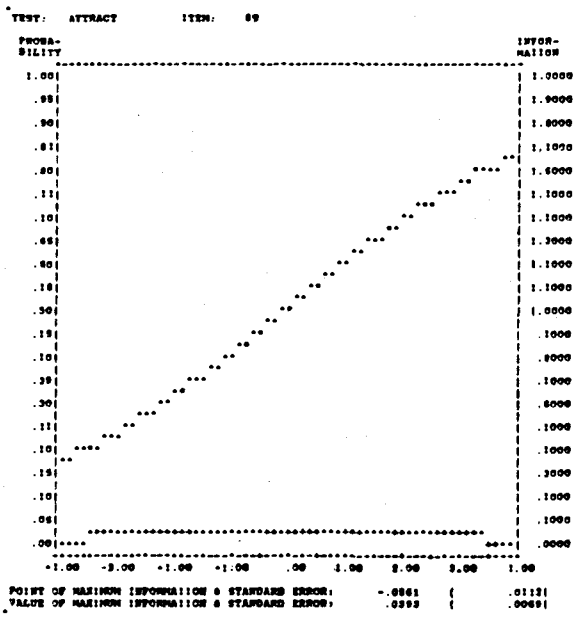

TEST: ATTRACT ITEM: 81
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.0000 (.0333)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .9916 (.0633)

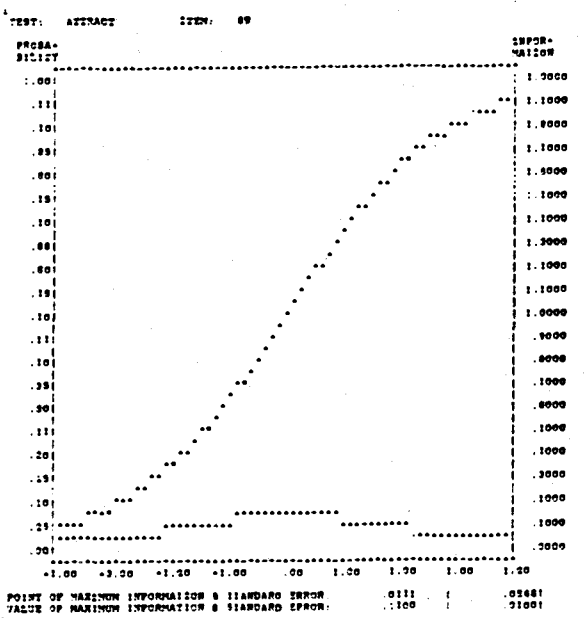

TEST: ATTRACT ITEM: 89
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.9922 (.0926)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3839 (.0233)

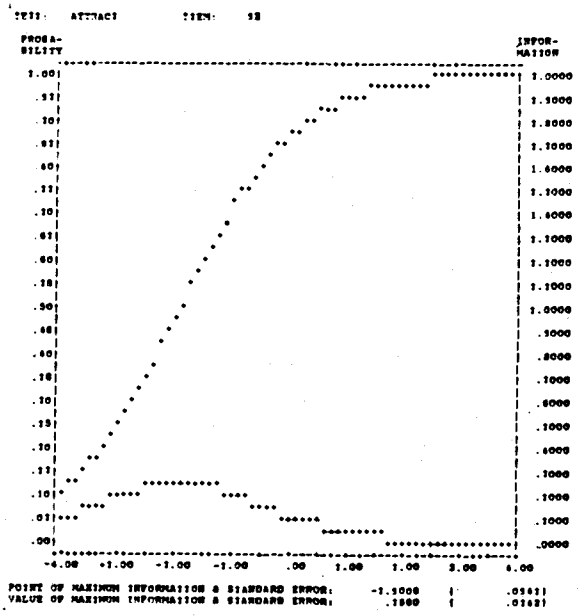

TEST: ATTRACT ITEM: 85
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.0000 (.0358)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3661 (.0358)


TEST: ATTRACT ITEM: 86
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.3118 .3111
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0184 .0011


TEST: ATTRACT ITEM: 86
PROBA-BILITY
INFOR-MATION


TEST: ATTRACT ITEM: 89
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0861 .0113
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0393 .0069


TEST: ATTRACT ITEM: 89
PROBA-BILITY
INFOR-MATION


TEST: ATTRACT ITEM: 93
PROBA-BILITY
INFOR-MATION
1.00
.95
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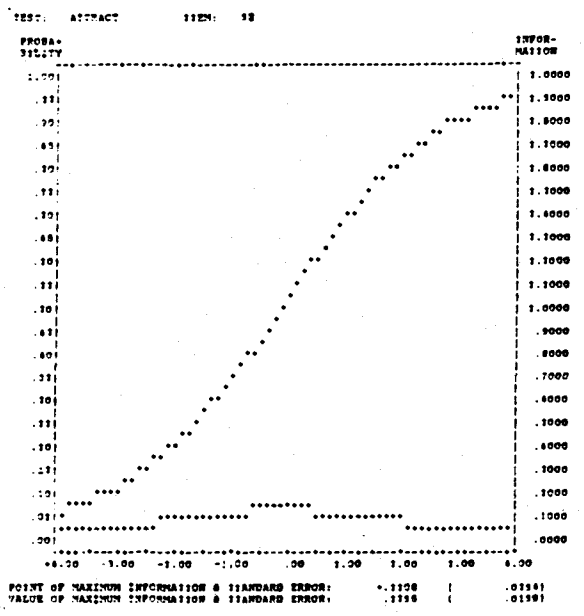
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1006 (.0161)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1580 (.0162)


TEST: ATTRACT ITEM: 93
PROBA-BILITY
INFOR-MATION
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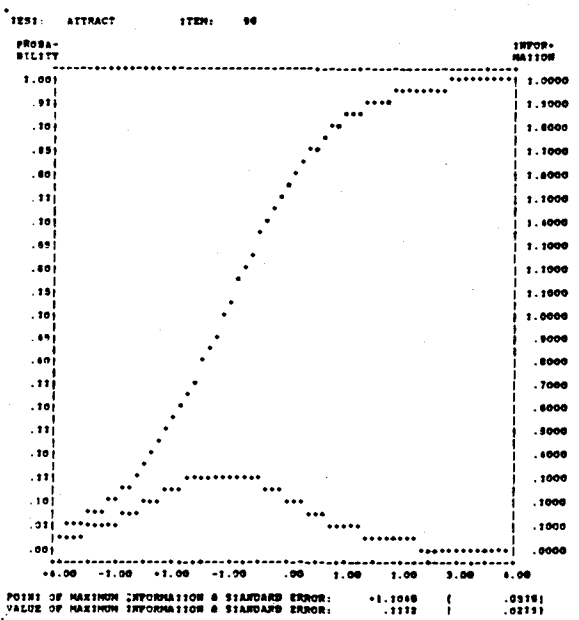
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1126 (.0154)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1336 (.0159)


TEST: ATTRACT ITEM: 96
PROBA-BILITY
INFOR-MATION
1.00
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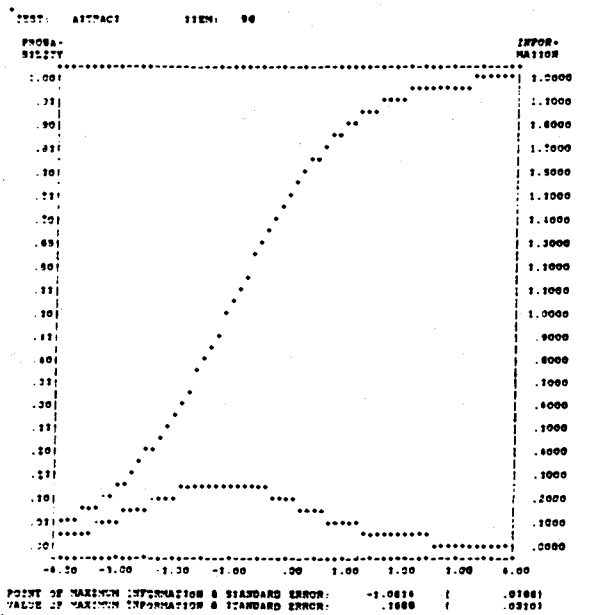
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.1048 (.0315)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1332 (.0235)


TEST: ATTRACT ITEM: 96
PROBA-BILITY
INFOR-MATION
1.00
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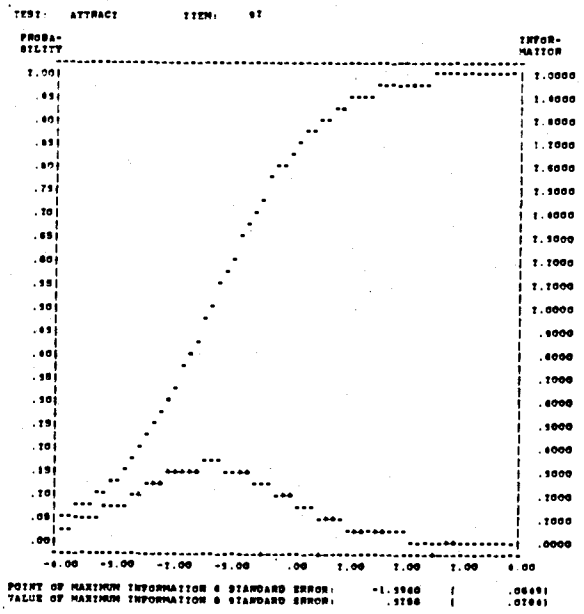
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0614 (.0168)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1668 (.0310)


TEST: ATTRACT ITEM: 87
PROBA-BILITY
INFOR-MATION
1.00
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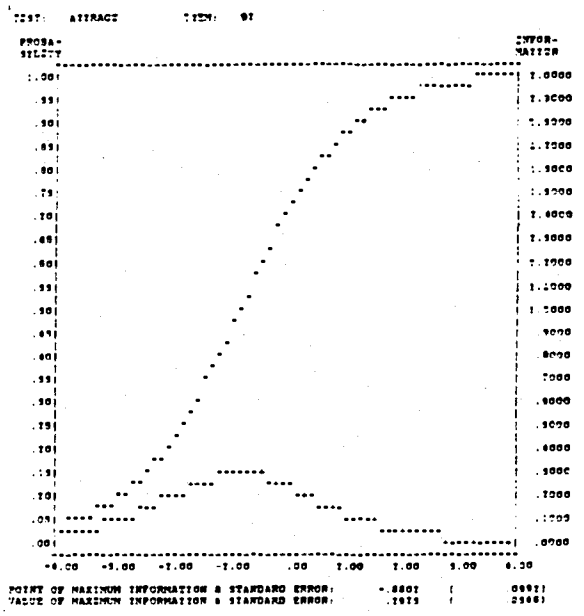
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.5940 (.0649)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .5788 (.0706)


TEST: ATTRACT ITEM: 87
PROBA-BILITY
INFOR-MATION
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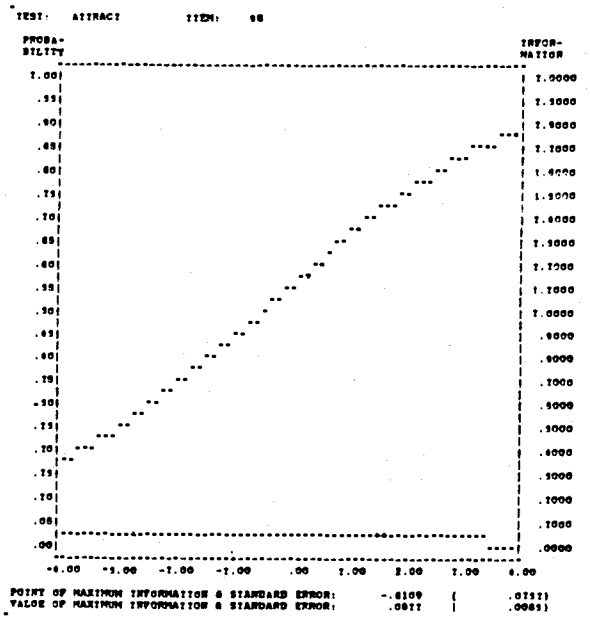
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.8801 (.0691)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1815 (.0706)


TEST: ATTRACT ITEM: 88
PROBA-BILITY
INFOR-MATION
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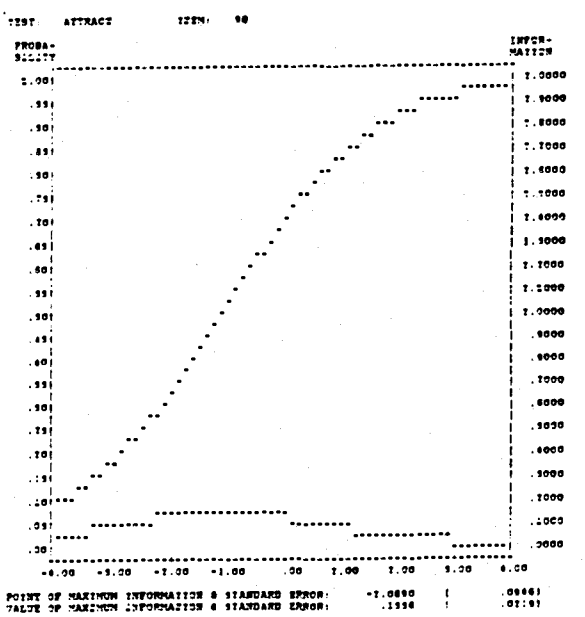
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6109 (.0737)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0811 (.0665)


TEST: ATTRACT ITEM: 88
PROBA-BILITY
INFOR-MATION
1.00
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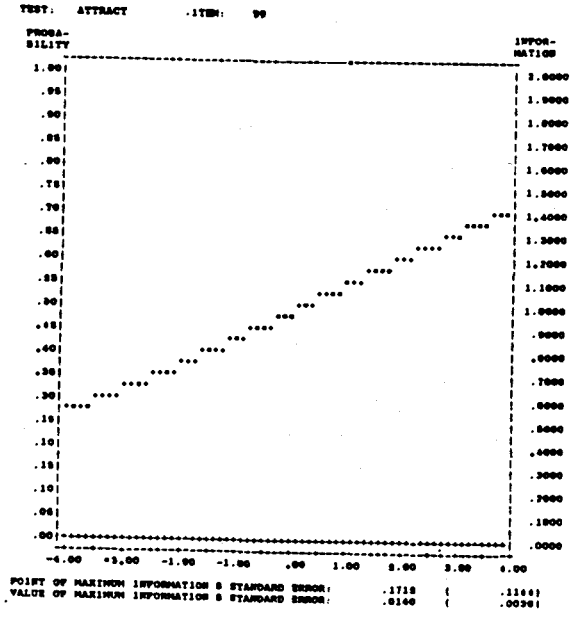
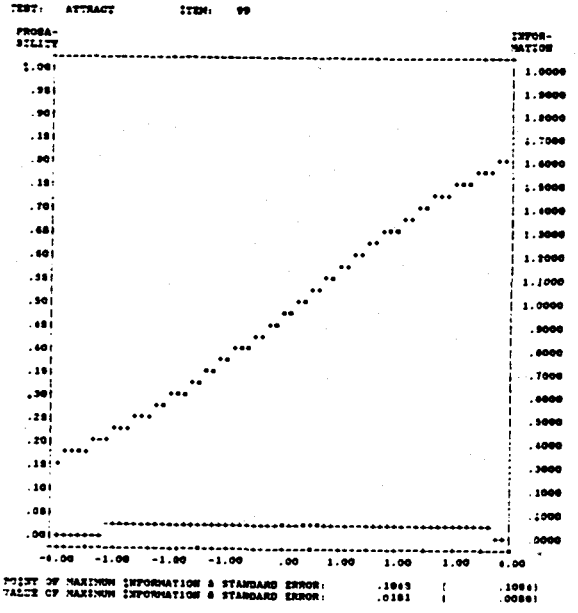
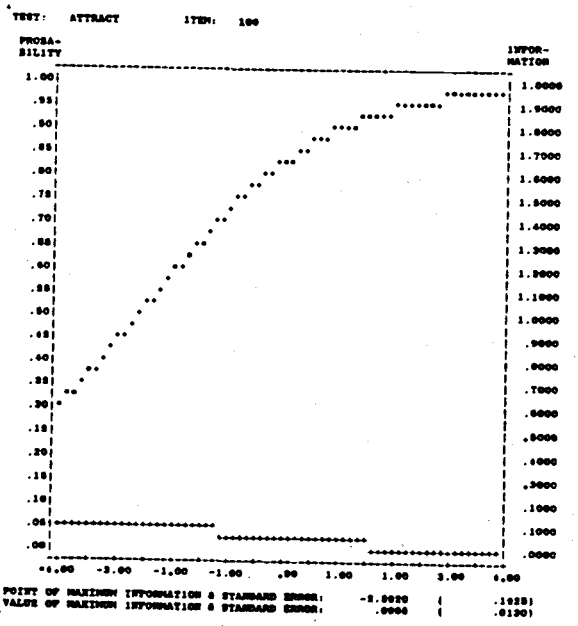
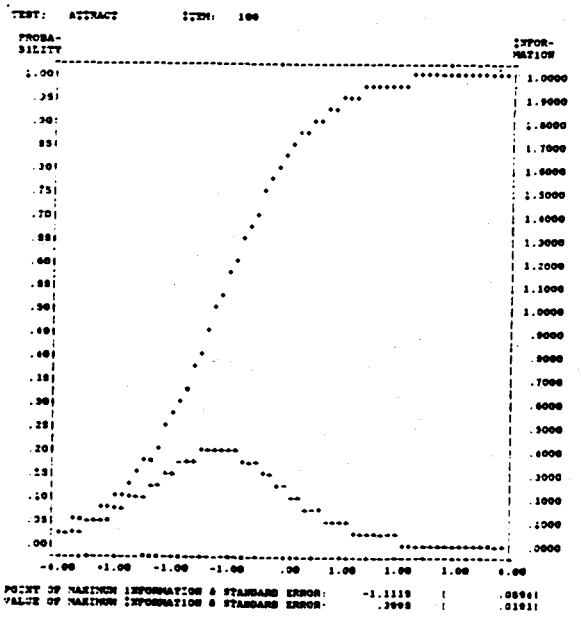
-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0890 (.0646)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1556 (.0719)


TEST: ATTRACT ITEM: 99
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .1718 (.1164)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .8140 (.0036)


TEST: ATTRACT ITEM: 99
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .1863 (.1086)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .8181 (.0088)

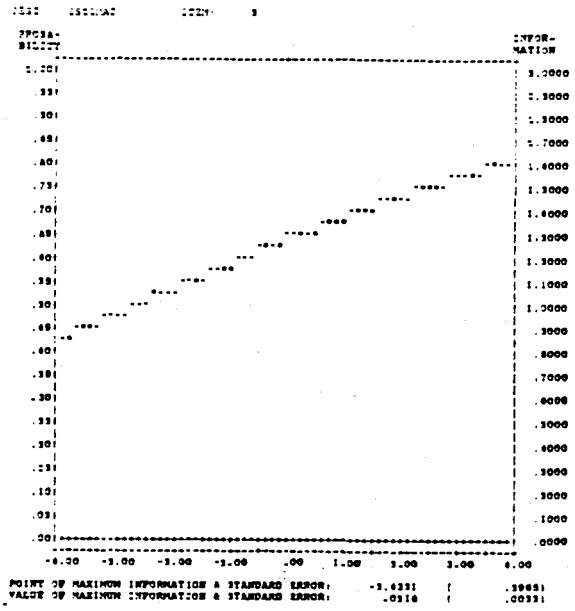

TEST: ATTRACT ITEM: 100
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -3.0030 (.1028)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0000 (.0130)

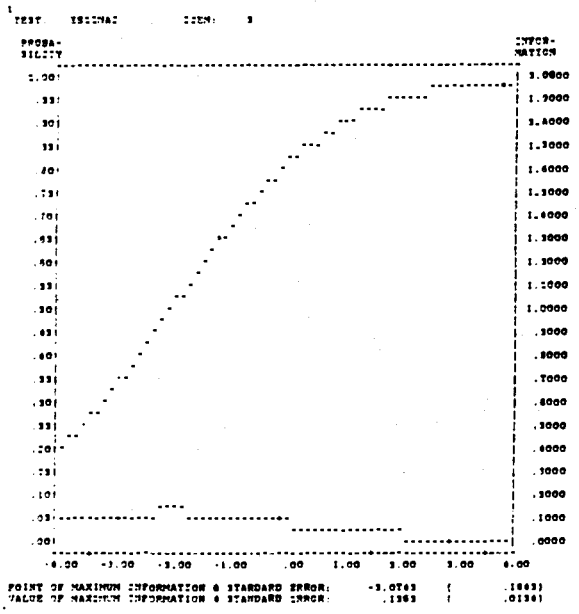

TEST: ATTRACT ITEM: 100
PROBABILITY
INFORMATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1119 (.0894)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3998 (.0101)

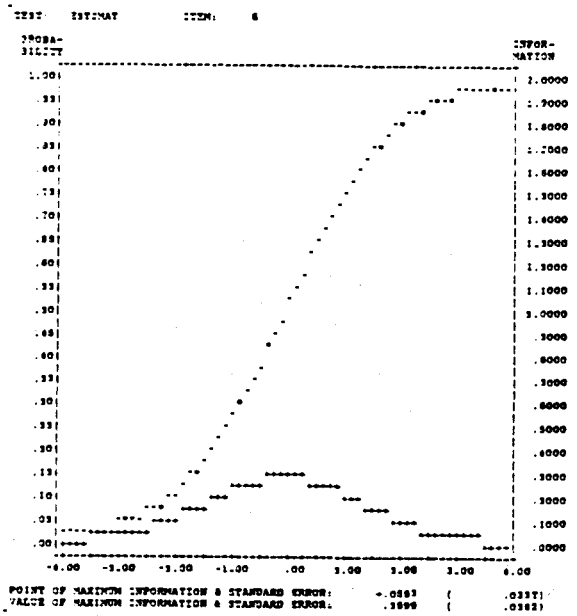
PEAS Thai version

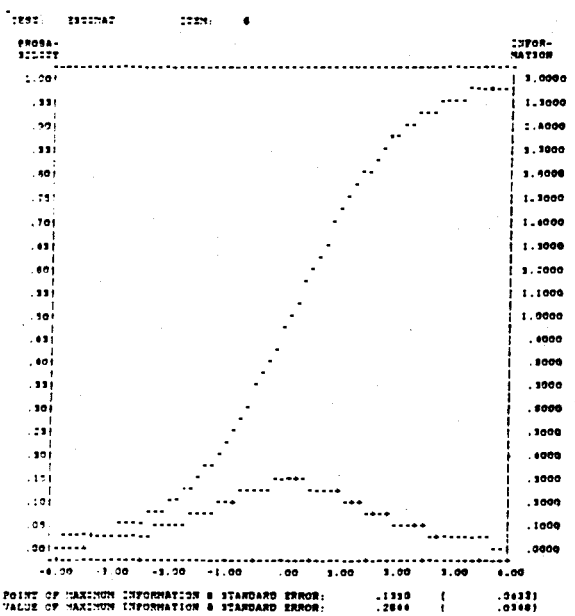
PEAS English version

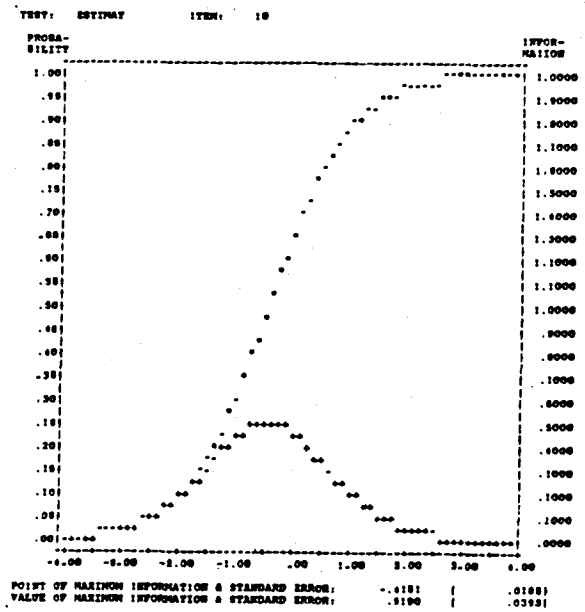
ESTIMATION SCALE

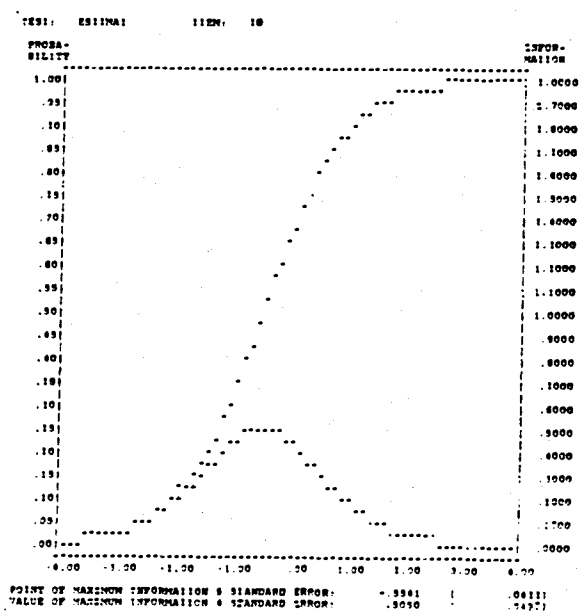


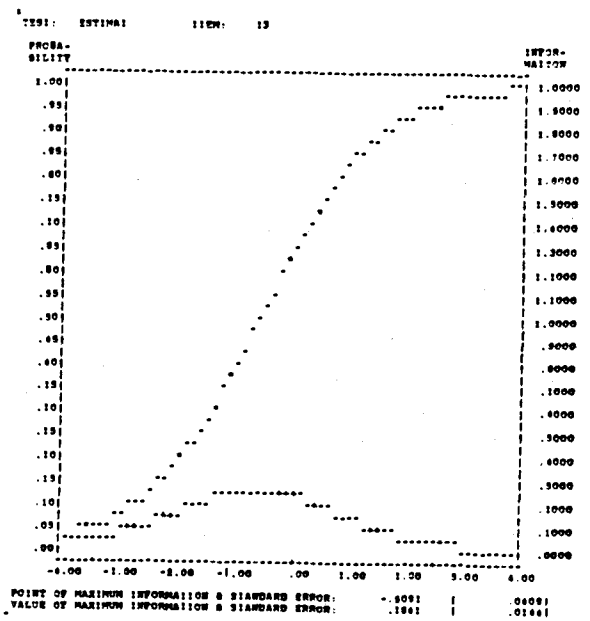


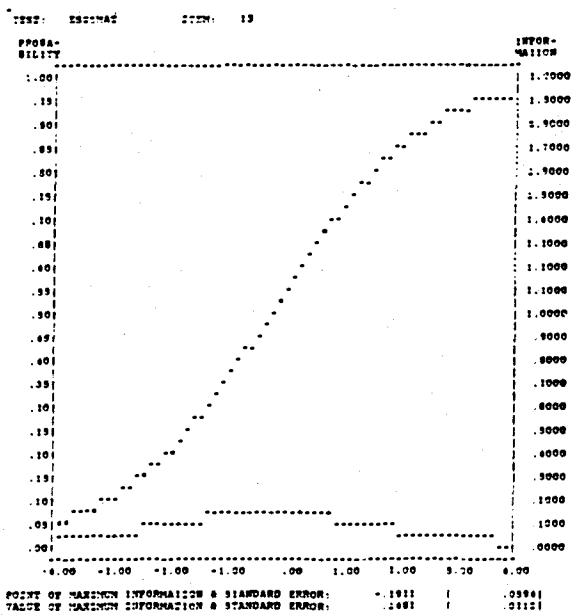


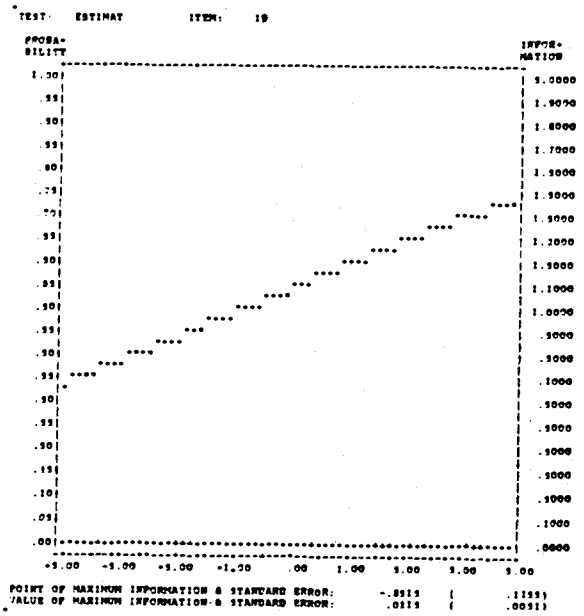


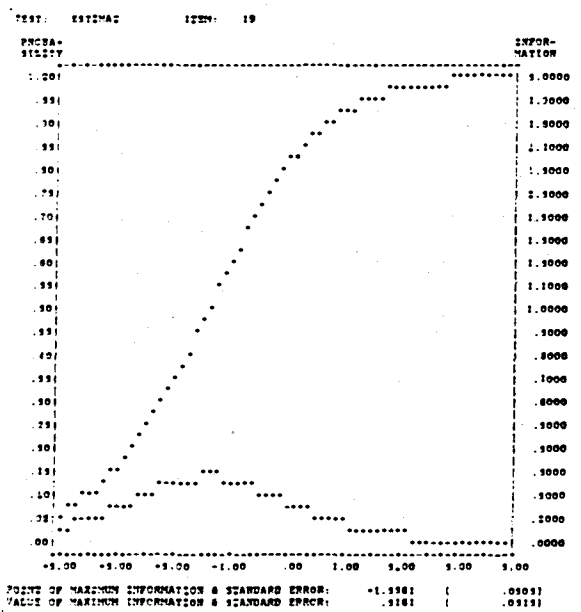

TEST: ESTIMAT ITEM: 10
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.6181 | .0188|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .9190 | .0393|

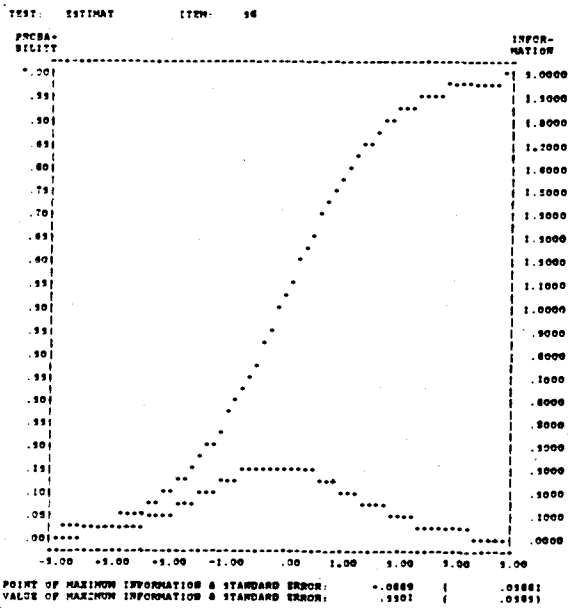

TEST: ESTIMAT ITEM: 10
PROBA-
BILITY
INFOR-
MATION

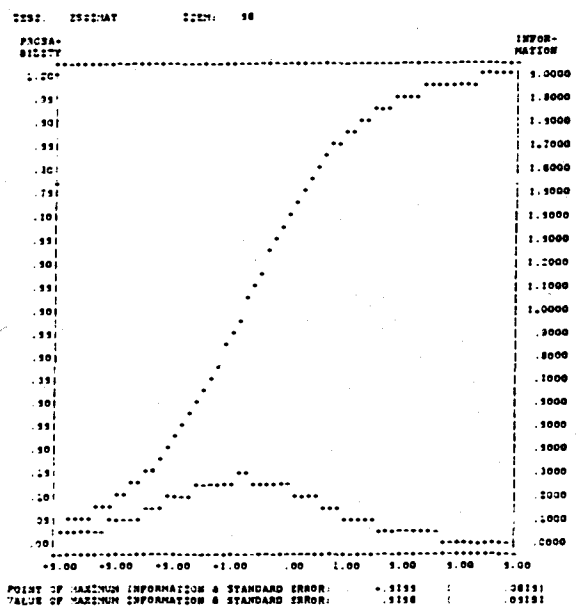

TEST: ESTIMAT ITEM: 13
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.5091 | .0608|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1961 | .0146|

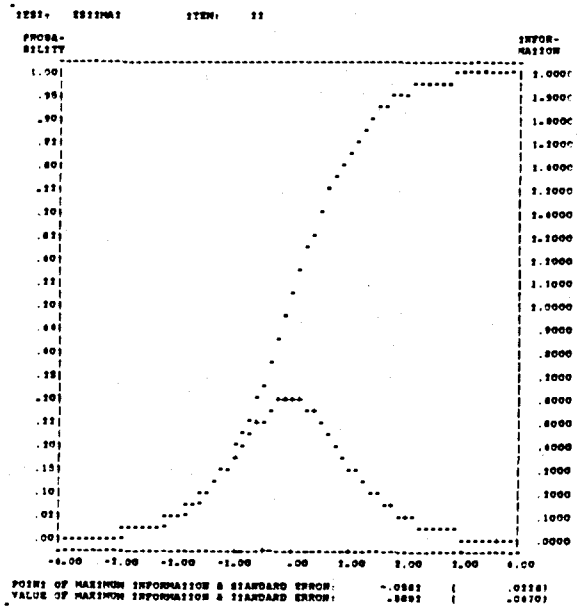

PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1911 | .0594|
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1481 | .0112|

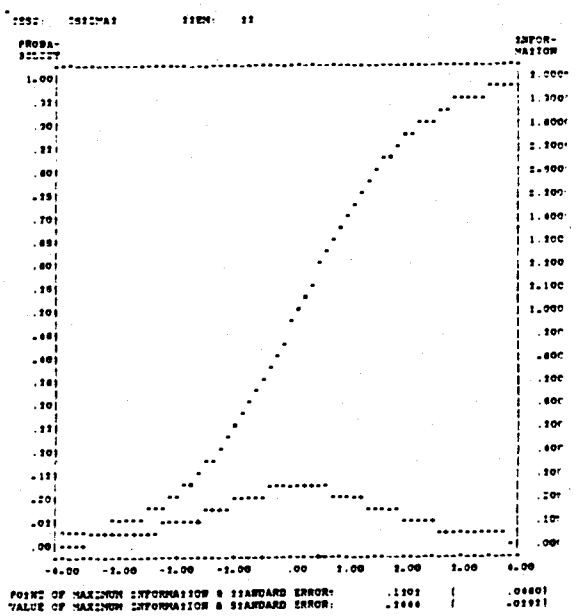

TEST: ESTIMAT ITEM: 19
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.8818 (.1159)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0118 (.0051)

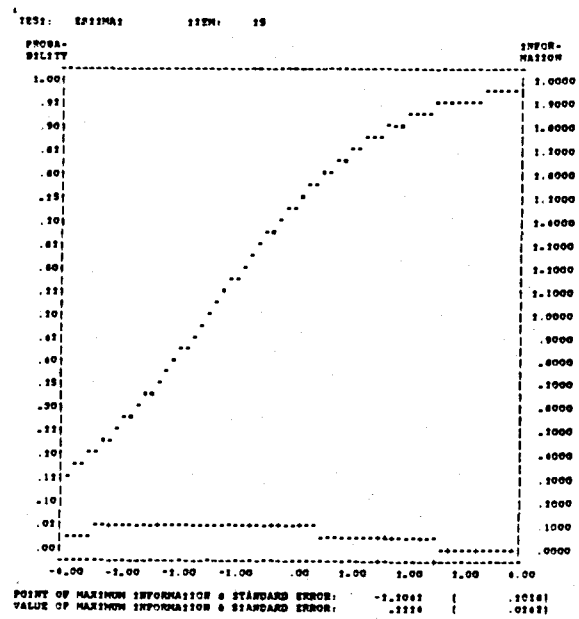

TEST: ESTIMAT ITEM: 19
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +1.3161 (.0103)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .5161 (.0919)

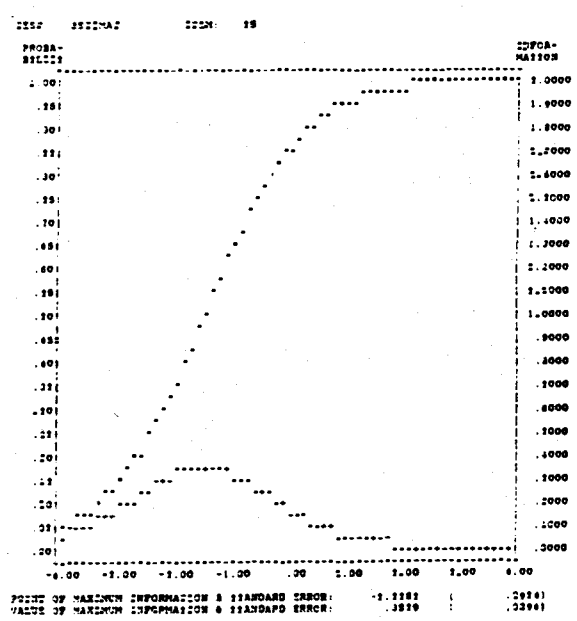

TEST: ESTIMAT ITEM: 16
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0669 (.0568)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1501 (.0169)

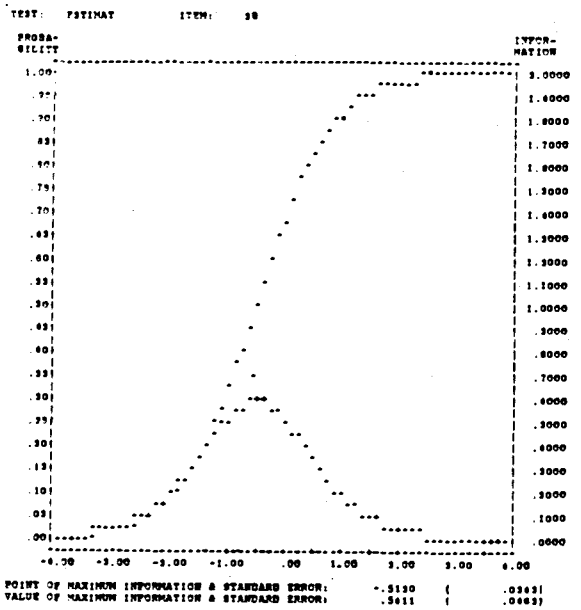

PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: +.5131 (.0813)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .5136 (.0919)










TEST: ESTIMAT ITEM: 38
PROBA-
BILITY
INFOR-
MATION
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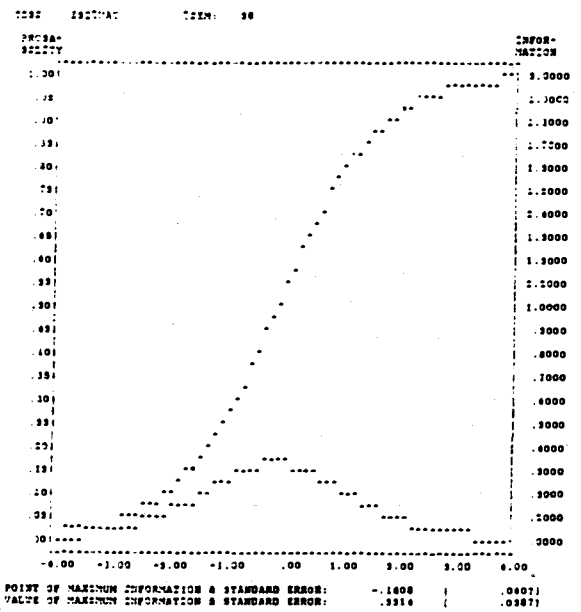
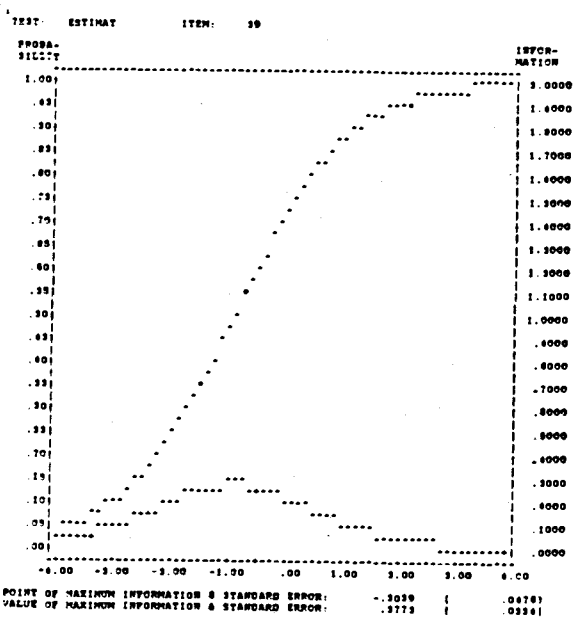
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.5130 (.0363)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .5611 (.0463)


TEST: ESTIMAT ITEM: 38
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1408 (.0407)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .5316 (.0387)


TEST: ESTIMAT ITEM: 39
PROBA-
BILITY
INFOR-
MATION
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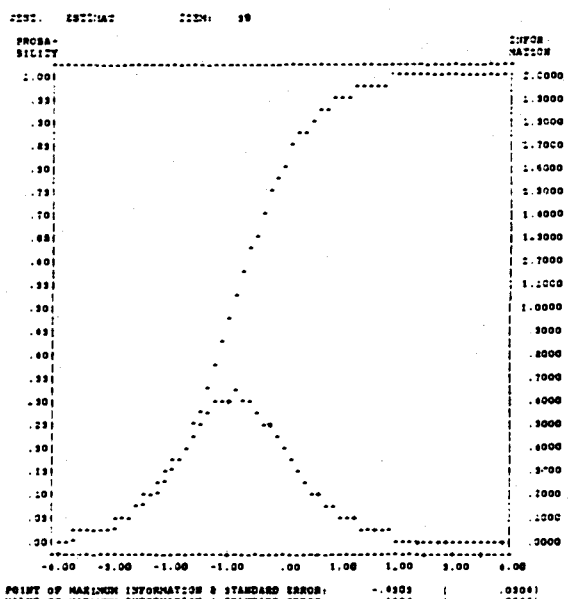
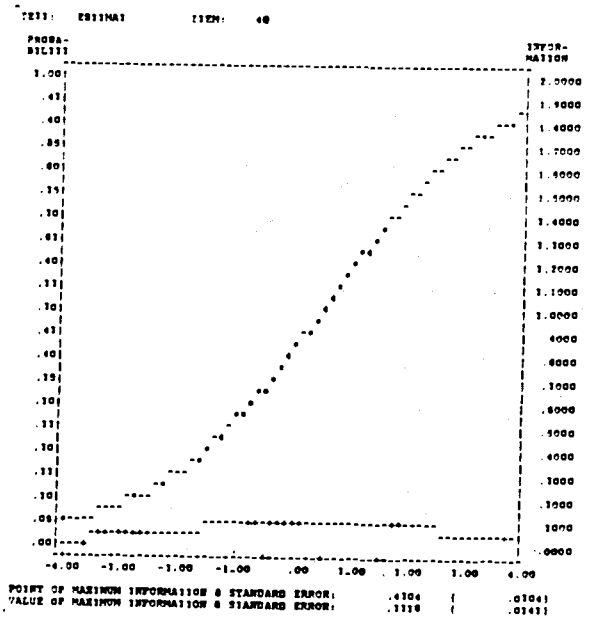
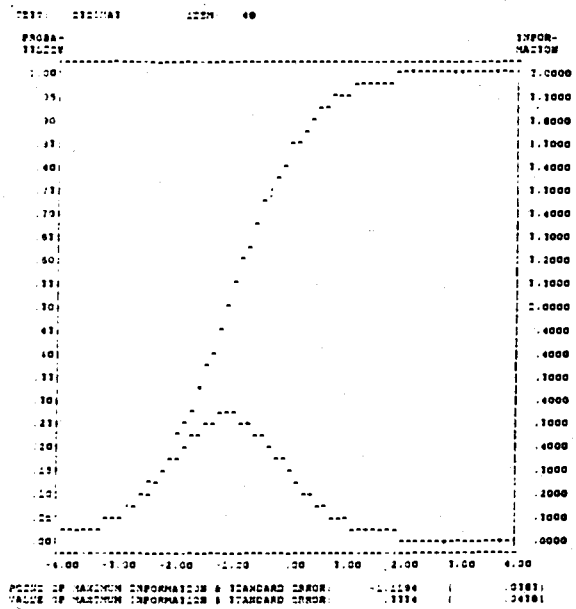
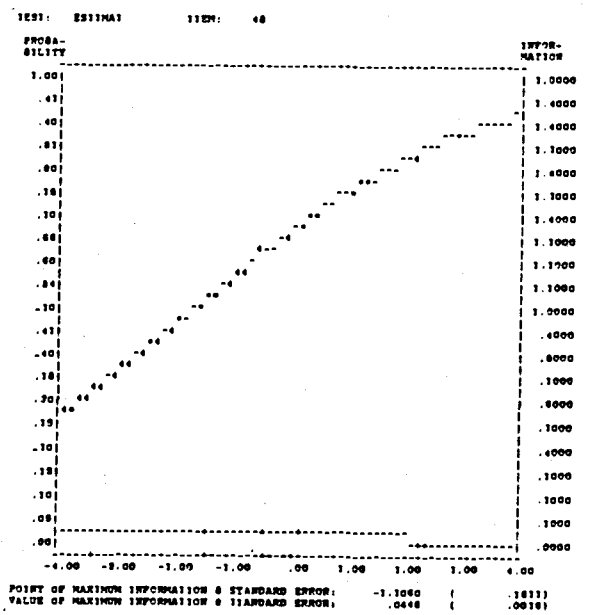
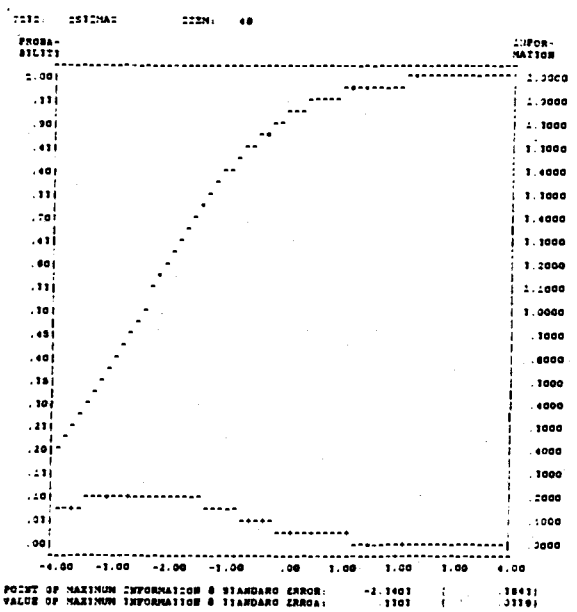
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3773 (.0336)

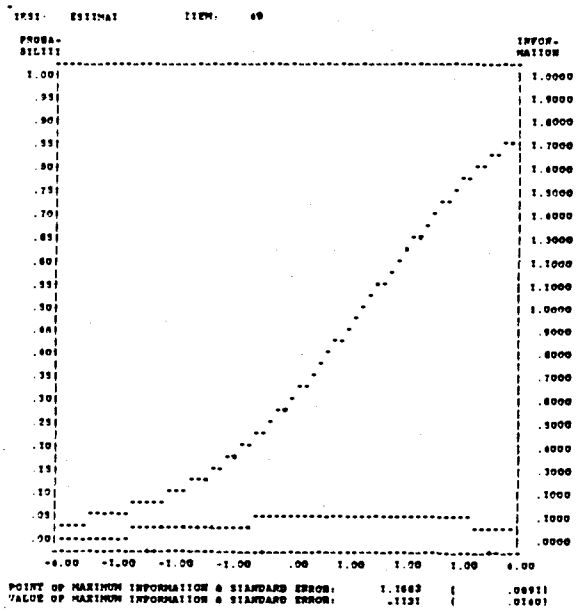

TEST: ESTIMAT ITEM: 39
PROBA-
BILITY
INFOR-
MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0303 (.0306)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .4373 (.0336)







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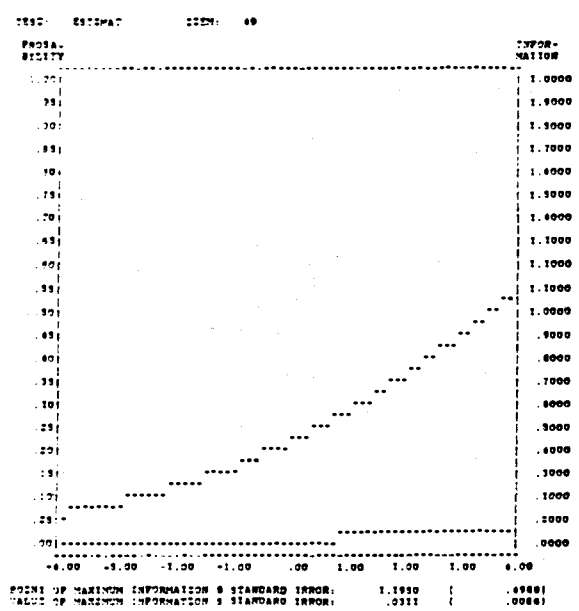
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1131 (.0160)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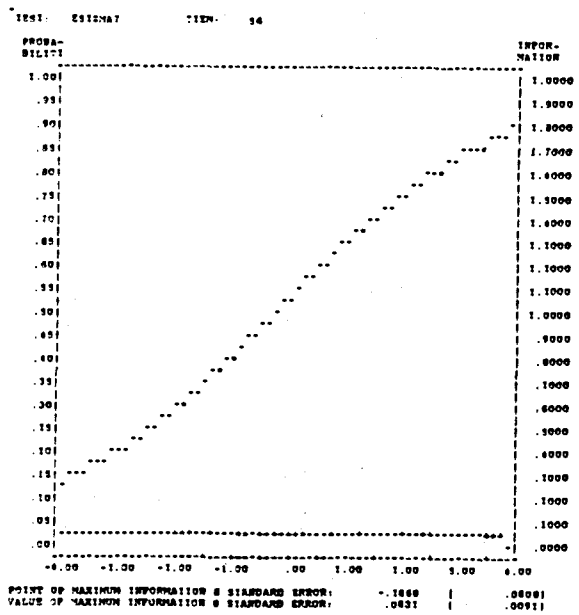
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: 1.1930 (.0968)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0311 (.0086)


PROBA-
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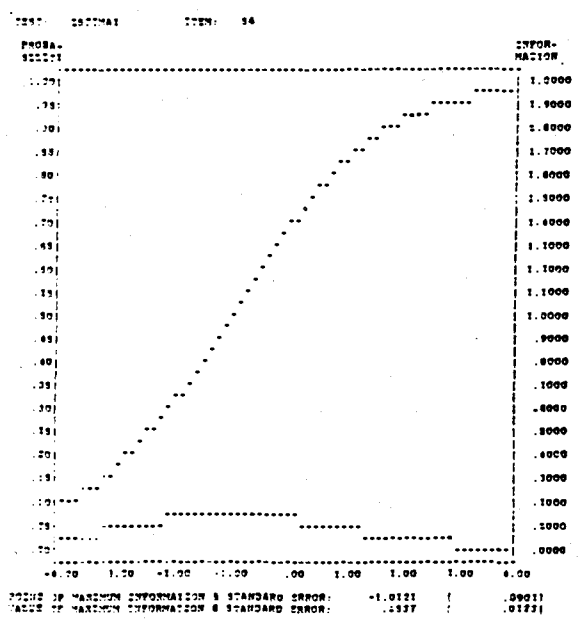
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1668 (.0808)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0831 (.0091)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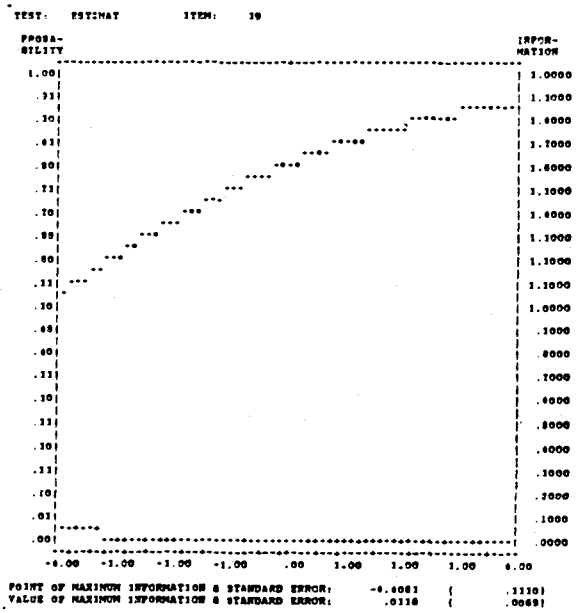
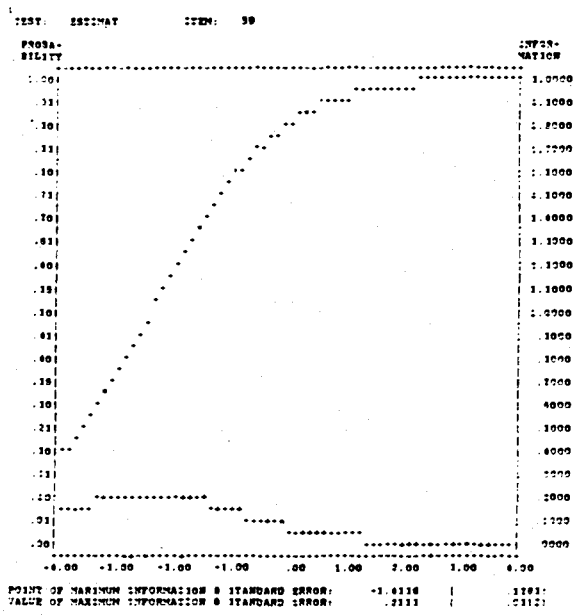
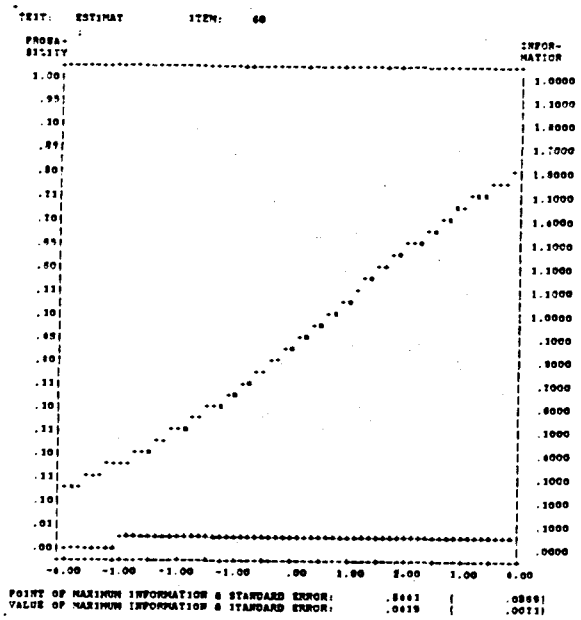
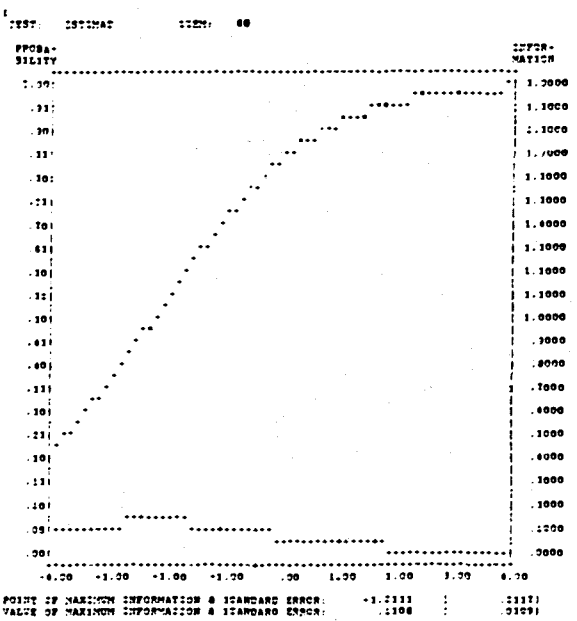
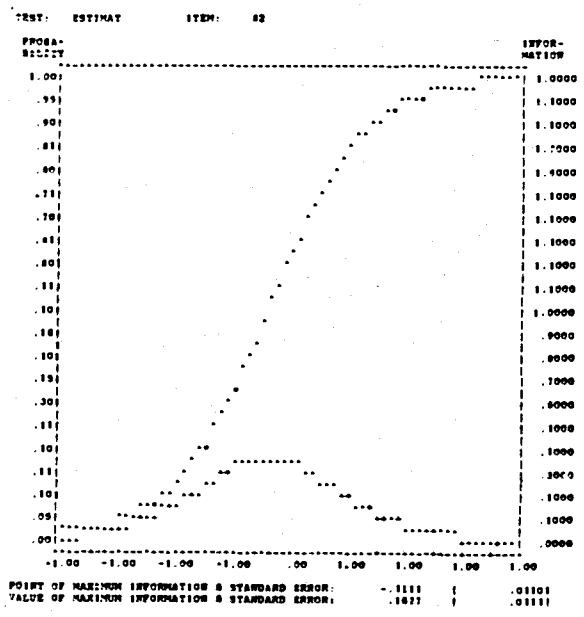
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0121 (.0901)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1937 (.0177)

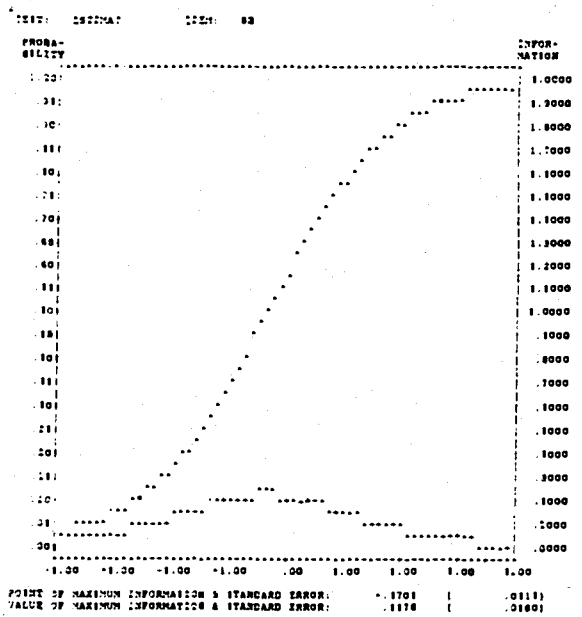

TEST: ESTIMAT ITEM: 19
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -6.6661 (.1110)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0118 (.0069)

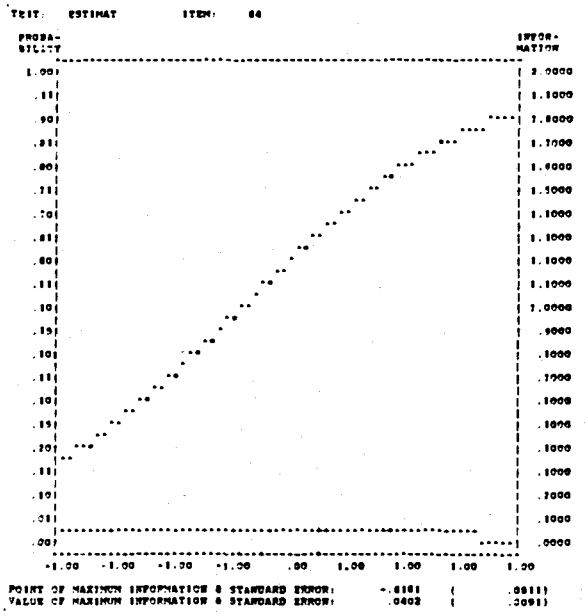

TEST: ESTIMAT ITEM: 39
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.6116 (.1191)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .2111 (.0312)

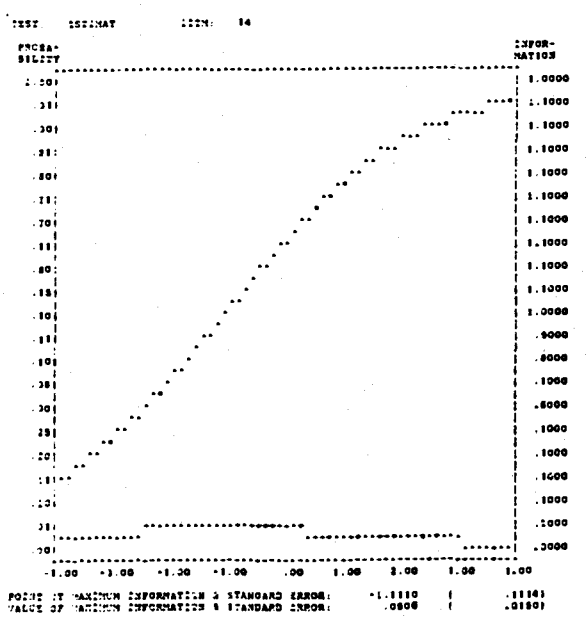

TEST: ESTIMAT ITEM: 60
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .5661 (.0869)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0619 (.0071)

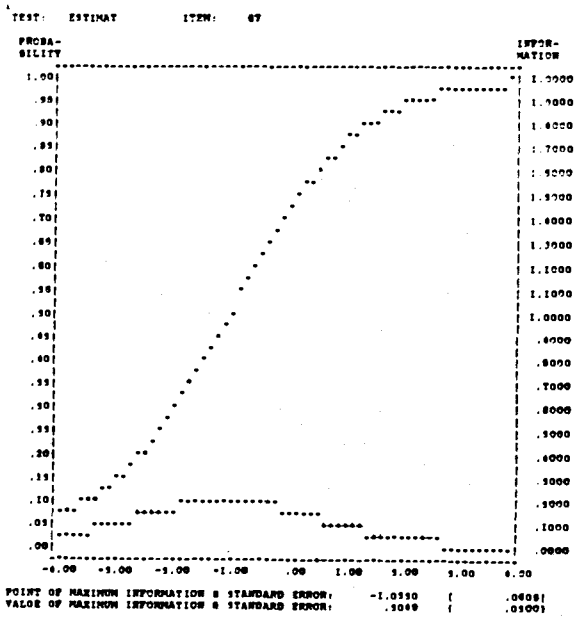

TEST: ESTIMAT ITEM: 60
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.2111 (.2117)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1108 (.0199)

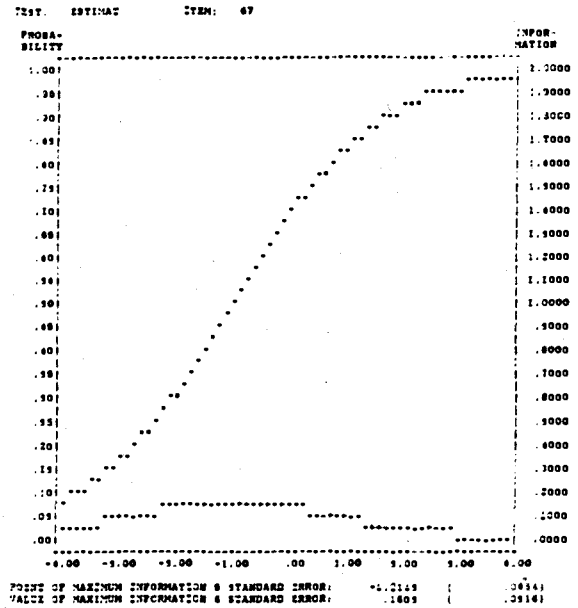

TEST: ESTIMAT ITEM: 82
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1111 (.0110)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1627 (.0111)

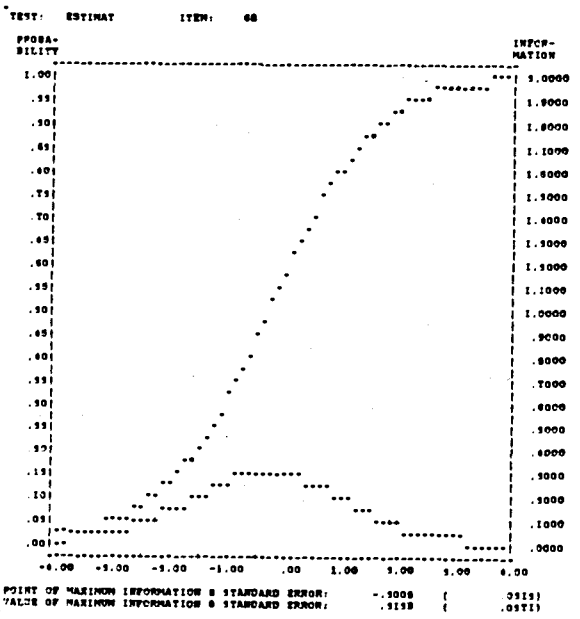

PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.1701 (.0113)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1178 (.0160)

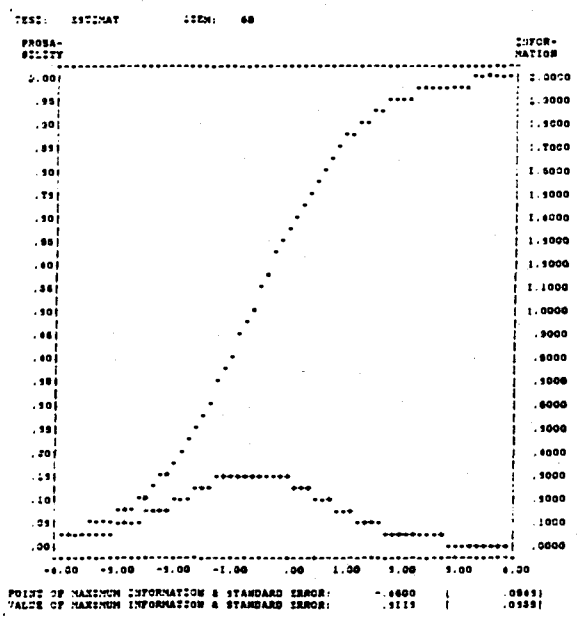

TEST: ESTIMAT ITEM: 84
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.0161 (.0111)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0402 (.0091)


PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1110 (.1116)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0808 (.0180)


TEST: ESTIMAT ITEM: 67
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.0550 (.0605)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3069 (.0300)


TEST. ESTIMAT ITEM: 67
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.2146 (.0934)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1805 (.0916)


TEST: ESTIMAT ITEM: 68
PROBA-BILITY
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.3006 (.0919)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .9198 (.0971)


TEST: ESTIMAT ITEM: 68
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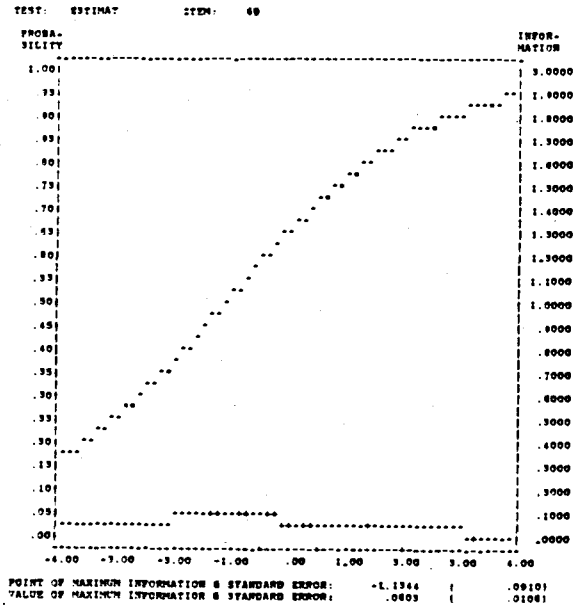
INFOR-MATION
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.4600 (.0843)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .9115 (.0958)


TEST: ESTIMAT ITEM: 69
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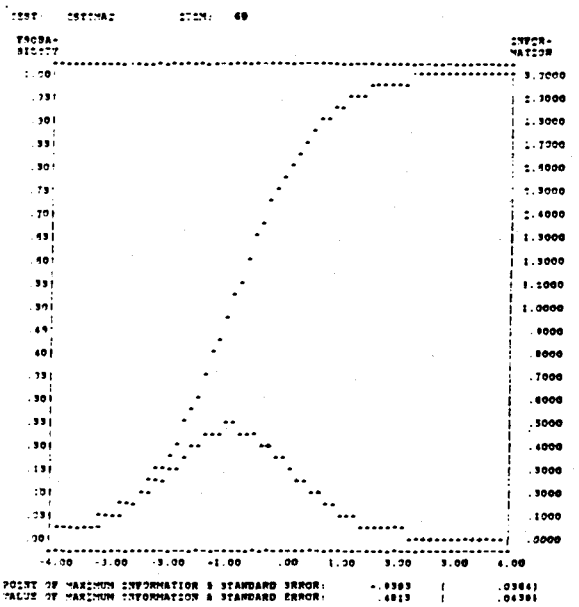
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.1344 (.0910)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0803 (.0106)


TEST: ESTIMAT ITEM: 69
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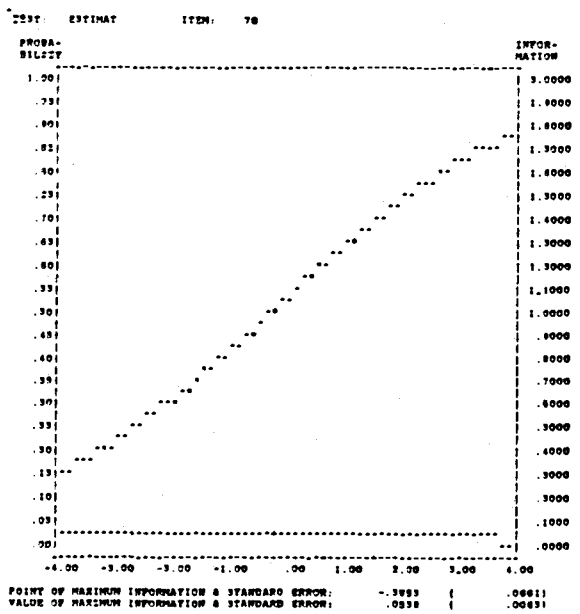
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.8969 (.0364)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .4813 (.0438)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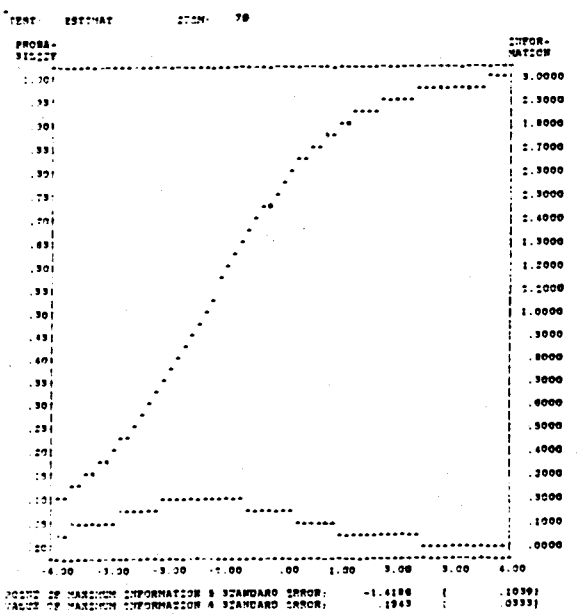
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.3993 (.0661)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0838 (.0069)


TEST: ESTIMAT ITEM: 70
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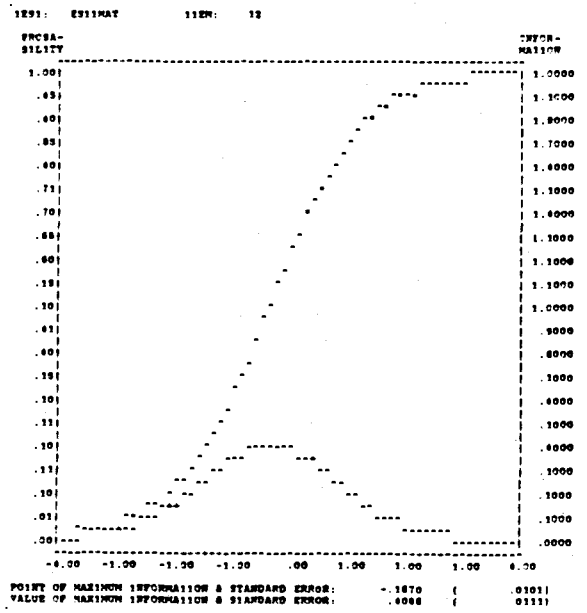
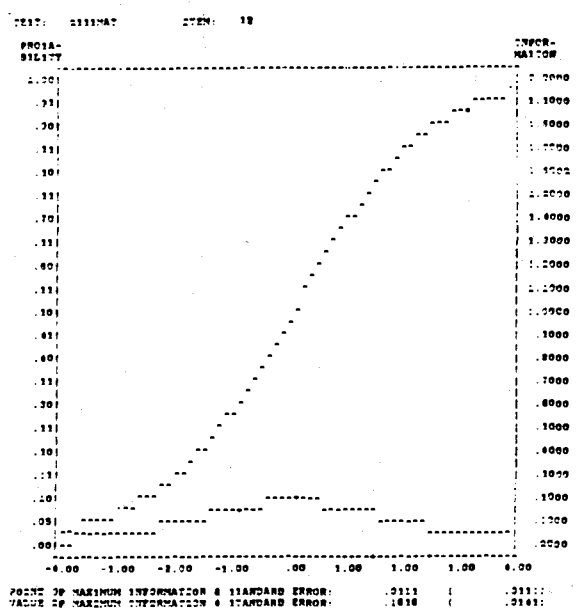
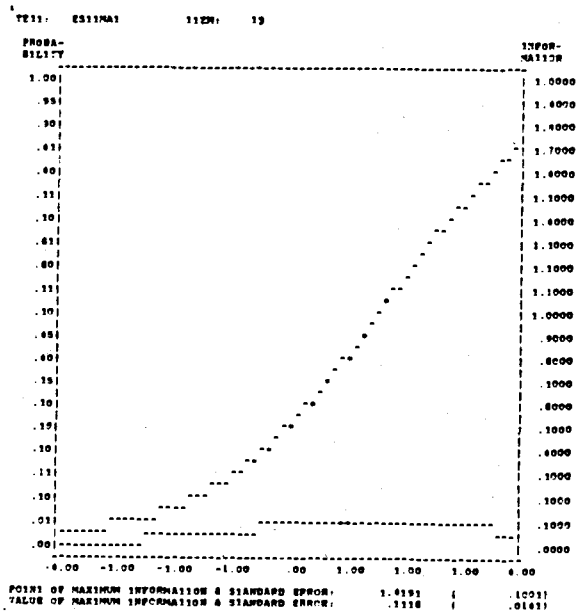
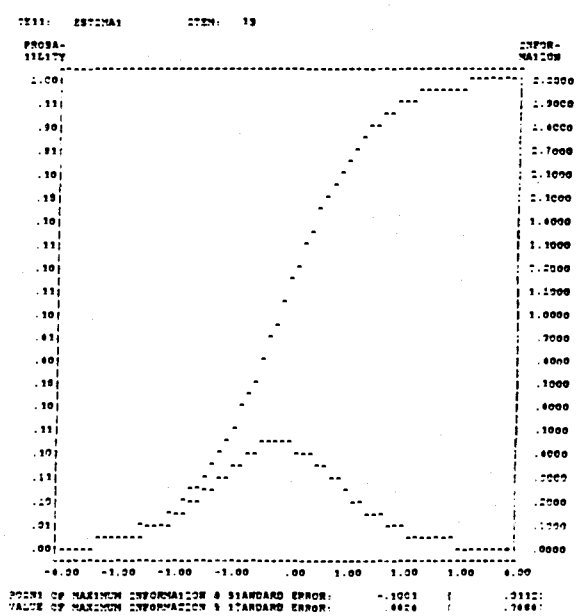
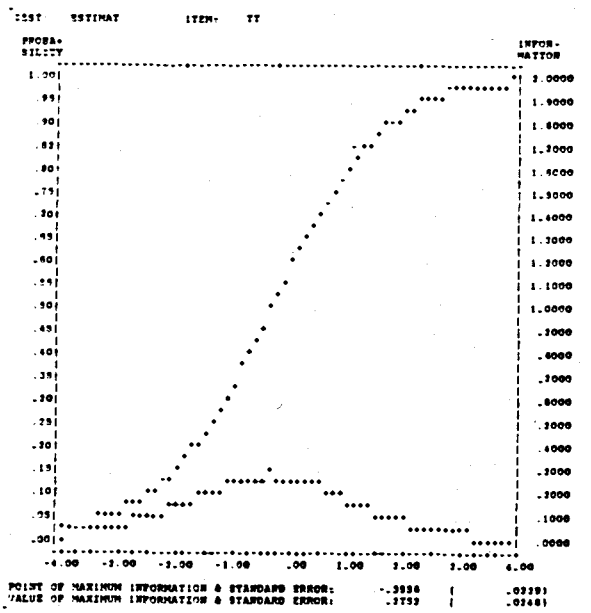
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -1.4186 (.1039)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1963 (.0393)







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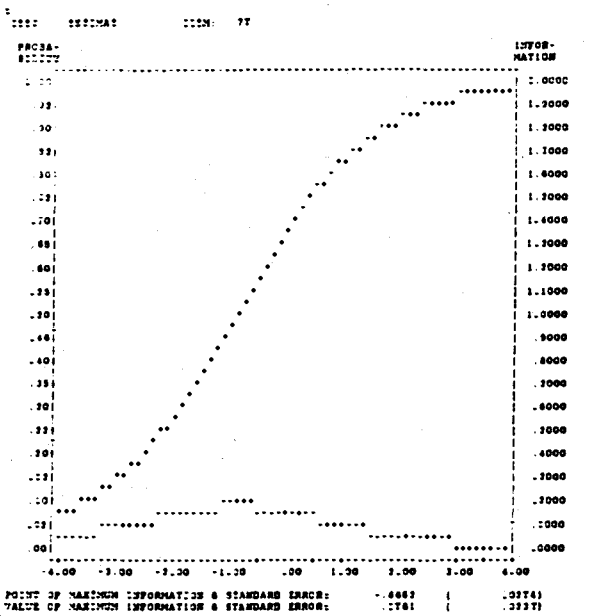
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.3936 (.0239)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3739 (.0348)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MATION
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-1.00
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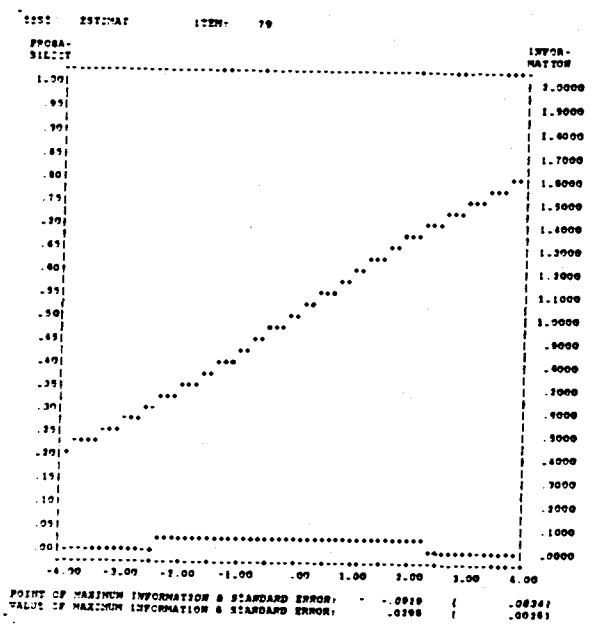
1.00
2.00
3.00
4.00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BILITY
INFOR-
MATION
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1.8000
1.7000
1.6000
1.5000
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1.1000
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-2.00
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.00
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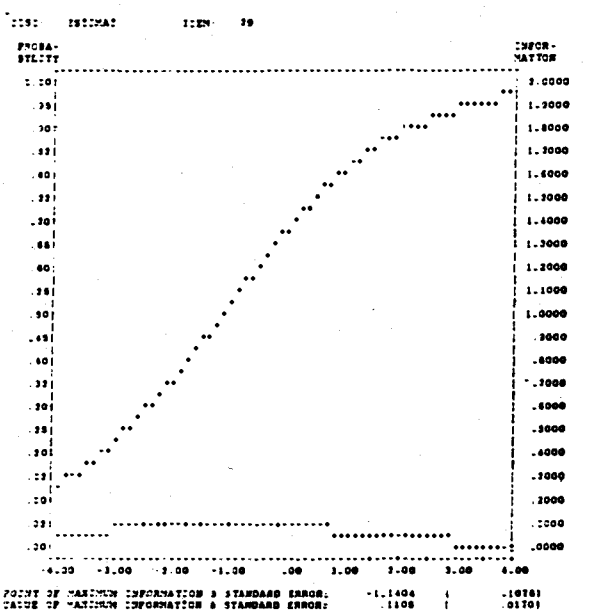
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0398 (.0036)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BILITY
INFOR-
MATION
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1.8000
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1.4000
1.3000
1.2000
1.1000
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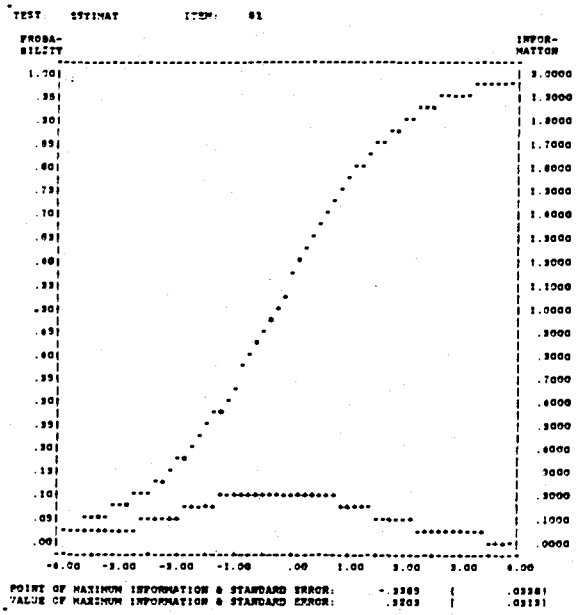
TEST: ESTIMAT ITEM: 81
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3.0000
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1.6000
1.5000
1.4000
1.3000
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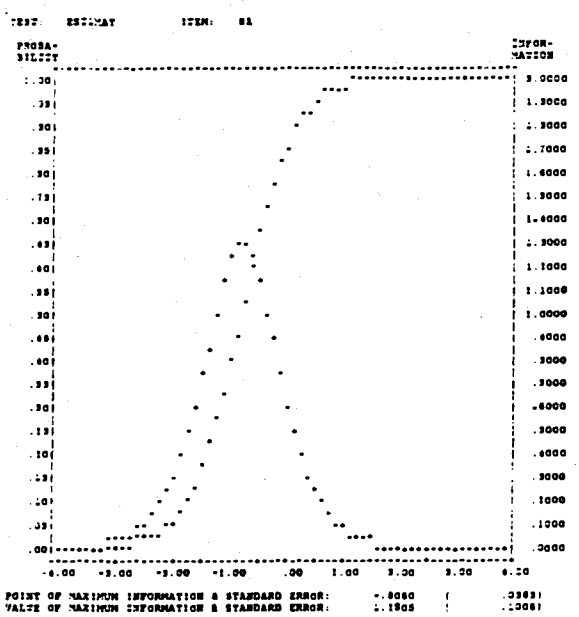
.0000
-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
POINT OF MAXIMUM INFORMATION & STANDARD ERROR: -.3365 (.0338)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3203 (.0319)


TEST: ESTIMAT ITEM: 81
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INFOR-MATION
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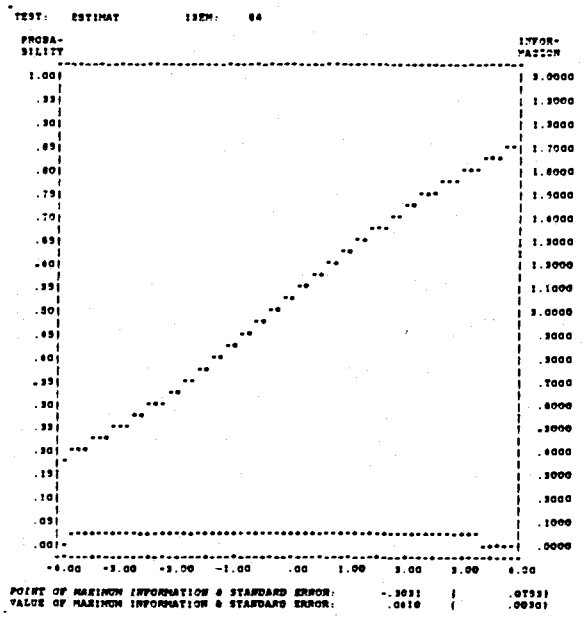
TEST: ESTIMAT ITEM: 84
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INFOR-MATION
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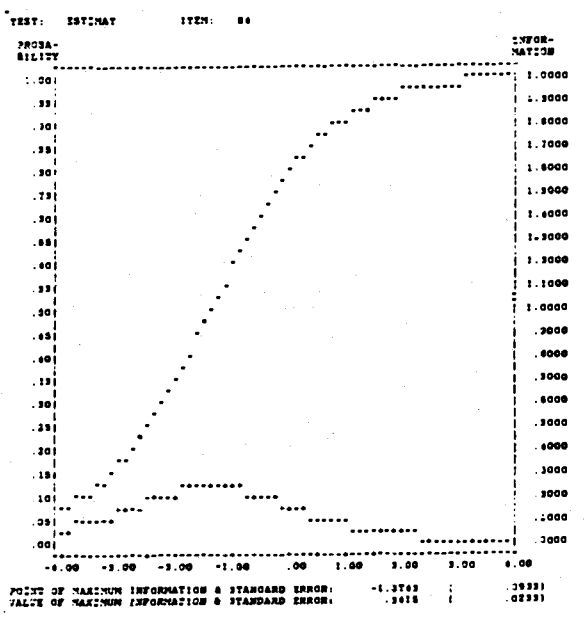
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .0610 (.0036)


TEST: ESTIMAT ITEM: 84
PROBA-BILITY
INFOR-MATION
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-6.00 -5.00 -4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
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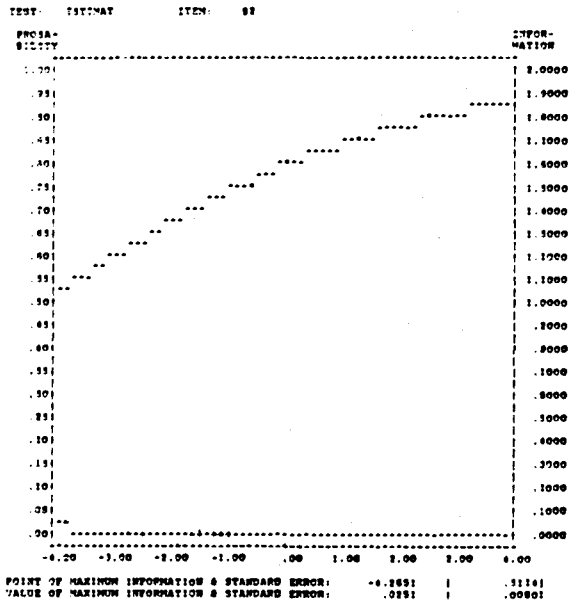
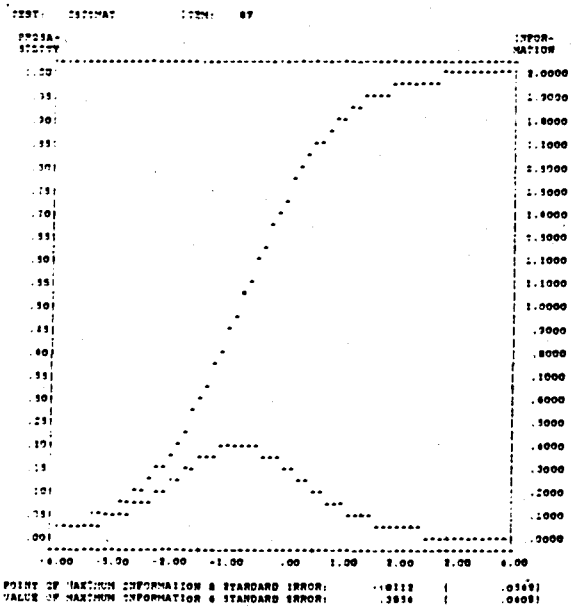
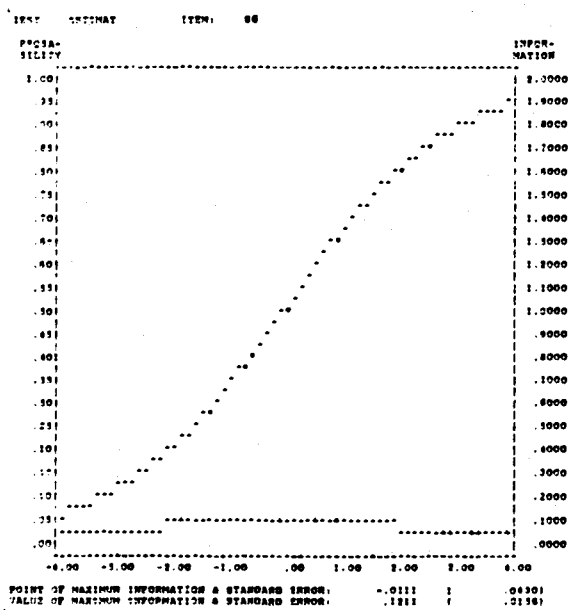
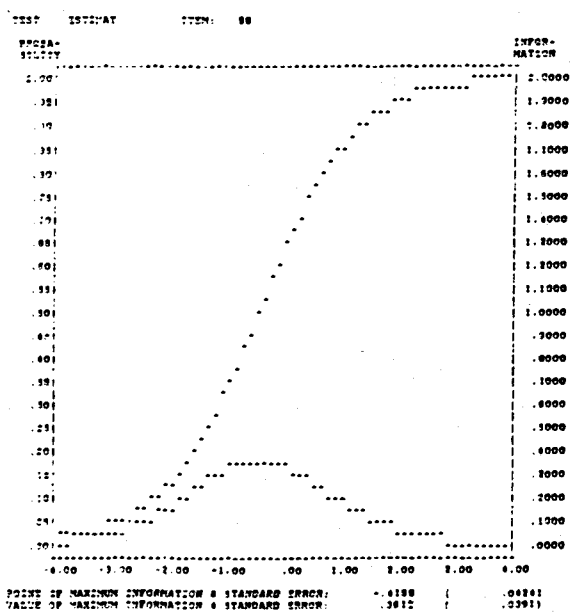
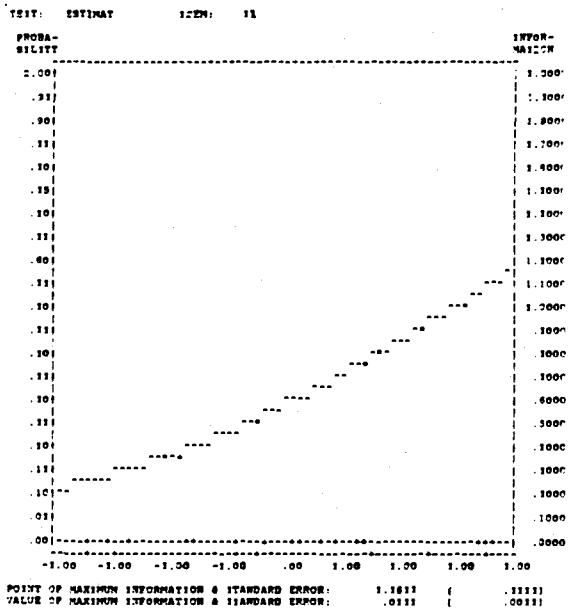
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3615 (.0233)

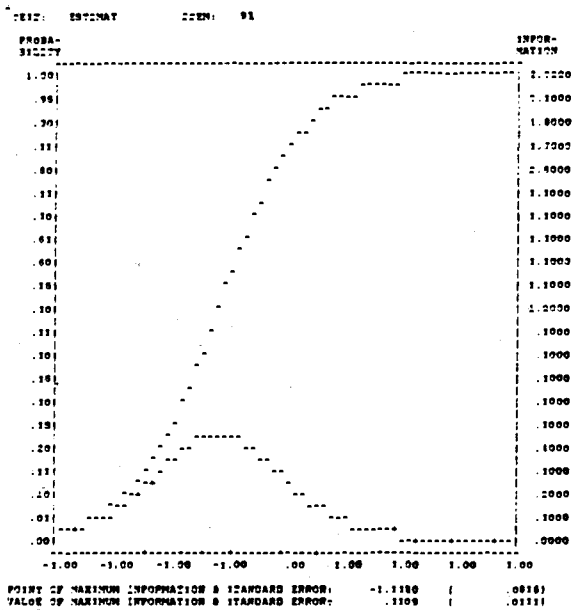


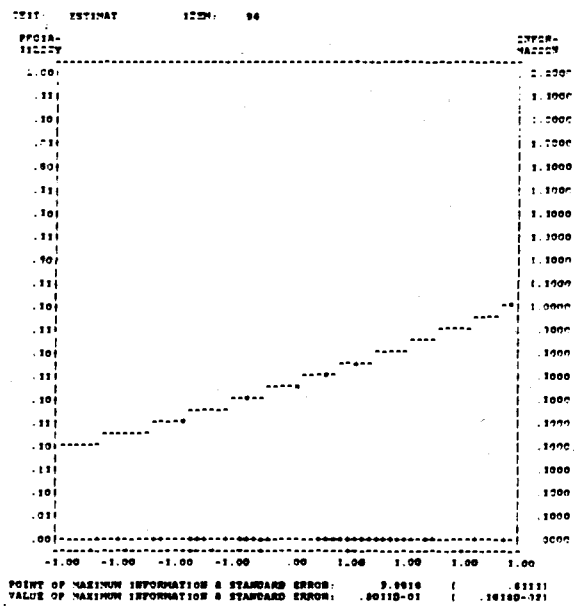


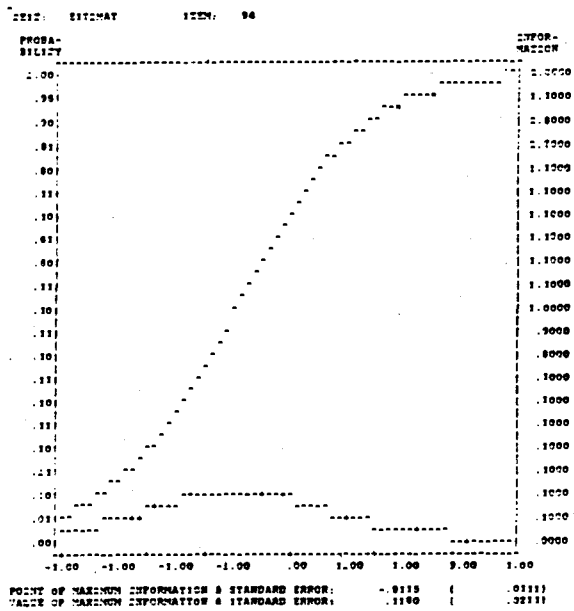


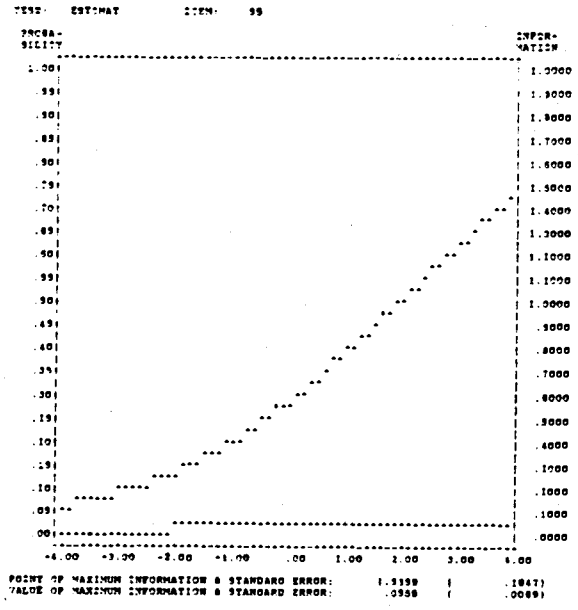











TEST: ESTIMAT ITEM: 99
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MATION
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-4.00 -3.00 -2.00 -1.00 .00 1.00 2.00 3.00 4.00
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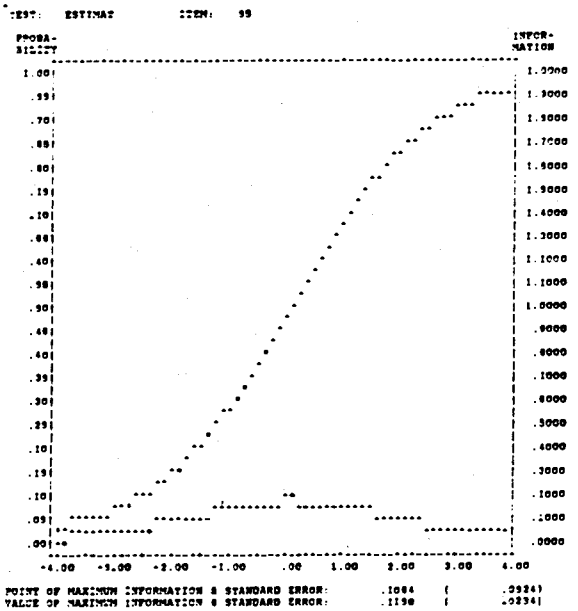
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .3958 (.0069)


TEST: ESTIMAT ITEM: 99
PROBA-
BILITY
INFOR-
MATION
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POINT OF MAXIMUM INFORMATION & STANDARD ERROR: .1064 (.0924)
VALUE OF MAXIMUM INFORMATION & STANDARD ERROR: .1150 (.0234)