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ITEM RESPONSE THEORY IN PERSONALITY ASSESSMENT: A DEMONSTRATION USING THE MMPI-2 DEPRESSION SCALE

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Item response theory (IRT) analyses have, over the past 3 decades, added much to our understanding of the relationships among and characteristics of test items, as revealed in examinees' response patterns. Assessment instruments used outside the educational context have only infrequently been analyzed using IRT, however. This study demonstrates the relevance of IRT to personality data through analyses of Scale 2 (the Depression Scale) on the revised Minnesota Multiphasic Personality Inventory (MMPI-2). A rich set of hypotheses regarding the items on this scale, including contrasts among the Harris-Lingoes and Wiener-Harmon subscales and differences in the items' measurement characteristics for men and women, are investigated through the IRT analyses.

Keywords: Item response theory, MMPI-2, Depression scale, Subtle-Obvious, Harris-Lingoes

Those who study personality have traditionally stressed the importance of measurement, but have been surprisingly slow in embracing some

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important psychometric developments from the educational testing literature over the past 3 decades. In particular, item response theory (IRT; Lord & Novick, 1968), which has demonstrated its utility in major cognitive testing programs, has been employed infrequently in personality assessment (e.g., Panter, Swygert, Dahlstrom, & Tanaka, 1997; Reise, 1999; Reise & Waller, 1990; Schaeffer, 1988; Steinberg & Thissen, 1995; Waller & Reise, 1989; Zalewski, Schatz, Gottesman, & Nichols, 1997) and attitude measurement (e.g., Ellis & Kimmel, 1992; Hulin, Drasgow, & Komocar, 1982; Reiser, 1981; Thissen, Steinberg, & Gerrard, 1986). There may be many reasons for this lack of communication of IRT to the personality domain, including uncertainty about the usefulness and

benefits of these methods with constructs involving the self. However, IRT can provide valuable insight into the structure of personality measures, illuminating the relationships among items and the ability of items to discriminate along personality dimensions.

In this investigation, we demonstrate by example the relevance of IRT to personality data. Our focus is on an important construct in the personality domain, as assessed by the instrument perhaps most closely associated with this construct: Depression as assessed by the revised Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989; Hathaway & McKinley, 1942). A rich set of hypotheses regarding the MMPI-2 Depression items can be clearly addressed and arbitrated using IRT.

Item Response Theory

Data and Assumptions

IRT provides models describing the relation of item responses to a hypothetical underlying trait. In this study, the 57 items comprising the MMPI-2 Depression scale (Scale 2) are hypothesized to reflect the individual's level on the underlying variable of depression. Not all the items in the scale refer to the same level of depression. For example, one item may describe a symptom experienced by individuals with only a low level of depression, while a second item describes an experience that will be endorsed as true only by individuals with a high level of depression. Judgments can be made about the relations of the items to the underlying trait by inspecting the items (content validity), or in terms of the endorsement rates and correlation with the total score (internal consistency). IRT, however, provides a more sophisticated empirically based view of the items' relationships to the underlying trait for a given population based on item responses from that population. IRT models assume that responses to a set of items are independent, apart from their relation to the underlying trait (Lord & Novick, 1968). In the case of the MMPI-2 Depression scale, which consists of 57 items distributed throughout

the 567-item MMPI-2, local independence of responses is a reasonable assumption.

Model, Estimation, and Parameters

The IRT model used in this study is the two-parameter logistic model (2PL model; Birnbaum, 1968, pp. 399-401):

$$P(\theta) = 1/\{1 + \exp[-a(\theta - b)]\}$$

In this model, the b parameter locates the item in relation to the underlying trait, θ . The value of b is the level of θ an individual must possess to have a 50% chance of responding positively to the item. (On the MMPI-2, a positive response may be either "true" or "false" depending on the direction in which the item is scored). An item with a large b parameter will be answered positively less frequently than an item with a small b . The latent variable (θ) is conventionally placed on a standard normal scale. Thus, items with $b = 0$ elicit positive responses from half the population. Items with $b > 2.00$ elicit few positive responses and items with $b < -2.00$ elicit mostly positive responses.

The other parameter of interest in the 2PL model is a . This parameter indicates how well an item discriminates among individuals at different levels of θ . In a graphical expression of the item response models, θ is on the x-axis, the probability of a positive response to the item is on the y-axis, and a trace line represents the probability of a positive response to the item as a function of θ . The parameter b locates the trace line in relation to the x-axis, while a describes the slope of the trace line. If a is large, the line rises steeply and the probability of a positive response changes quickly over a small range of θ . If a is small, then the line rises slowly; knowing whether or not an individual responded positively to the item will tell one little about his or her probable θ . The a parameter will be small if responses to the item seem to be unrelated to responses to the other items.

The 2PL model differs from the 1PL and Rasch models in its inclusion of a unique a parameter for each item. Because the possible variability in discrimination across items is of interest in this study, the 2PL model was selected.

Information Functions

While a trace line represents the relation of item responses to θ , a different graph, called an information function, indicates the range of θ over which the items are most useful for distinguishing among individuals. An information curve may be produced to indicate one item's ability to discriminate or may represent the discriminating power of a group of items, such as those on a scale or subscale. The information curves presented in this article are of the latter type. An information curve is a plot of the expected value of the inverse of the squared standard errors of the θ estimates against θ .

Hypotheses

Item-Level and Scale Evaluation

The application of the IRT model described above requires an investigation of the unidimensionality of the Depression scale (however, see Reckase, 1997, for a discussion of multidimensional IRT). We investigate the degree to which the total MMPI-2 Depression scale assesses a single dominant factor and the degrees to which the five Harris-Lingoes (1955) subscales (Subjective Depression, Psychomotor Retardation, Physical Malfunctioning, Mental Dullness, and Brooding) represent distinct constructs.

Our first set of hypotheses concerns the properties and performance of the MMPI-2 Depression scale and the Harris-Lingoes subscales in a sample of normal individuals. Published item and scale descriptive statistics (cf. Butcher et al., 1989) provide some information about the adequacy of individual items and of the scale, using psychometric criteria based in classical test theory. However, these statistics do not provide information about the degree of unidimensionality of the scales or the relative precision of measurement for different levels of depression. If the Depression scales are unidimensional, the item slope (a) parameters would be expected to be relatively and consistently high; therefore, we first examine these parameters. In addition, we present the scale information curves, which characterize the precision of measurement at different levels of depression, with higher information denoting greater precision.

The psychological measurement literature includes a variety of methods for investigating dimensionality, including item-level linear factor analysis of tetrachoric correlations, item-level non-linear factor analysis, multidimensional scaling, item-level linear factor analysis, Stout's (1987) Test of Essential Unidimensionality, Bejar's (1980) IRT parameter comparison, and IRT residual analysis (for a comparison of methods, see Sireci, 1997) and a detailed investigation of dimensionality would likely integrate the results of several methods. However, because the purpose of this study is to illustrate the utility of IRT, this investigation is limited to a straightforward examination of the IRT item parameter estimates and scale information curves.

Gender-Related Differences

A second hypothesis concerns the well-documented link between respondent gender and depression (cf. Gumbiner & Flowers, 1997; Nolen-Hoeksema, 1987). While theoretical explanations for this finding arise from very diverse literatures, we can employ simple IRT methods to explore the extent to which this difference exists in the context of the MMPI-2 Depression scale and the Harris-Lingoes and Wiener-Harmon (1946) subscales. In particular, individual item parameters and information functions for the samples of men and women show which items are strongly defining Depression in each sample and where along the underlying Depression dimension the items are most discriminating in that sample. For example, we might expect the Harris-Lingoes Brooding subscale to show a very different number and pattern of strongly discriminating items for women compared to men, given research in the role of rumination in negative affect (e.g., Nolen-Hoeksema, 1991), longitudinal patterns of persistence and depression (e.g., Block, Gjerde, & Block, 1991), and experimental results on thought-invoking situations and negative affect (e.g., Schwarz, 1990).

It is important to note that beyond the simple qualitative methods illustrated here, IRT also encompasses complex techniques for quantifying differential item functioning (DIF) across

subgroups. Panter et al. (1997), for example, apply one such technique to MMPI-2 Depression scale items.

Subtle Versus Obvious Items

Our third hypothesis concerns a distinction between item types that has been made in the MMPI-2 literature: In contrast to an obvious item, the literal meaning of a subtle item is not clearly pathological. For example, Item 146, which refers to crying, is classified as an obvious item by Wiener and Harmon (1946) because most respondents would perceive a positive response to the item as suggestive of depressive affect. Item 5, which asks about susceptibility to being awakened by noise, in contrast, is a subtle item because it is not clearly indicative of depression. Jackson (1971) contends that subtle items were included on the MMPI scales due to random error in the initial construction of the scales. He questions the validity of any item scored on the Depression scale that is not indicative of obvious depressive pathology. However, recent investigations (e.g., Hovanitz & Jordan-Brown, 1986) of both internal consistency and discriminant validity suggest that subtle items may contribute to the clinical scales despite their lack of face validity. Additionally, an individual who responds positively to many more obvious than subtle items may be attempting to appear depressed as an impression management strategy (e.g., Paulhus, 1989). To examine the relative contribution of obvious and subtle items, we compare the slope (a) parameters for the two item-types. If the obvious and subtle items contribute equally, these parameters should be comparable.

Method

Participants and Procedure

The data consist of the responses of 2,600 "normal" participants (1,462 women and 1,138 men) to the 704 items on the "adult experimental" form of the MMPI. These participants were retained from a sample of 2,900 volunteers from seven states (California, Minnesota, North Carolina, Ohio, Pennsylvania, Virginia, and Washington). In

this sample, Asian Americans and Hispanic Americans are slightly underrepresented and levels of education and socioeconomic status are higher than those of the general population; this last finding is due to the recruitment techniques (Butcher et al., 1989).

The adult experimental form contains all the items from both the MMPI (550 items) and the MMPI-2 (567 items), as well as some experimental items which were not selected for inclusion in the MMPI-2. For the analyses described here, only the items comprising the Depression scale for the MMPI-2 are considered.

Scale Description

The Depression scale on the original MMPI was developed by identifying items on which the answers of individuals diagnosed as suffering from depression differed from the answers of the original sample of "normal" individuals. On the MMPI, the Depression scale had 60 items; on the MMPI-2, 3 of these items were dropped, leaving 57 items in the current Depression scale.

The Depression scale measures two aspects of depression (Butcher et al., 1989; Dahlstrom, Welsh, & Dahlstrom, 1972; Hathaway & McKinley, 1942). The first is the affective and cognitive state of the depressed individual, including feelings, such as hopelessness and pessimism, and cognitions, such as a preoccupation with death and suicide. The second aspect involves the personality traits that might predispose an individual to experience depression. These traits include perfectionism and tendencies to dissatisfaction with the self and to be over-controlled.

Model Specification

The Multilog program (Thissen, 1991) was used to fit the two-parameter logistic IRT model to these data. Parameter estimates were generated for all of the items in the Depression scale simultaneously, and then for the subsets of items in the five Harris-Lingoes subscales and the two Wiener-Harmon subscales. All of the analyses reported here were performed separately for the data from the women and from the men in the sample.

Results

Item-Level and Scale Evaluation

The first stage of our analysis involved examining the item parameters and overall scale performance for each of the MMPI-2 Depression scales (the full scale and the 5 Harris-Lingoes subscales). Table 1 shows all the items included on the Depression scale and the estimates of a and b for men and women. Tables 2 through 6 present the estimated values of a and b for each item for each of the five Harris-Lingoes subscales. Note that most items appear in more than one of the Harris-Lingoes subscales. In each table, the parameter estimates for an item refer only to that item's relationship to the θ for that scale.

An examination of the range of item parameters presented in Table 1 for the Depression scale suggests that it may have more than one dimension. Item response models describe the probability of item responses in relation to the underlying trait or dimension that accounts for the most regularity in the response patterns. When items have responses that are largely unrelated to this trait they will have small estimates of a , the slope parameter. The responses to these items might be related to a different trait; that is, more than the single dimension represented may be needed to adequately model the response patterns. Alternatively, some of the items may not be providing discrimination in a nonclinical population.

Item 181, for example, has an a parameter of 0.10 for both men and women. In a graphical representation, this item's trace line would be almost flat, suggesting that responses are not related to responses on the majority of other items. As we might expect, the very low b parameter for this item (-10.90 for women and -11.40 for men) reflects an almost constant overall positive response rate across θ (in this case, about 75% even at the lowest levels of θ).

In contrast, consider Item 73, which has a high a parameter (1.76 for women and 1.55 for men). This item's trace line would have a fairly steep slope, indicating that it is able to distinguish well between individuals over a small range of θ . For women, the b parameter is 0.76; for men, it is

1.36. For both men and women, a positive response to this item suggests that the individual has a high level of θ ; however, because the b parameter is higher for men, a positive response suggests a higher level of θ for men.

Item 146 has similar estimates of a for men and women (0.64 and 0.66, respectively). The estimates of b are very different, however (for women b is 0.19; for men, 3.16). The trace line for this item across samples has a similar shape, but very different locations along the Depression dimension. For women the trace line is located at an intermediate level of θ , so that the item distinguishes among women with moderate levels of depression. For men the trace line is at a high level of θ , and the item only distinguishes among men with very high levels of depression.

We also find this pattern with Item 127, which has similar a parameter estimates and different b parameter estimates for women and men (a is 0.92 for women and 0.79 for men; b is -0.46 for women and 0.78 for men). This item provides information about women with moderately low levels of depression and men with moderately high levels of depression.

The fact that many of the items in Table 1 have very low a parameters suggests that they are measuring other dimensions of personality than that corresponding to θ . It is possible that this apparent nonunidimensionality of the Depression scale is a consequence of the "normal" sample. Dahlstrom, Welsh, and Dahlstrom (1972) state that, for normal individuals, "the [Depression] scale coherence breaks down into relatively specific kinds of experiences and concerns" (p. 187).

The Harris-Lingoes subscales were analyzed to determine if they represent unidimensional subsets of the Depression-scale items (that appear to be multidimensional, taken as a whole). An examination of Tables 2 through 6 reveals that each of these smaller sets of items still has many items that are not related to the θ s that underlie the strongest patterns of responses on each of those subscales. This suggests that even these smaller subsets may be multidimensional.

Table 1
Estimated Parameters for the MMPI-2 Depression Scale (Scale D)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
5. I am easily awakened by noise	0.27	-0.67	0.18	1.92
15. I work under a great deal of tension	0.39	1.42	0.29	1.82
18. I have attacks of nausea and vomiting	0.76	4.52	0.86	5.62
31. It is hard to keep my mind on a task	1.47	1.68	1.08	2.04
38. Periods when I couldn't "get going"	1.26	0.93	0.93	1.35
39. My sleep is fitful and disturbed	1.31	1.71	0.90	2.55
46. I pass people unless they speak first	0.54	2.35	0.60	2.56
56. I wish I could be as happy as others	1.52	0.56	1.13	0.83
73. I am lacking in self-confidence	1.76	0.76	1.55	1.36
92. I don't seem to care what happens to me	1.01	3.72	1.10	2.98
117. I have never vomited blood	0.19	-9.89	0.16	-9.98
127. Criticism/scolding hurts me terribly	0.92	-0.46	0.79	0.78
130. I certainly feel useless at times	1.60	0.39	1.28	0.63
146. I cry easily	0.66	0.19	0.64	3.16
147. I don't understand what I read as well	1.22	1.74	1.01	1.95
170. I am afraid of losing my mind	1.21	2.20	1.17	2.59
175. I feel weak all over much of the time	1.58	2.42	1.90	2.30
181. I do not have spells of hay fever	0.10	-10.90	0.10	-11.40
215. I brood a great deal	1.76	1.22	1.32	1.67
233. I have difficulty starting things	1.21	0.72	1.08	0.67
False				
2. I have a good appetite	1.29	2.88	0.99	3.54
9. My life is full of interesting things	1.36	1.40	1.42	1.61
10. I am as able to work as I ever was	1.03	2.05	0.93	2.08
20. I am seldom troubled by constipation	0.58	2.18	0.49	4.09
29. At times I feel like swearing	0.12	12.00	0.13	12.20
33. I seldom worry about my health	0.84	0.73	0.66	0.86
37. At times I feel like smashing things	0.04	-12.70	0.04	-8.99
43. My judgment is better than it ever was	0.79	1.70	0.73	1.97
45. I am in as good health as my friends	1.17	1.87	1.21	1.90
49. I am a very sociable person	0.63	1.86	0.54	1.36
55. I keep at it until others lose patience	0.05	-10.20	0.02	-9.72
68. I sometimes tease animals	0.14	-13.30	0.10	-9.59
75. I usually feel that life is worthwhile	0.97	3.41	1.37	2.60
76. A lot of argument to convince people	0.05	-12.40	0.04	-8.73
95. I am happy most of the time	2.21	1.47	1.97	1.60
109. I seem about as capable as others	1.02	2.88	0.98	3.22
118. I do not worry about catching diseases	0.52	1.13	0.47	1.20
134. At times I feel like picking a fight	0.18	-13.30	0.13	-12.50
140. I go to sleep without ideas bothering me	1.03	1.09	0.71	1.88
141. I have been well most of the time	1.28	2.15	1.38	2.50
142. I have never had a fit or convulsion	0.58	4.75	0.47	5.60
143. I am neither gaining nor losing weight	0.45	0.55	0.46	2.26

continued

Table 1 (continued)
Estimated Parameters for the MMPI-2 Depression Scale (Scale D)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
148. I have never felt better in my life	0.93	-0.14	0.87	-0.30
165. My memory seems to be all right	1.36	2.02	1.08	2.39
178. I break into a sweat when embarrassed	0.07	-12.60	0.10	-10.80
188. I enjoy different kinds of recreation	0.59	2.86	0.74	2.48
189. I like to flirt	0.14	0.94	0.04	12.00
212. Stood in the way because of principle	0.11	-10.40	0.09	-8.13
221. I dream frequently, best kept to myself	0.06	-15.20	0.08	-11.90
223. I am no more nervous than most others	1.04	1.64	0.93	2.05
226. Sometimes without reason I feel happy	0.04	-9.21	0.08	-6.68
238. I sweat very easily even on cool days	0.15	-10.40	0.10	-10.40
245. Not worry about whether door is locked	0.25	-3.63	0.05	-16.50
248. Not blame for taking advantage of people	0.19	-11.10	0.13	-14.10
260. Once in a while I laugh at a dirty joke	0.26	9.89	0.33	9.62
267. Periods cheerful without any reason	0.10	8.80	0.06	9.03
330. At times I am all full of energy	0.98	3.15	0.93	2.81

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^a*n* = 1,462. ^b*n* = 1,138.

On the Harris-Lingoes Physical Malfunctioning subscale (Table 4), for example, items related to specific physical symptoms (Items 20, 117, and 181) tend to have low *a* parameter estimates. These items appear to be measuring dimensions other than the strongest dimension underlying the subscale. This strongest dimension, as indicated by the items with high *a* parameter estimates (Items 2, 45, 141, and 175), may be characterized as a general malaise.

Using factor analysis for dichotomous data (e.g., Mislevy, 1986), it may be possible in future research to identify unidimensional subsets of Depression items based solely on the response patterns of this sample (for an illustrative analysis, see Panter et al., 1997). Different samples are likely to yield different subsets, however. The application of subscales created in this way to different populations would require caution.

Figures 1 through 6 provide information curves for men and women for the total Depression scale and each of the subscales. Recall that information

curves describe precision of measurement of θ ; these curves indicate that for most of the scales the items will be most useful for measuring individuals with fairly high levels of θ .

Inspection of the set of information curves associated with the total scale and its subscales, not considering the comparison across respondent gender, shows that in most cases, higher information is associated with higher levels of the underlying trait. This implies that, overall, these scales show more discriminability for respondents with relative high levels of depression – a characteristic that is consistent with the stated purpose of the instrument.

Gender-Related Differences

In most cases, item parameters on the full Depression scale and its subscales are similar for men and women. As expected, the information curves associated with these scales also are similar. There is a slight tendency for women to have stronger slopes and higher overall information in most scales. A clear exception to this is the

Table 2
Estimated Parameters for the MMPI-2 Harris-Lingoes Subjective Depression Subscale (Subscale D₁)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
31. It is hard to keep my mind on a task	1.39	1.80	1.14	1.99
38. Periods when I couldn't "get going"	1.23	0.98	1.01	1.29
39. My sleep is fitful and disturbed	1.08	2.01	0.76	2.95
46. I pass people unless they speak first	0.56	2.32	0.66	2.38
56. I wish I could be as happy as others	1.49	0.60	1.23	0.80
73. I am lacking in self-confidence	1.89	0.77	1.65	1.36
92. I don't seem to care what happens to me	1.04	3.72	1.13	2.96
127. Criticism/scolding hurts me terribly	0.91	-0.45	0.83	0.77
130. I certainly feel useless at times	1.67	0.41	1.45	0.61
146. I cry easily	0.67	0.21	0.64	3.19
147. I don't understand what I read as well	1.05	1.99	0.90	2.16
170. I am afraid of losing my mind	1.21	2.27	1.08	2.79
175. I feel weak all over much of the time	1.21	2.97	1.54	2.63
215. I brood a great deal	1.75	1.27	1.47	1.60
233. I have difficulty starting things	1.24	0.74	1.12	0.66
False				
2. I have a good appetite	1.06	3.40	0.85	4.04
9. My life is full of interesting things	1.30	1.49	1.37	1.68
43. My judgment is better than it ever was	0.72	1.89	0.51	2.71
49. I am a very sociable person	0.64	1.87	0.55	1.33
75. I usually feel that life is worthwhile	0.92	3.62	1.25	2.83
95. I am happy most of the time	2.12	1.57	1.93	1.67
109. I seem about as capable as others	0.92	3.18	0.89	3.50
118. I do not worry about catching diseases	0.43	1.39	0.36	1.55
140. I go to sleep without ideas bothering me	0.92	1.22	0.63	2.09
148. I have never felt better in my life	0.79	-0.14	0.65	-0.37
178. I break into a sweat when embarrassed	0.07	-12.90	-0.47	2.53
188. I enjoy different kinds of recreation	0.50	3.38	0.67	2.75
189. I like to flirt	0.10	1.44	0.01	38.60
223. I am no more nervous than most others	0.98	1.77	0.87	2.19
260. Once in a while I laugh at a dirty joke	0.20	12.90	0.32	9.80
267. Periods cheerful without any reason	0.11	7.71	0.07	8.40
330. At times I am all full of energy	0.80	3.78	0.73	3.49

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^a*n* = 1,462. ^b*n* = 1,138.

Table 3

Estimated Parameters for the MMPI-2 Harris-Lingoes Psychomotor Retardation Subscale (Subscale D₂)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
38. Periods when I couldn't "get going"	0.75	1.45	0.09	12.50
46. I pass people unless they speak first	0.85	1.66	0.14	10.10
170. I am afraid of losing my mind	0.64	3.76	0.25	10.40
233. I have difficulty starting things	0.91	0.95	0.07	8.42
False				
9. My life is full of interesting things	1.12	1.68	0.18	9.76
29. At times I feel like swearing	0.16	9.58	1.43	1.52
37. At times I feel like smashing things	0.07	-7.04	1.48	-0.41
49. I am a very sociable person	1.18	1.19	0.05	15.00
55. I keep at it until others lose patience	0.05	-9.96	0.76	-0.38
76. A lot of argument to convince people	0.09	-7.42	0.23	-1.63
134. At times I feel like picking a fight	0.22	-11.00	1.78	-1.38
188. I enjoy different kinds of recreation	1.05	1.83	0.40	4.41
189. I like to flirt	0.36	0.41	0.54	0.83
212. Stood in the way because of principle	0.08	-14.00	0.59	-1.45

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^a*n* = 1,462. ^b*n* = 1,138.

Table 4

Estimated Parameters for the MMPI-2 Harris-Lingoes Physical Malfunctioning Subscale (Subscale D₃)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
18. I have attacks of nausea and vomiting	0.75	4.64	1.12	4.60
117. I have never vomited blood	0.15	-12.50	0.13	-12.30
175. I feel weak all over much of the time	1.87	2.32	1.89	2.37
181. I do not have spells of hay fever	0.11	-10.50	0.13	-8.78
False				
2. I have a good appetite	1.17	3.18	1.03	3.47
20. I am seldom troubled by constipation	0.49	2.63	0.35	5.67
45. I am in as good health as my friends	2.39	1.37	2.29	1.41
141. I have been well most of the time	3.04	1.55	2.59	1.91
142. I have never had a fit or convulsion	0.56	5.03	0.65	4.21
143. I am neither gaining nor losing weight	0.45	0.59	0.55	1.97
148. I have never felt better in my life	0.75	-0.12	1.02	-0.25

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Table 5
Estimated Parameters for the MMPI-2 Harris-Lingoes Mental Dullness Subscale (Subscale D₄)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
15. I work under a great deal of tension	0.25	2.25	0.18	3.01
31. It is hard to keep my mind on a task	1.79	1.61	1.22	1.93
38. Periods when I couldn't "get going"	1.34	0.96	0.98	1.33
73. I am lacking in self-confidence	1.31	0.96	1.39	1.51
92. I don't seem to care what happens to me	0.88	4.26	1.12	3.00
147. I don't understand what I read as well	1.26	1.78	1.18	1.80
170. I am afraid of losing my mind	1.09	2.47	0.96	3.06
233. I have difficulty starting things	1.53	0.68	1.35	0.60
False				
9. My life is full of interesting things	1.25	1.56	1.11	1.95
10. I am as able to work as I ever was	0.74	2.76	0.76	2.50
43. My judgment is better than it ever was	0.71	1.92	0.67	2.16
75. I usually feel that life is worthwhile	0.67	4.78	1.08	3.15
109. I seem about as capable as others	1.03	2.96	0.96	3.33
165. My memory seems to be all right	1.28	2.20	1.26	2.22
188. I enjoy different kinds of recreation	0.44	3.83	0.58	3.12

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Table 6
Estimated Parameters for the MMPI-2 Harris-Lingoes Brooding Subscale (Subscale D₅)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
38. Periods when I couldn't "get going"	1.19	1.03	0.99	1.32
56. I wish I could be as happy as others	1.57	0.61	1.42	0.74
92. I don't seem to care what happens to me	1.11	3.56	1.20	2.86
127. Criticism/scolding hurts me terribly	0.88	-0.44	0.95	0.70
130. I certainly feel useless at times	1.58	0.44	1.69	0.57
146. I cry easily	0.72	0.22	0.57	3.55
170. I am afraid of losing my mind	1.21	2.30	1.04	2.88
215. I brood a great deal	1.98	1.23	1.50	1.60
False				
75. I usually feel that life is worthwhile	1.05	3.29	1.06	3.18
95. I am happy most of the time	2.16	1.59	1.79	1.74

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Harris-Lingoes Psychomotor Retardation subscale (Figure 3). For women, higher levels of information are associated with greater levels of the underlying trait, θ , whereas for men, the opposite is true.

An analysis at the item parameter level suggests that only a few items on the Harris-Lingoes Psychomotor Retardation subscale appear to be related to the common trait for men and women. An examination of the items strongly related to θ for women (Items 9, 49, 188, and 233) suggests that θ is best characterized as a lack of interest in daily activities. For men, θ may be characterized as a disinclination to be physically or verbally violent (Items 29, 37, and 134). The difference between dominant dimensions for women versus men suggests that elevated scores on this subscale represent different kinds of variation.

Subtle Versus Obvious Items

Item parameters for the Depression Subtle subscale and the Depression Obvious subscale are provided in Tables 7 and 8, respectively. Inspection of Table 8 shows that for both men and women very few items previously classified by Wiener and Harmon as Subtle have high values for a (e.g., Items 37, 134, 221).

The lack of discriminating items in the Subtle subscale indicates that respondents in these samples are responding with very little consistency to this set of 18 items. Relative to the full Depression scale, our analysis indicates that the Subtle items are not related to the θ assessed by the full scale items. For the items comprising the Obvious subscale, however, it is clear that a greater proportion of strong positive slopes is obtained (for both men and women).

The information curves for the Subtle and Obvious subscales (Figures 7 and 8) show very different patterns of discriminability that are consistent across samples of men and women. As suggested by the low slopes for the Subtle subscale, little information for any level of θ is available from the item responses. It appears that the Obvious subscale behaves as the full Depression scale; these items have high a estimates on the full scale, and the information curves based on the

scales show highest discriminability at greater levels of depression. This finding suggests the need for more detailed analyses. Kemp (1993) describes one such investigation of subtle and obvious MMPI items using IRT methodology.

Discussion and Conclusions

In this investigation we evaluated the item properties and full-scale performance of the MMPI-2 Depression scale and the Harris-Lingoes and Wiener-Harmon subscales using the two-parameter IRT model. We also examined hypotheses related to differences between men and women in item response patterns and to a priori classifications of subtle versus obvious item types.

Our results for the full Depression scale show that, while there are some very strongly discriminating items and the scale, as a whole, discriminates in the expected area of the underlying dimension, there appear to be subsets of consistent responding likely indicative of multidimensionality. Further analyses on the Harris-Lingoes subscales produced highly variable slope parameters, suggesting that these subsets of items may also be multidimensional.

While the full scale and most of the subscales had similar parameter estimates and information curves for men and women (although women tended to have slightly stronger a parameters), the Harris-Lingoes Psychomotor Retardation subscale appeared to reflect different underlying traits for men and women. In particular, the subsets of items showing the strongest slope parameters for men and women were consistent with different components of Harris-Lingoes' conceptual definition of the subscale (cf. Butcher et al., 1989), with women exhibiting a lack of interest in daily activities and men showing a disinclination to be physically or verbally violent.

Our analyses of the subtle versus obvious classifications made by Wiener and Harmon (1946) suggest that there may be real differences in the response consistency for each of the item subsets. The dominant items comprising each subscale differed and their information functions showed discriminability at very different levels of their

Table 7
Estimated Parameters for the MMPI-2 Wiener-Harmon Depression, Subtle Subscale (Subscale D-S)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
5. I am easily awakened by noise	0.02	-9.80	0.02	14.70
117. I have never vomited blood	0.49	-3.97	0.25	-6.46
181. I do not have spells of hay fever	0.09	-13.30	0.08	-15.00
False				
29. At times I feel like swearing	0.69	2.39	0.92	2.04
37. At times I feel like smashing things	1.10	-0.56	1.33	-0.44
55. I keep at it until others lose patience	0.71	-0.84	0.68	-0.42
68. I sometimes tease animals	0.84	-2.47	0.94	-1.20
76. A lot of argument to convince people	0.48	-1.51	0.45	-0.89
134. At times I feel like picking a fight	1.94	-1.87	1.57	-1.48
143. I am neither gaining nor losing weight	0.02	10.10	0.09	10.80
148. I have never felt better in my life	0.00	-24.50	0.01	-25.80
178. I break into a sweat when embarrassed	0.53	-1.90	0.64	-1.94
189. I like to flirt	0.65	0.24	0.54	0.84
212. Stood in the way because of principle	0.56	-2.22	0.60	-1.43
221. I dream frequently, best kept to myself	1.07	-1.16	0.78	-1.36
226. Sometimes without reason I feel happy	0.90	-0.52	0.84	-0.73
238. I sweat very easily even on cool days	0.66	-2.66	0.44	-2.49
267. Periods cheerful without any reason	0.94	1.08	0.92	0.73

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respective underlying traits. For this sample, the observed pattern of responses was more consistent (and related to depression) for the obvious than for the subtle items. However, the generalizability of this finding must be demonstrated in further research on clinical samples. It is possible that the response patterns for the two populations would be sufficiently different that the relations of the items on each scale to the underlying trait would be dramatically altered.

In this study, we have demonstrated how IRT can be employed to address hypotheses in the context of personality data. However, in interpreting our findings, the following issues should be considered. First, this large normative sample of MMPI

item responses provided an unusual opportunity for modeling, unconstrained by common concerns of sample size and homogeneity of respondents. Second, given the construct under consideration, we must be aware of possible violations of distributional assumptions of the IRT model. Specifically, the parameter estimation system we used assumed that the underlying θ is normally distributed. In this sample, the validity of that assumption is unknown. Finally, much of our evidence has suggested that the full Depression scale and its associated subscales may be multidimensional, suggesting that IRT models applied to unidimensional subsets of items based on an item factor analysis would be more informative.

Table 8

Estimated Parameters for the MMPI-2 Wiener-Harmon Depression, Obvious Subscale (Subscale D-O)

Item	Women ^a		Men ^b	
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
True				
15. I work under a great deal of tension	0.37	1.50	0.32	1.66
18. I have attacks of nausea and vomiting	0.76	4.55	0.88	5.57
31. It is hard to keep my mind on a task	1.48	1.70	1.14	1.98
38. Periods when I couldn't "get going"	1.26	0.94	0.96	1.32
39. My sleep is fitful and disturbed	1.23	1.81	0.84	2.70
46. I pass people unless they speak first	0.54	2.36	0.65	2.42
56. I wish I could be as happy as others	1.47	0.58	1.17	0.82
73. I am lacking in self-confidence	1.72	0.78	1.57	1.37
92. I don't seem to care what happens to me	1.02	3.71	1.17	2.87
127. Criticism/scolding hurts me terribly	0.88	-0.48	0.77	0.80
130. I certainly feel useless at times	1.58	0.40	1.34	0.62
146. I cry easily	0.65	0.20	0.65	3.15
147. I don't understand what I read as well	1.14	1.84	0.97	2.03
170. I am afraid of losing my mind	1.20	2.24	1.19	2.59
175. I feel weak all over much of the time	1.52	2.52	1.84	2.37
215. I brood a great deal	1.71	1.26	1.36	1.66
233. I have difficulty starting things	1.19	0.74	1.04	0.69
False				
2. I have a good appetite	1.23	3.01	1.00	3.53
9. My life is full of interesting things	1.31	1.46	1.39	1.65
10. I am as able to work as I ever was	0.92	2.27	0.77	2.44
20. I am seldom troubled by constipation	0.55	2.29	0.53	3.82
33. I seldom worry about my health	0.79	0.78	0.60	0.93
43. My judgment is better than it ever was	0.72	1.85	0.60	2.33
45. I am in as good health as my friends	1.08	2.00	1.08	2.08
49. I am a very sociable person	0.59	1.96	0.50	1.45
75. I usually feel that life is worthwhile	0.94	3.52	1.34	2.67
95. I am happy most of the time	2.06	1.55	1.87	1.67
109. I seem about as capable as others	0.98	3.01	0.97	3.26
118. I do not worry about catching diseases	0.50	1.18	0.45	1.24
140. I go to sleep without ideas bothering me	0.99	1.14	0.71	1.88
141. I have been well most of the time	1.20	2.29	1.22	2.76
142. I have never had a fit or convulsion	0.61	4.54	0.45	5.86
165. My memory seems to be all right	1.28	2.14	1.00	2.57
188. I enjoy different kinds of recreation	0.53	3.14	0.66	2.75
223. I am no more nervous than most others	1.03	1.67	0.92	2.08
245. Not worry about whether door is locked	-0.08	11.40	-0.05	14.70
248. Not blame for taking advantage of people	-0.28	7.83	-0.56	3.36
260. Once in a while I laugh at a dirty joke	0.23	11.20	0.25	12.30
330. At times I am all full of energy	0.91	3.36	0.82	3.13

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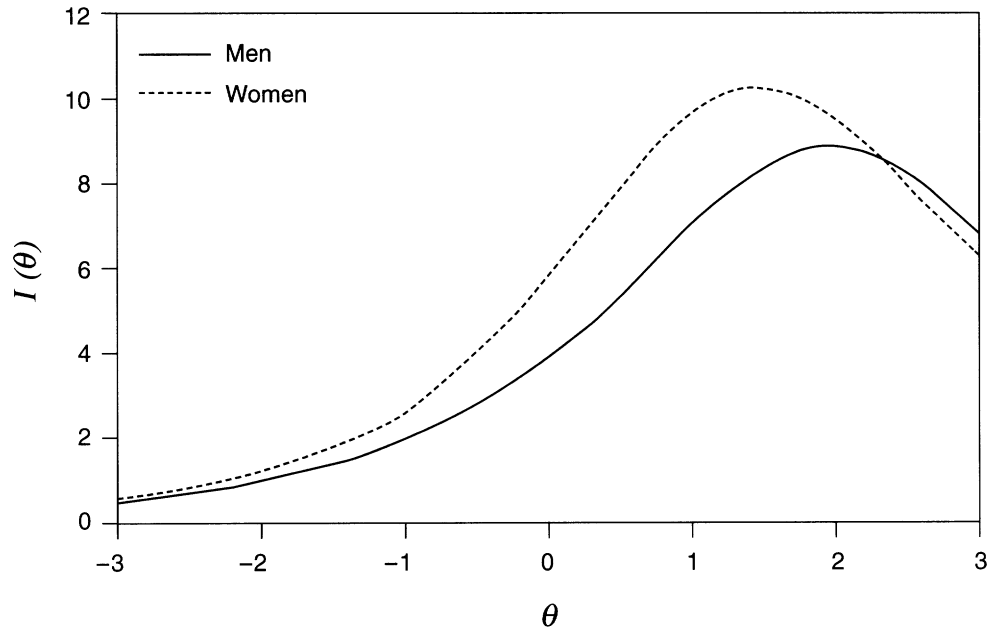


Figure 1. Information curves for the MMPI-2 Depression Scale (Scale D).

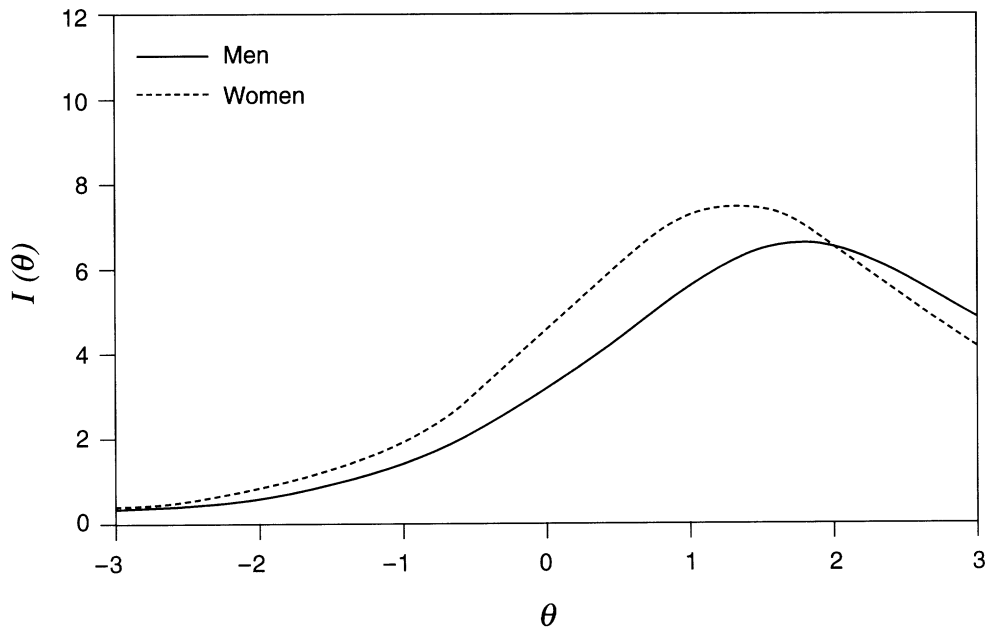


Figure 2. Information curves for the MMPI-2 Harris-Lingoes Subjective Depression Subscale (Subscale D_1).

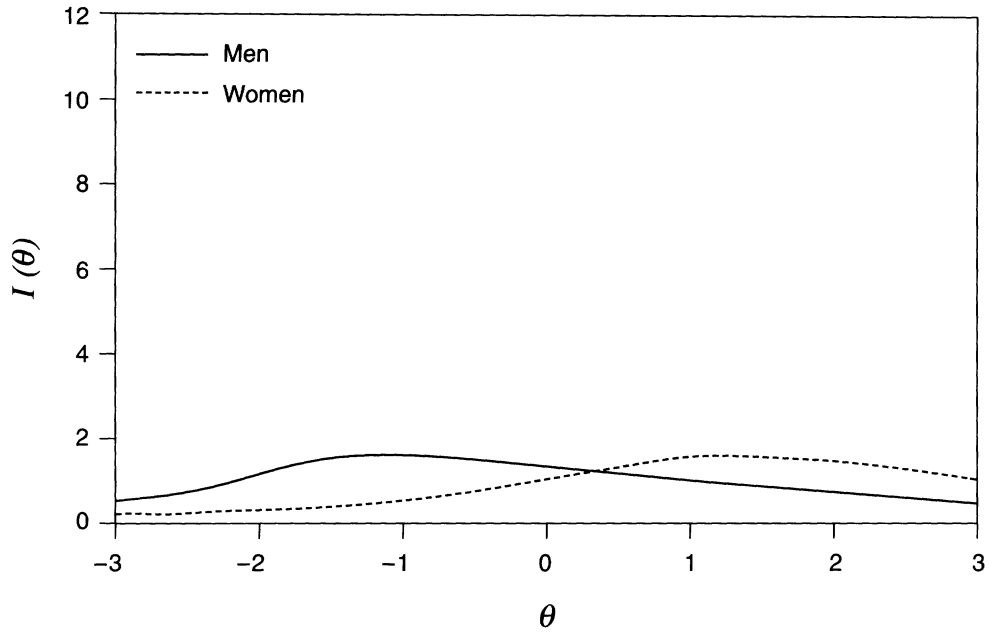


Figure 3. Information curves for the MMPI-2 Harris-Lingoes Psychomotor Retardation Subscale (Subscale D_2).

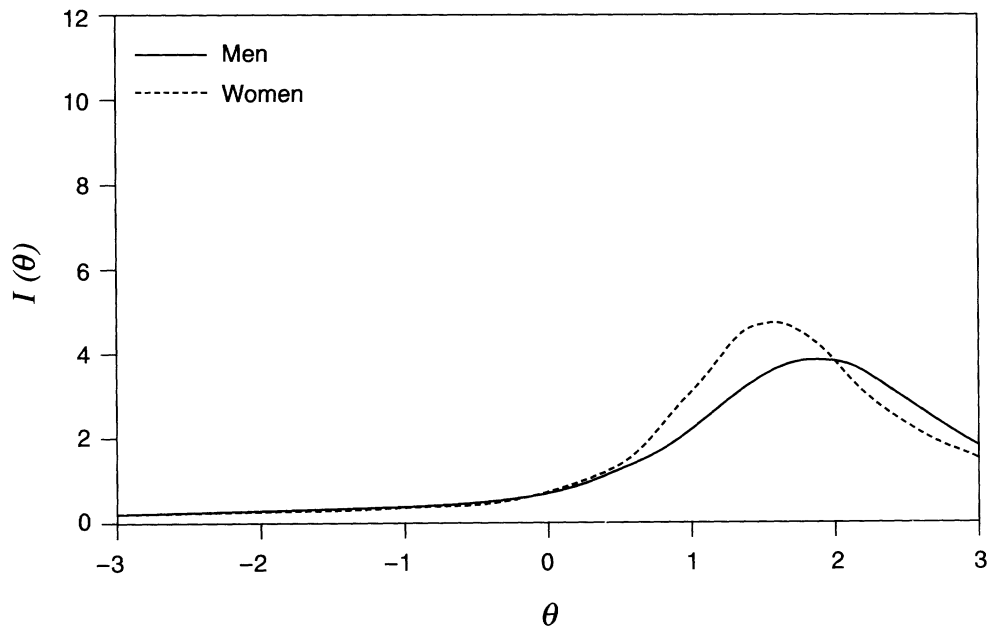


Figure 4. Information curves for the MMPI-2 Harris-Lingoes Physical Malfunctioning Subscale (Subscale D_3).

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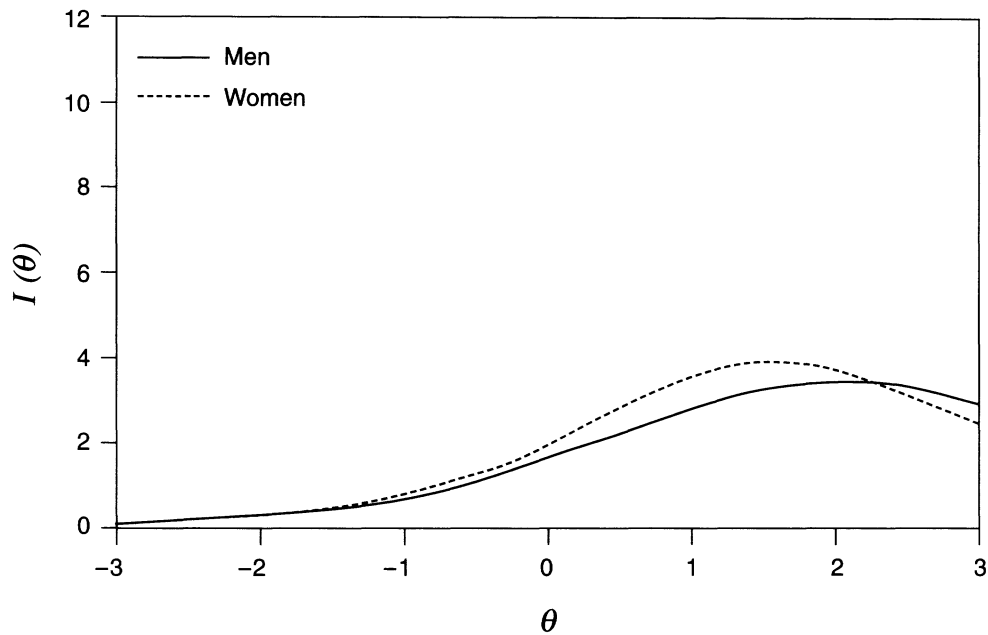


Figure 5. Information curves for the MMPI-2 Harris-Lingoes Mental Dullness Subscale (Subscale D_4).

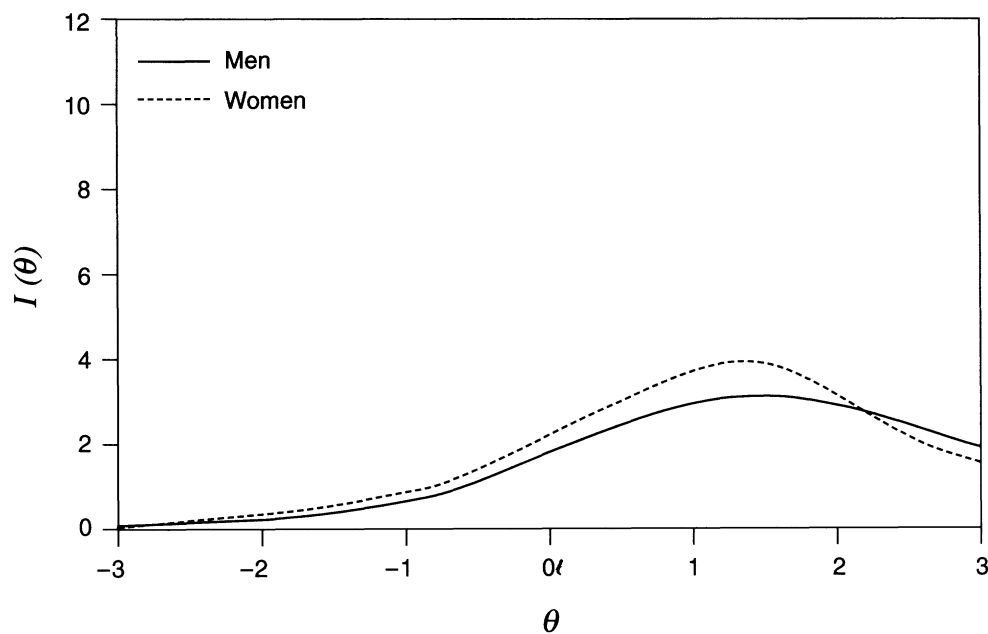


Figure 6. Information curves for the MMPI-2 Harris-Lingoes Brooding Subscale (Subscale D_5).

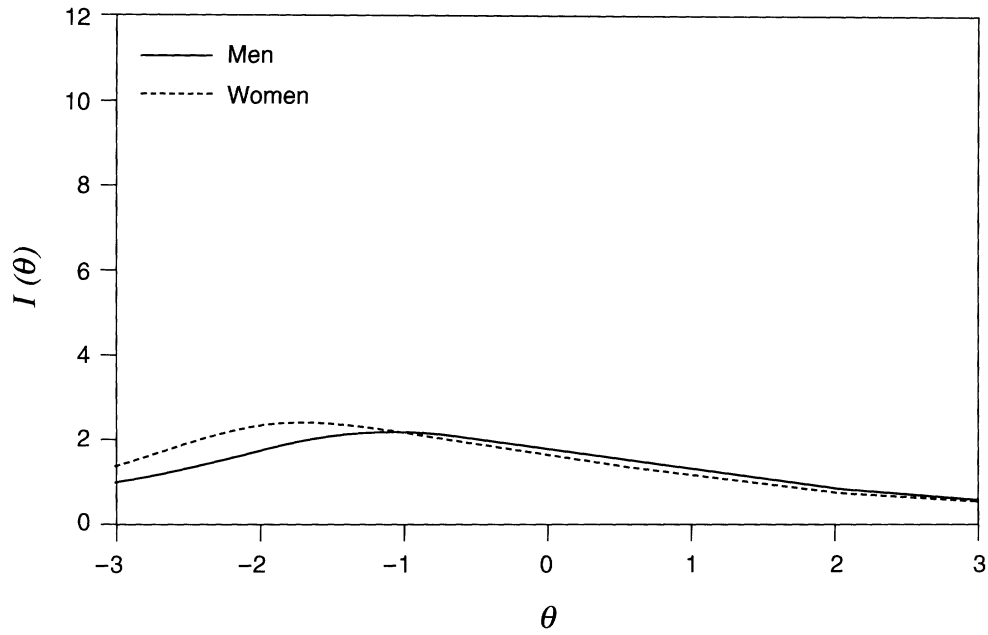


Figure 7. Information curves for the MMPI-2 Wiener-Harmon Depression, Subtle Subscale (Subscale *D-S*).

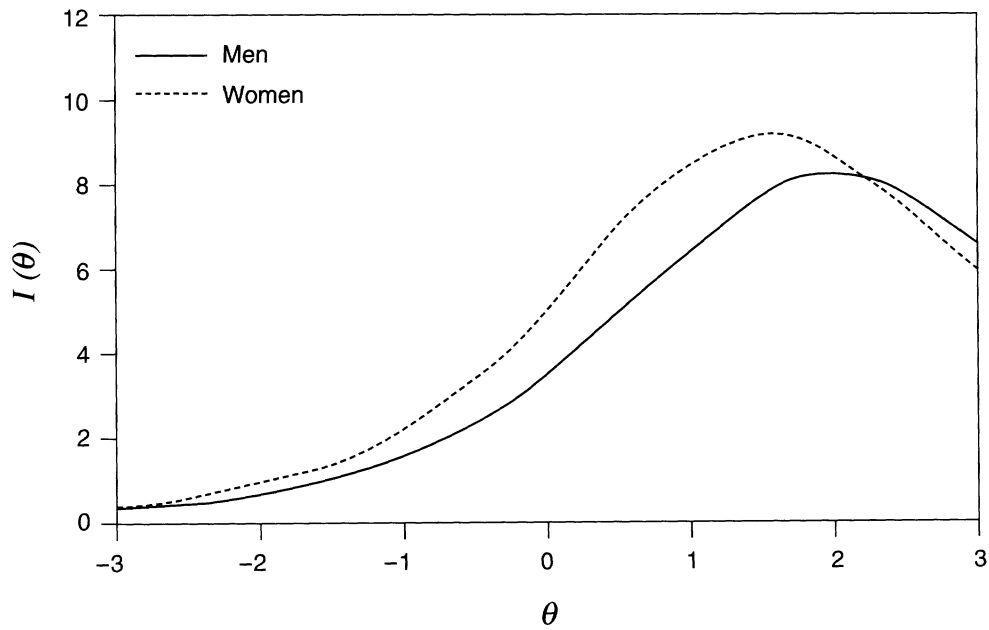


Figure 8. Information curves for the MMPI-2 Wiener-Harmon Depression, Obvious Subscale (Subscale *D-O*).