Fatigue Archival Analysis Report

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General Introduction:

The SCC secondary analyses were conducted to provide information about the psychometric properties of existing measures in the five targeted PROMIS domains (physical function, emotional distress, fatigue, pain, social health). We were interested in evaluating whether sets of items putatively measuring the same thing were sufficiently unidimensional for IRT analyses and estimating item parameters (i.e., difficulty and discrimination) for the items in the measures. These analyses were intended to provide preliminary information about item characteristics and performance that could help guide decisions for the PROMIS field test. This report documents the results of the fatigue related analyses.

We started by identifying items that were potentially measuring fatigue in seven datasets in the SCC archives (shown on Table 1). Among four datasets that included fatigue items, one had only 2 items and another had only 4 items; therefore, they were not analyzed. This report summarizes analysis results of the UBC Fatigue (CHC; 13 items) and the NWU/CORE Cancer Fatigue (Cancer Fatigue; 72 items) datasets.

Table 1. Datasets Summary

Dataset	# of fatigue related items	Analyzed?
CHC (UBC Fatigue)	13	Yes
NWU/CORE Cancer Fatigue	72	Yes
WHOQOL	4	No
CHS	2	No
NGHS	0	No
DIG	0	No
CSSCD	0	No

Sample:

- *CHC:*
  - 1,225 Patients with chronic hepatitis C who participated phase II and III clinical trials in Europe and the United States.
- *Cancer Fatigue:*
  - 555 patients who received cancer treatment in four oncology clinics (Northwestern Memorial Hospital, Evanston Hospital, Glenbrook Hospital and Highland Park Hospital) in the Chicago metropolitan.

Items that were analyzed:

- *CHC:*
  - Nine Fatigue Severity Scale (FSS) and four SF-36 vitality items.
- *Cancer Fatigue:*
  - 72 CORE fatigue items (13 FACIT-fatigue items, 1 FACT-G item, and 58 items written by the CORE item banking research team). All negatively worded items were reversed so that higher scores represent less fatigue (better quality of life).

Item descriptions are shown in Table 2 and item descriptive characteristics (mean, standard deviation, median, range, floor and ceiling effects) are shown on Table 3.

Support for sufficient unidimensionality:

- *CHC:*
    - Cronbach's α = 0.95; item-total correlations ranged from 0.61 to 0.87. Exploratory factor analysis suggested the existence of one common factor among these 13 items using the scree-greater-than-one criterion. The highest eigenvalue is 8.08, and the next highest is 0.98. A one-factor confirmatory factor analysis resulted in a Bentler and Bonnet (1980) normed fit index of 0.87 and non-normed fit index of 0.87, with a root mean square residual of 0.057.
- *Cancer Fatigue:*
    - Cronbach's α = 0.99; item-total correlations ranged from 0.47 to 0.80. Items were divided into five sub-domains: non-specific cancer-related fatigue, negatively-worded items assessing physical functioning fatigue, positively-worded items assessing physical functioning fatigue, social and family functioning fatigue, and mental health fatigue. A bi-factor CFA analysis was conducted on all but two items. The highly correlated pair of items "I feel fatigued" and "I feel tired" (rho=0.85) caused difficulties, so we set aside "I feel fatigued" from the analysis. Item "I have had energy to take a bath or shower" had more unexplained than explained variance and was also set aside from this analysis. Bi-factor analysis showed sufficient unidimensionality among the remaining 70 items. All item had a significantly higher factor loading on the general factor than on the sub-domain.

IRT item parameter estimation

Item parameters were estimated using the graded response model with free slope parameters. Table 4 shows the slope and thresholds of each item. The threshold parameter is the location where the probability is 50% of endorsing that response category or a higher category.

CHC:

Samejima's Graded Response Model was estimated using MULTILOG. In general, the slope parameters of all items are large, indicating a strong association between the items and the latent trait. The item with the highest slope parameter was FSS 5 (Fatigue causes frequent problem for me), and FSS 1 (My motivation is lower when I am fatigue) had the smallest slope parameter. Six out of nine FSS items had slope parameters above 3.0, but all four of the SF-36 Vitality items were around 2.0. The reason for this difference is due to having more FSS items than SF-36 vitality scale items in the analysis (9 vs. 4). However, slope parameters of 2.0 still indicate strong association. Of the 13 items, the FSS item 1 represents the least severity of fatigue and the SF-36 Vitality item 3 indicates the most severe fatigue symptom.

Cancer Fatigue:

Samejima's Graded Response Model was estimated using PARSCALE. Slope parameters ranged from 0.93 (AN8: need to sleep during the day) to 2.36 (F34: I have been too tired to do errands). Two items had slope less than 1.00 (AN8 and F57: I have had enough energy to eat, 0.98), nine had slopes greater than 2.00, and the remaining items had slopes between 1.00 (included) and 2.00 (included). Item locations ranged from -1.94 (F09: I am too tired to take a bath or shower) to 0.95 (F75: I have had enough energy to exercise strenuously).

Number of response categories

Matrix plots of the item characteristic curves are shown in Figure 1.

CHC:

The characteristic curves for FSS item 1 are relatively flat, especially for the middle category responses, where they are almost on top of each other. This is an indication that few patients endorsed the middle category responses and suggests that FSS item 1 could use fewer response categories than its current 7-point rating scale. Frequency distribution of all response categories in all items show that a relatively small portion of the patients endorsed categories 1, 2, or 3. We may be able to collapse these response categories and make FSS item 1 a 5-response-category item. The characteristics curves for FSS 2-4, 6 and 8 show that the middle categories (e.g., 3 or 4) were not distinct from the others, suggesting the possibility of collapsing them with other categories. No disordered response categories were identified on SF-36 vitality items.

Cancer Fatigue:

Using a 5-point rating scale, two out of 70 items (F57: I have had enough energy to eat; F76: I have had enough energy to play sports) demonstrated disordered steps where category 2 (a little bit) was buried between categories #1 (not at all) and #3 (somewhat). Though there were no clear disordered steps, several items (particularly positively worded items) showed that the middle categories were not significantly differentiated from each others; for example, F33 (#38 in Figure 1a), F54 (#48), F74 (#66), F75 (#65), F77 (#67), and F78 (#69).

In conclusion, we feel that a 5-point (or less than 5) rating scale is appropriate for measuring fatigue for patients with either chronic hepatitis C or cancer.

Coverage of fatigue continuum

Scale information function and error function results are shown in Figure 2. Sufficient coverage of the fatigue continuum is determined by comparing person measures to the range of the threshold parameters.

CHC:

When examining the threshold parameters for when the response category is 1 (no fatigue), we find that the values range from -2.61 (FSS 1) to -0.54 (FSS 8). On the other hand, when examining the threshold parameter for the highest response category (most severe fatigue), we find that the values range from 0.69 (FSS 1) to 2.38 (SF-36 Vitality 3). Other threshold parameters seem to be evenly spread between the lowest and highest values. These threshold parameters indicate that this set of items can measure patients with various degrees of severity of fatigue. Though from scale information function's perspective, the CHC data seem not to be as precise as the cancer fatigue at the lower end of the fatigue continuum. Person measures range from -2.81 to 2.55 (mean=-0.05; SD=0.03), which is well-covered by the above thresholds (lowest: -2.61; highest: 2.38). Therefore, we still conclude that items of the CHC dataset are measuring reasonable fatigue range commonly seen in clinic.

Cancer Fatigue

When examining the threshold parameters for when the response category is 0 (no fatigue), the values range from -0.75 (F57) to 1.88 (F75). When examining the threshold parameters for when the response category is 4 (worst fatigue), the values range from -0.14 (F75) to -3.83 (F04). Other threshold parameters seem to be evenly spread between the lowest and highest values. These threshold parameters indicate that this set of items can measure patients with various degrees of severity of fatigue. Person measures of Cancer Fatigue range from -3.03 (information function=34.54; error function=0.17) to 2.70 (information function=4.12; error function=0.49). Of these persons, 30 (5.4%) had fatigue measures out of the range of the threshold parameters (ranged from -3.83 to 1.88), and all of them were on the higher end of the continuum (i.e., mild or no fatigue).

Conclusion

Items included in both CHC and Cancer Fatigue demonstrated sufficient unidimensionality and could be analyzed using an item response theory model. Though a seven-point rating scale worked well on a number of CHC items, results suggest that a 5-point (or less) rating scale would be an alternative choice for better measuring fatigue. Both item pools had good coverage of the fatigue continuum being measured.

Table 2. Items Analyzed in the Current Report

Table 2a. CHC (UBC Fatigue)

Item		Completely Disagree						Completely Agree
FSS 1.	My motivation is lower when I am fatigue	1	2	3	4	5	6	7
FSS 2.	Exercise brings me fatigue	1	2	3	4	5	6	7
FSS 3.	I am easily fatigued	1	2	3	4	5	6	7
FSS 4.	Fatigue interferes with my physical function	1	2	3	4	5	6	7
FSS 5.	Fatigue causes frequent problems for me	1	2	3	4	5	6	7
FSS 6.	My fatigue prevents sustained physical	1	2	3	4	5	6	7
FSS 7.	Fatigue interferes with carrying out	1	2	3	4	5	6	7
FSS 8.	Fatigue is among my 3 most disabling symptoms	1	2	3	4	5	6	7
FSS 9.	Fatigue interferes with my work, family,	1	2	3	4	5	6	7

Item		All of the time	Most of the time	Some of the time	A little of the time	None of the time
SF-36	Vitality item 1 (Did you feel full of life?)	1	2	3	4	5
SF-36	Vitality item 2 (Did you have a lot of energy?)	1	2	3	4	5
SF-36	Vitality item 3 (Did you feel worn out?)	1	2	3	4	5
SF-36	Vitality item 4 (Did you feel tired?)	1	2	3	4	5

Table 2b. Cancer Fatigue

Item		Rating Scale
GP1	I have a lack of energy.	Intensity
HI7	I feel fatigued.	Intensity [note]
HI12	I feel weak all over.	Intensity
AN1	I feel listless (washed out)	Intensity
AN2	I feel tired.	Intensity
AN3	I have trouble starting things because I am tired	Intensity
AN5	I have energy.	Intensity
AN4	I have trouble finishing things because I am tired.	Intensity
AN7	I am able to do my usual activities.	Intensity
AN8	I need to sleep during the day.	Intensity
AN12	I am too tired to eat	Intensity
AN14	I need help doing my usual activities	Intensity
AN15	I am frustrated by being too tired to do the things I want to do	Intensity
AN16	I have to limit my social activity because I am tired	Intensity
F04	I have been too tired to think clearly.	Frequency
F05	I have been too tired to prepare a meal.	Frequency
F08	I have been too tired to take a short walk.	Frequency
F09	I have been too tired to take a bath or shower.	Frequency
F10	I have been too tired to write a letter.	Frequency
F11	I have been too tired to read.	Frequency
F12	I have been too tired to watch television.	Frequency
F13	I have been too tired to eat.	Frequency
F14	I have been too tired to do my normal household chores.	Frequency
F15	I have been too tired to go out with my friends.	Frequency
F16	I have been too tired to go out with my family.	Frequency
F17	I have been too tired to clean the house.	Frequency
F18	I have been too tired to climb one flight of stairs.	Frequency
F19	I have been too tired to climb more than one flight of stairs.	Frequency
F20	I have been too tired to carry groceries.	Frequency
F21	I have been too tired to enjoy life.	Frequency
F23	I have been too tired to leave the house.	Frequency
F24	I have been too tired to enjoy the things I do for fun.	Frequency
F25	I have been too tired to feel happy.	Frequency
F26	I have been too tired to concentrate.	Frequency
F27	I have felt worn out.	Frequency
F28	I have been so tired that I need to rest during the day.	Frequency
F29	I have been too tired to exercise lightly.	Frequency
F30	I have been too tired to exercise moderately.	Frequency
F33	I have been too tired to lift heavy objects.	Frequency
F34	I have been too tired to do errands.	Frequency
F36	Fatigue interferes with my family life.	Frequency
F37	Fatigue interferes with my social activities.	Frequency
F38	Fatigue interferes with my ability to work.	Frequency
F39	Fatigue interferes with my ability to do household chores.	Frequency

Table 2b. Cancer Fatigue (continued)

Item		Rating Scale
F40	Fatigue makes me depressed.	Frequency
F41	Fatigue interfere with my ability to eat meals.	Frequency
F43	Fatigue interferes with my ability to concentrate.	Frequency
F44	Fatigue interferes with my mood.	Frequency
F53	I have had enough energy to take a bath or shower.	Frequency [note]
F54	I have had enough energy to write a letter.	Frequency
F55	I have had enough energy to read.	Frequency
F57	I have had enough energy to eat.	Frequency
F58	I have had enough energy to do my normal household chores.	Frequency
F59	I have had enough energy to go out with my friends.	Frequency
F60	I have had enough energy to go out with my family.	Frequency
F61	I have had enough energy to clean the house.	Frequency
F62	I have had enough energy to climb one flight of stairs.	Frequency
F63	I have had enough energy to climb more than one flight of stairs.	Frequency
F64	I have had enough energy to carry groceries.	Frequency
F65	I have had enough energy to enjoy life.	Frequency
F67	I have had enough energy to leave the house.	Frequency
F68	I have had enough energy to enjoy the things I do for fun.	Frequency
F69	I have had enough energy to feel happy.	Frequency
F70	I have had enough energy to concentrate.	Frequency
F71	I have felt energetic.	Frequency
F72	I have had enough energy to get through the day without resting.	Frequency
F73	I have had enough energy to exercise lightly.	Frequency
F74	I have had enough energy to exercise moderately.	Frequency
F75	I have had enough energy to exercise strenuously.	Frequency
F76	I have had enough energy to play sports.	Frequency
F77	I have had enough energy to lift heavy objects.	Frequency
F78	I have had enough energy to do errands.	Frequency

Rating Scale:

Intensity: *Not at all; A little bit; Somewhat; Quite a bit; Very much*

Frequency: *None of the time; A little of the time; Some of the time; Most of the time; All of the time*

Note: Two items were not included in the final 2-PL IRT analysis because they had either too high (HI7) or too low (F53) correlation to other items in the pool.

Table 3. Distributional Characteristics

Table 3a. CHC (N=1225)

Items	Mean(SD)	Range	Median	Floor (n, %)	Ceiling (n, %)	Missing (n, %)
FSS 1.	5.2(1.8)	1.0-7.0	6.0	(72, 5.9%)	(387, 31.6%)	(8, 0.7%)
FSS 2.	3.8(2.0)	1.0-7.0	4.0	(207, 16.9%)	(151, 12.3%)	(4, 0.3%)
FSS 3.	3.8(2.0)	1.0-7.0	4.0	(206, 16.8%)	(173, 14.1%)	(7, 0.6%)
FSS 4.	4.1(2.0)	1.0-7.0	4.0	(164, 13.4%)	(198, 16.2%)	(8, 0.7%)
FSS 5.	3.3(2.0)	1.0-7.0	3.0	(298, 24.3%)	(128, 10.4%)	(10, 0.8%)
FSS 6.	3.6(2.1)	1.0-7.0	3.0	(271, 22.1%)	(161, 13.1%)	(5, 0.4%)
FSS 7.	3.4(2.1)	1.0-7.0	3.0	(295, 24.1%)	(142, 11.6%)	(7, 0.6%)
FSS 8.	3.2(2.2)	1.0-7.0	3.0	(407, 33.2%)	(180, 14.7%)	(7, 0.6%)
FSS 9.	3.4(2.1)	1.0-7.0	3.0	(326, 26.6%)	(160, 13.1%)	(4, 0.3%)
SF-36 Vitality item 1[1]	3.5(1.3)	1.0-6.0	3.0	(44, 3.6%)	(91, 7.4%)	(13, 1.1%)
SF-36 Vitality item 2[1]	3.6(1.4)	1.0-6.0	4.0	(45, 3.7%)	(124, 10.1%)	(14, 1.1%)
SF-36 Vitality item 3[1]	2.8(1.3)	1.0-6.0	3.0	(198, 16.2%)	(49, 4.0%)	(14, 1.1%)
SF-36 Vitality item 4[1]	3.2(1.3)	1.0-6.0	3.0	(77, 6.3%)	(84, 6.9%)	(8, 0.7%)

[1] Reversed coding from original SF-36 Vitality items

Table 3b. Cancer Fatigue

					Floor (worst rating)		Ceiling (best rating)		Missing	
Item	**Mean**	**SD**	**Median**	**Range**	**n**	**%**	**n**	**%**	**n**	**%**
GP1	2.47	1.15	3	0-4	34	6.13%	108	19.46%	1	0.18%
HI12	3.07	1.12	3	0-4	19	3.42%	265	47.75%	2	0.36%
HI7	2.43	1.15	3	0-4	34	6.13%	107	19.28%	1	0.18%
AN1	2.82	1.16	3	0-4	21	3.78%	194	34.95%	6	1.08%
AN2	2.43	1.12	3	0-4	34	6.13%	92	16.58%	1	0.18%
AN3	2.82	1.12	3	0-4	21	3.78%	183	32.97%	4	0.72%
AN4	2.81	1.10	3	0-4	22	3.96%	182	32.79%	3	0.54%
AN5	2.28	1.06	2	0-4	35	6.31%	68	12.25%	1	0.18%
AN7	2.54	1.18	3	0-4	34	6.13%	135	24.32%	1	0.18%
AN8	2.94	1.04	3	0-4	16	2.88%	190	34.23%	2	0.36%
AN12	3.59	0.78	4	0-4	2	0.36%	404	72.79%	1	0.18%
AN14	3.23	1.04	4	0-4	18	3.24%	297	53.51%	4	0.72%
AN15	2.69	1.27	3	0-4	39	7.03%	192	34.59%	5	0.90%
AN16	2.77	1.20	3	0-4	29	5.23%	193	34.77%	5	0.90%
F04	3.33	0.85	4	0-4	2	0.36%	298	53.69%	6	1.08%
F05	3.02	1.06	3	0-4	13	2.34%	235	42.34%	15	2.70%
F08	3.03	1.12	3	0-4	17	3.06%	250	45.05%	12	2.16%
F09	3.63	0.73	4	0-4	3	0.54%	409	73.69%	3	0.54%
F10	3.30	0.99	4	0-4	8	1.44%	317	57.12%	17	3.06%
F11	3.29	0.92	4	0-4	4	0.72%	305	54.95%	3	0.54%
F12	3.47	0.82	4	0-4	2	0.36%	359	64.68%	2	0.36%
F13	3.59	0.74	4	0-4	2	0.36%	400	72.07%	2	0.36%
F14	2.87	1.09	3	0-4	17	3.06%	196	35.32%	12	2.16%
F15	2.98	1.13	3	0-4	20	3.60%	237	42.70%	8	1.44%
F16	3.14	1.03	3	0-4	11	1.98%	271	48.83%	6	1.08%
F17	2.66	1.20	3	0-4	25	4.50%	170	30.63%	27	4.86%
F18	3.43	0.95	4	0-4	5	0.90%	359	64.68%	15	2.70%
F19	3.08	1.20	4	0-4	22	3.96%	289	52.07%	19	3.42%
F20	3.23	1.10	4	0-4	23	4.14%	308	55.50%	18	3.24%
F21	3.19	0.97	3	0-4	9	1.62%	271	48.83%	4	0.72%
F23	3.27	0.94	4	0-4	5	0.90%	296	53.33%	4	0.72%
F24	2.93	1.08	3	0-4	10	1.80%	221	39.82%	5	0.90%
F25	3.30	0.92	4	0-4	4	0.72%	306	55.14%	5	0.90%
F26	3.13	0.90	3	0-4	4	0.72%	230	41.44%	7	1.26%
F27	2.61	1.05	3	0-4	19	3.42%	114	20.54%	5	0.90%
F28	2.83	1.08	3	0-4	19	3.42%	169	30.45%	5	0.90%
F29	2.74	1.21	3	0-4	27	4.86%	186	33.51%	13	2.34%
F30	2.48	1.29	3	0-4	53	9.55%	145	26.13%	18	3.24%
F33	2.27	1.43	2	0-4	77	13.87%	144	25.95%	32	5.77%
F34	2.93	1.09	3	0-4	22	3.96%	209	37.66%	11	1.98%
F36	2.93	1.09	3	0-4	20	3.60%	213	38.38%	10	1.80%
F37	2.83	1.12	3	0-4	22	3.96%	196	35.32%	9	1.62%

Table 3b. Cancer Fatigue (continued)

					Floor (worst rating)		Ceiling (best rating)		Missing	
Item	Mean	SD	Median	Range	n	%	n	%	n	%
F38	2.78	1.22	3	0-4	36	6.49%	182	32.79%	50	9.01%
F39	2.73	1.14	3	0-4	19	3.42%	177	31.89%	18	3.24%
F40	3.06	1.08	3	0-4	17	3.06%	249	44.86%	6	1.08%
F41	3.46	0.90	4	0-4	7	1.26%	368	66.31%	4	0.72%
F43	3.01	0.99	3	0-4	10	1.80%	212	38.20%	6	1.08%
F44	2.88	1.01	3	0-4	12	2.16%	179	32.25%	6	1.08%
F53	3.38	1.02	4	0-4	22	3.96%	347	62.52%	5	0.90%
F54	2.96	1.20	3	0-4	31	5.59%	239	43.06%	21	3.78%
F55	3.12	1.02	3	0-4	15	2.70%	248	44.68%	5	0.90%
F57	3.45	0.90	4	0-4	12	2.16%	353	63.60%	4	0.72%
F58	2.67	1.17	3	0-4	27	4.86%	155	27.93%	18	3.24%
F59	2.68	1.26	3	0-4	46	8.29%	180	32.43%	7	1.26%
F60	2.90	1.14	3	0-4	25	4.50%	208	37.48%	8	1.44%
F61	2.37	1.27	3	0-4	54	9.73%	115	20.72%	31	5.59%
F62	3.15	1.13	4	0-4	22	3.96%	288	51.89%	16	2.88%
F63	2.68	1.36	3	0-4	59	10.63%	204	36.76%	19	3.42%
F64	2.84	1.31	3	0-4	48	8.65%	230	41.44%	20	3.60%
F65	2.92	1.07	3	0-4	16	2.88%	195	35.14%	5	0.90%
F67	3.15	1.03	3	0-4	16	2.88%	262	47.21%	4	0.72%
F68	2.68	1.15	3	0-4	31	5.59%	157	28.29%	7	1.26%
F69	2.96	1.00	3	0-4	18	3.24%	181	32.61%	4	0.72%
F70	3.03	0.90	3	0-4	10	1.80%	176	31.71%	3	0.54%
F71	2.10	1.16	2	0-4	63	11.35%	56	10.09%	3	0.54%
F72	2.31	1.27	3	0-4	68	12.25%	97	17.48%	4	0.72%
F73	2.30	1.37	3	0-4	76	13.69%	128	23.06%	17	3.06%
F74	2.03	1.42	2	0-4	112	20.18%	100	18.02%	23	4.14%
F75	1.12	1.35	1	0-4	257	46.31%	40	7.21%	36	6.49%
F76	1.32	1.41	1	0-4	217	39.10%	50	9.01%	61	10.99%
F77	1.77	1.45	2	0-4	153	27.57%	78	14.05%	27	4.86%
F78	2.60	1.24	3	0-4	42	7.57%	154	27.75%	7	1.26%

Table 4. Item Parameter Estimates by Graded Response Model with Free Slope Parameters

Table 4a. CHC

Item	Slope	Threshold 1	Threshold 2	Threshold 3	Threshold 4	Threshold 5	Threshold 6
FSS 1	1.38	-2.61	-1.85	-1.45	-0.82	-0.05	0.69
FSS 2	1.59	-1.47	-0.77	-0.33	0.35	1.05	1.63
FSS 3	3.17	-1.15	-0.51	-0.16	0.25	0.76	1.15
FSS 4	2.57	-1.39	-0.71	-0.34	0.14	0.62	1.12
FSS 5	4.04	-0.82	-0.16	0.17	0.52	0.94	1.27
FSS 6	3.64	-0.91	-0.29	0.02	0.37	0.73	1.16
FSS 7	3.37	-0.85	-0.22	0.11	0.43	0.84	1.27
FSS 8	3.34	-0.54	-0.05	0.21	0.55	0.84	1.11
FSS 9	3.67	-0.74	-0.19	0.11	0.40	0.78	1.16
SF-36 Vitality 1	1.90	-2.59	-0.79	-0.05	0.91	1.93	
SF-36 Vitality 2	2.10	-2.47	-0.81	-0.12	0.71	1.60	
SF-36 Vitality 3	1.89	-1.41	-0.23	0.78	1.62	2.38	
SF-36 Vitality 4	2.12	-2.08	-0.64	0.38	1.10	1.89	

[1] Reversed coding from original SF-36 Vitality items

Table 4b. Cancer Fatigue

Item	Slope	Threshold 1	Threshold 2	Threshold 3	Threshold 4
GP1	1.58	0.97	0.12	-0.66	-1.85
HI12	1.89	0.12	-0.60	-1.17	-1.91
AN1	1.77	0.51	-0.41	-0.95	-1.88
AN2	1.65	1.05	0.18	-0.57	-1.88
AN3	1.82	0.50	-0.30	-0.98	-1.94
AN5	1.54	1.33	0.48	-0.61	-1.88
AN4	1.67	0.47	-0.19	-1.11	-2.01
AN7	1.38	0.83	-0.01	-0.84	-1.92
AN8	0.93	0.48	-0.60	-1.46	-2.97
AN12	1.35	-0.50	-1.58	-2.35	-3.10
AN14	1.44	-0.22	-0.73	-1.40	-2.27
AN15	1.84	0.46	-0.20	-0.79	-1.59
AN16	2.10	0.44	-0.28	-0.84	-1.68
F04	1.02	0.13	-1.24	-2.77	-3.83
F05	1.45	0.27	-0.55	-1.46	-2.29
F08	1.54	0.19	-0.58	-1.27	-2.05
F09	1.33	-0.73	-1.46	-2.38	-3.20
F10	1.47	-0.10	-0.95	-1.66	-2.36
F11	1.20	0.05	-1.04	-2.27	-3.10
F12	1.23	-0.20	-1.44	-2.52	-3.36
F13	1.35	-0.59	-1.40	-2.48	-3.22
F14	2.04	0.44	-0.28	-1.11	-1.92
F15	2.03	0.24	-0.42	-1.11	-1.84
F16	1.88	0.12	-0.63	-1.44	-2.16
F17	1.99	0.67	-0.17	-0.87	-1.62
F18	1.40	-0.13	-1.28	-1.89	-2.52
F19	1.29	0.13	-0.75	-1.32	-1.93
F20	1.73	-0.24	-0.65	-1.26	-1.92
F21	2.03	0.04	-0.64	-1.47	-2.28
F23	2.19	0.04	-0.82	-1.64	-2.37
F24	2.23	0.48	-0.50	-1.28	-1.99
F25	1.60	0.07	-1.03	-1.87	-2.68
F26	1.46	0.35	-0.72	-1.93	-2.96
F27	1.89	0.88	-0.03	-0.85	-2.06
F28	1.44	0.57	-0.33	-1.04	-2.25
F29	1.71	0.55	-0.31	-0.87	-1.74
F30	1.33	0.74	0.03	-0.66	-1.60
F33	1.33	0.84	0.07	-0.44	-1.19
F34	2.36	0.24	-0.25	-1.06	-1.86
F36	1.73	0.29	-0.28	-1.22	-2.01
F37	2.12	0.41	-0.21	-1.05	-1.79
F38	1.63	0.39	-0.12	-0.84	-1.68
F39	2.30	0.62	-0.20	-0.98	-1.71

Table 4b. Cancer Fatigue (continued)

Item	Slope	Threshold 1	Threshold 2	Threshold 3	Threshold 4
F40	1.10	0.23	-0.65	-1.52	-2.47
F41	1.33	-0.45	-1.13	-1.99	-2.66
F43	1.31	0.40	-0.53	-1.58	-2.63
F44	1.37	0.57	-0.32	-1.42	-2.48
F54	1.16	0.09	-0.50	-1.23	-2.14
F55	1.00	-0.02	-0.77	-1.69	-2.97
F57	0.98	-0.75	-1.32	-2.04	-3.23
F58	1.98	0.59	-0.13	-0.76	-1.74
F59	1.68	0.39	-0.10	-0.74	-1.64
F60	1.68	0.26	-0.35	-0.99	-1.96
F61	1.77	0.81	0.17	-0.45	-1.50
F62	1.25	-0.08	-0.72	-1.35	-2.13
F63	1.22	0.37	-0.18	-0.78	-1.59
F64	1.49	0.14	-0.36	-0.84	-1.64
F65	1.77	0.36	-0.43	-1.11	-2.19
F67	1.57	-0.07	-0.64	-1.36	-2.34
F68	1.77	0.53	-0.05	-0.88	-1.87
F69	1.33	0.27	-0.35	-1.23	-2.61
F70	1.22	0.28	-0.54	-1.43	-3.10
F71	1.61	1.37	0.65	-0.23	-1.59
F72	1.19	1.02	0.33	-0.37	-1.75
F73	1.39	0.84	0.17	-0.38	-1.34
F74	1.39	1.02	0.45	-0.12	-1.08
F75	1.17	1.88	1.29	0.77	-0.14
F76	1.34	1.53	1.05	0.49	-0.34
F77	1.28	1.23	0.69	0.14	-0.89
F78	1.78	0.54	-0.10	-0.64	-1.69

Figure 1. Matrix Plot of Item Characteristics Curves

Figure 1a. CHC Fatigue

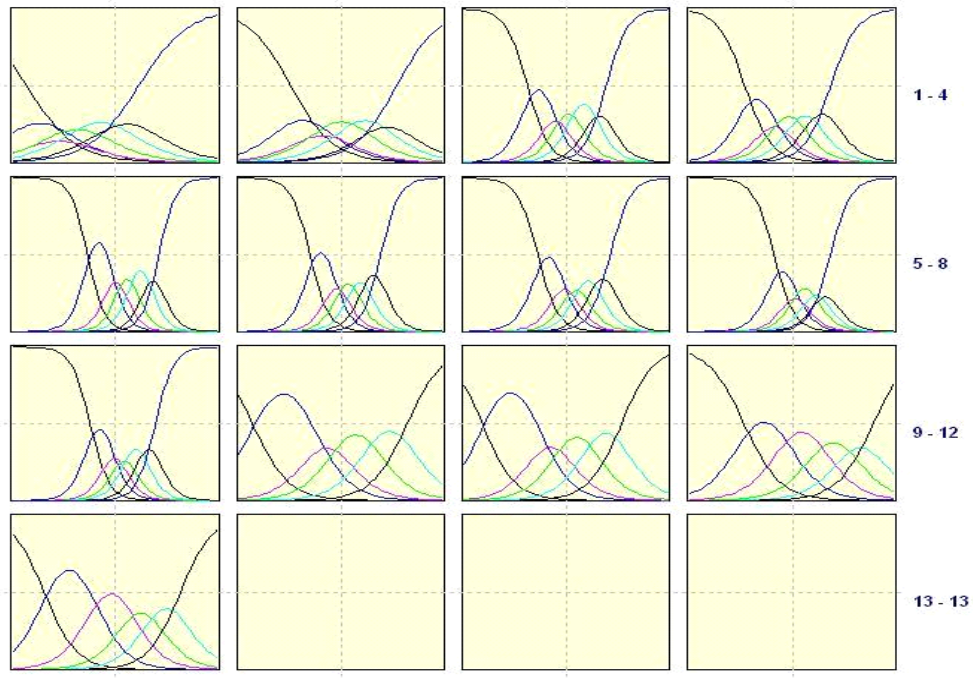

Figure 1b. Cancer Fatigue

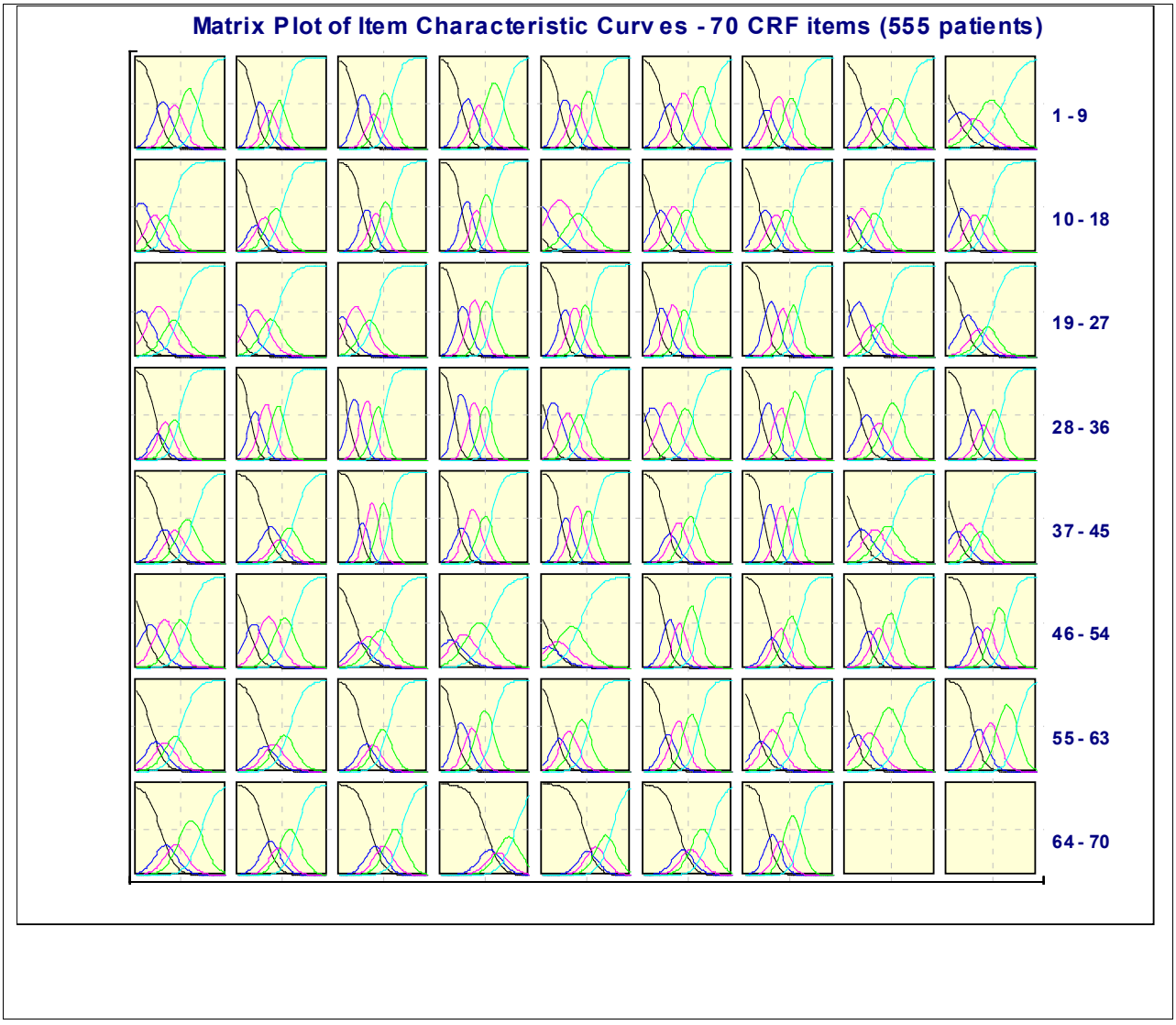

Figure 2. Scale Information Function and Error Function

Figure 2a. CHC Fatigue

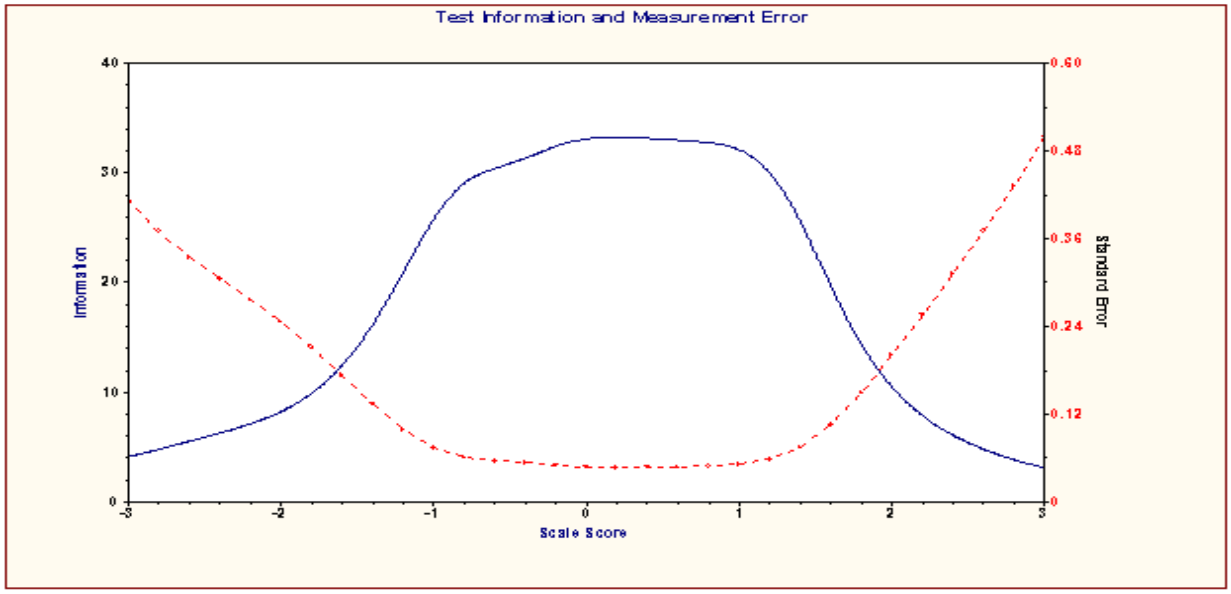

Figure 2b. Cancer Fatigue