

Functional Assessment of Comfort Employing Technology (FACETS): Reliability and Validity

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### Abstract

**Introduction:** Health protocols have not included technology as a specific area of assessment or treatment. The Functional Assessment of Comfort Employing Technology Scale (FACETS) was designed to do so. FACETS is a 10 item questionnaire assessing 5 functional domains. The current study was conducted to establish validity & reliability for FACETS.

**Methods:** Using 423 pre-existing deidentified FACETS forms from clinical records, analyses were conducted including Cronbach's alpha coefficient, McDonald's omega, confidence intervals for alpha and omega, multiple group factor analysis, Fleming's index of scale fit, and differential item (domain) function (DIF).

**Results:** Internal consistency and factor validity for the 10 FACETS items and intra-domain correlations were high. Fleming's factor scale fit index indicated excellent fit. All but one domain contains sufficient unique information to produce differential item functioning.

**Discussion and Conclusions:** FACETS demonstrated high internal consistency reliability, strong general factor validity, and strong factor validity for the five domains.

## Functional Assessment of Comfort Employing Technology (FACETS): Reliability and Validity

### **Introduction**

Protocols for health professionals have not included technology per se as a specific area of assessment or treatment [1]. Most of the research exploring acceptance and utilization of new technologies has come from the information technology sector [2-14]. Several instruments have been developed that assess a person's perception of their own proficiency with various technologies [15-21]. The studies and models described above assess factors determining a person's decision to use specific technologies, or self-perceived proficiency in using specific technologies, but none of them functionally assesses the person's comfort using commonplace current technologies in a way that informs individualized treatment planning, and directs choice of media for communicating with a specific patient to facilitate better treatment outcomes and higher satisfaction ratings by patients and providers of care. The Functional Assessment of Comfort Employing Technology Scale (FACETS, Appendix 1) was designed specifically to meet those previously unaddressed needs.

The FACETS questionnaire consists of 10 questions, two in each of 5 functional domains: Home, Social, E-commerce, Health Care, and Technical. Each question has 6 optional answers that characterize the respondent's comfort with the use of a specific type of technology. The scores for the two questions in each functional domain are added to produce a subtotal for that domain. The five domain subtotal scores are then added to produce an overall total score. Higher scores suggest greater comfort using technologies across domains. There are no foreseen risks or benefits associated with completing FACETS. The current study was conducted to establish validity & reliability for FACETS.

### **Methods**

423 completed FACETS forms were randomly selected using pre-existing deidentified records originally collected for clinical purposes. Respondents varied in age, ethnicity, socioeconomic status, household income, and educational level. No control group was applicable. The Santa Barbara Cottage Health Hospital Review Board granted a waiver for the current data.

### **Statistical Analysis**

The distribution of FACETS scores was markedly non-normally distributed. Consequently, nonparametric statistical tests were used when possible. Cronbach's alpha coefficient was used to assess internal consistency. Additionally, calculated McDonald's omega [22] was calculated. Confidence intervals for alpha and omega were found using bootstrap resampling (5,000 iterations). Item statistics were also derived including the alpha if each item was removed with corrected item total correlations. To address the factor validity of the five domains, multiple group factor analysis, a quasi-confirmatory method, was used [23, 24]. This method uses a weighting matrix to pre-define the factors, in this case the five domains. The weights used the item standard deviations to simulate actually summing the items to construct the domains. An oblique extraction allowed the domains to remain correlated. Fleming's index of scale fit is reported [25]. Differential item (domain) function (DIF) was assessed using partial correlations. Each domain was correlated with age while controlling for the sum of the other domains. Statistical analyses were performed using STATA 15MP and R.

### **Results**

A description of the sample is shown in Table 1. The mean age in the sample was 54.58 (sd = 18.42). The youngest respondent was 18 years of age while the oldest was 95 years old. The sample was predominantly female and had an income between \$50,000 and \$100,000. The

most frequently cited education was a Bachelor's degree. Over 90% had home access to a computer and to the internet.

-----insert Table 1 here-----

Internal consistency for the 10 items was high, Cronbach's alpha = 0.95 (95% CI: 0.94 – 0.96). Similarly, omega was 0.95 (95% CI: 0.94 – 0.96). These high internal consistency values suggest a strong general factor underlying the FACETS score. Alpha is not increased by removing any item and all of the corrected item total correlations are moderate to high, indicating some item redundancy between the items and the large general factor. Item statistics appear in Table 2.

-----insert Table 2 here-----

Table 3 shows the factor structure of the five domain scores.

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All of the items were correlated with all of the domains due to the large general factor. However, the domain specific correlations were near 1.0. Communalities were all 0.95 or higher. The domain intercorrelations ranged from 0.51 (Domain 2 and 4) to 0.83 (Domain 1 and 2). The factor solution accounted for 97.87% of the total variance and the root mean squared residual was less than 0.01, indicating good fit. Fleming's factor scale fit index was 0.99 overall and greater than 0.97 for each domain, also indicating excellent fit.

Differential item (domain) functioning (DIF) was also investigated regarding age of the respondent. Partial correlations were calculated between age and each domain, controlling for the sum of the remaining domains. If the relationship of age was constant across all domains, controlling for the remaining domains should make the partial correlation go to near zero. Only Domain 1 did not show DIF (partial  $r = 0.06$ ,  $p > 0.21$ ). Domains 2, 3, 4, and 5 all showed

differential correlations with the partial correlations ranging from -0.17 (Domain 2) to -0.35 (Domain 3;  $p$ 's < 0.001). These analyses were repeated using partial Spearman correlations with nearly identical results. The partial Spearman correlations ranged from -0.23 (Domain 2) to -0.50 (Domain 3;  $p$ 's < 0.001). Thus, while there is a strong general factor, all but one domain contain sufficient unique information to produce differential item functioning.

### **Discussion and Conclusions**

There are two main findings to this study. One finding is both the large alpha and omega coefficients indicate very high internal consistency reliability for FACETS. The other finding is that FACETS demonstrated strong factor validity for the five domains, in addition to the strong general factor. This finding suggests that both the overall score (summing all of the items) and the five individual domain scores can offer meaningful values.

Additional analyses indicated that domains demonstrated differential item functioning with regard to dependent variables. While this can cause some issues for instruments thought to have a general factor, it adds weight to the validity of the domains. The DIF also supports the need for considering the domains separately, and further confirms the validity of the five domain factor solution.

This study has several strengths as well as limitations. The strengths include a large sample size to generate accurate estimates for the internal consistency coefficients and the factor solution. Another strength was the broad ranges for age, education, and income. However, this was also a convenience sample in a clinical setting, which may limit the generalizability to the general public.

Overall, the high internal consistency reliability and strong factor validity suggest that FACETS has value for determining not only an individual's overall comfort employing various

technologies, but also for determining in which technology domains the individual has greater or lesser comfort. FACETS also appears effective for determining differences between groups, not only in general comfort with IT usage, but within specific IT usage domains. FACETS has demonstrated value in a clinical setting, but further research is recommended using FACETS with a general population. Longitudinal studies using FACETS may also be of value for understanding age, gender, and other differences over time.

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**Summary Table:**

What was already known on the topic:

- Previous research on utilization of technology has come almost entirely from the information technology sector.
- Previous research on utilization of technology has assessed self-perceived proficiency, but not comfort/frequency of use for specific technologies.
- Health assessment and treatment protocols have not assessed comfort/frequency of use for specific technologies.

What this study added to our knowledge:

- The Functional Assessment of Comfort Employing Technology (FACETS) questionnaire was developed for use with general or clinical populations.
- FACETS assesses comfort/frequency of use for specific technologies
- Used as part of a health assessment and treatment planning protocol with a clinical population, FACETS demonstrated high internal consistency reliability and strong factor validity for determining: overall comfort/frequency of use employing various technologies; comfort/frequency of use within specific technology domains; and for both of the above, differences between groups.
- Further FACETS research is recommended with the general population.

**Table 1: Sample Demographics**

<u>Trait</u>	<u>Number of Respondents</u>	<u>% of Sample</u>
<b>Gender</b>		
Male	173	40.9
Female	250	59.1
<b>Race/Ethnicity</b>		
Hispanic	50	11.99
African American	5	1.2
Asian	11	2.64
Other	351	84.17
<b>Income</b>		
<\$25,000	8	1.9
<\$50,000	71	16.9
<\$100,000	154	36.67
<\$150,000	98	23.33
>\$150,000	89	21.19
<b>Education</b>		
N/A	4	0.96
High School	80	19.14
Some college	97	23.21
AA	8	1.91
Bachelor's	180	43.06
Post graduate	49	11.72
<b>Access to computer</b>		
Yes	386	92.79
No	30	7.21
<b>Access to High-speed Internet</b>		
Yes	388	93.49
No	27	6.51

**Table 2: Data by Item, SD, Alpha and Corrected Item Total Correlations if Item Removed**

<u>Item Number</u>	<u>Mean</u>	<u>SD</u>	<u>Alpha if Item Removed</u>	<u>Corrected Item Total Correlation</u>
1	4.32	1.50	0.95	0.73
2	4.19	1.54	0.95	0.75
3	4.35	1.63	0.95	0.68
4	4.07	1.77	0.95	0.69
5	3.11	2.17	0.94	0.89
6	3.13	2.16	0.94	0.87
7	2.63	2.14	0.94	0.86
8	2.58	2.13	0.94	0.85
9	3.14	2.21	0.94	0.80
10	2.74	2.03	0.95	0.79

**Table 3: Factor Structure for Five Domain Scores**

<u>Item Number</u>	<u>Domain 1</u>	<u>Domain 2</u>	<u>Domain 3</u>	<u>Domain 4</u>	<u>Domain 5</u>
1	0.99	0.83	0.55	0.50	0.52
2	0.99	0.80	0.60	0.54	0.55
3	0.82	0.97	0.55	0.47	0.45
4	0.79	0.97	0.56	0.53	0.42
5	0.58	0.57	0.99	0.87	0.75
6	0.58	0.56	0.99	0.85	0.74
7	0.53	0.51	0.87	1.00	0.76
8	0.53	0.51	0.85	1.00	0.75
9	0.55	0.46	0.75	0.75	0.99
10	0.52	0.43	0.74	0.75	0.99



**Appendix 1: Functional Assessment of Comfort Employing Technology Scale**

Age: \_\_\_\_\_  Male/  Female  Hispanic  African American  Asian  Other  
 Household Income:  < \$25,000  < \$50,000  < \$100,000  < \$150,000  > \$150,000  
 Degree:  N/A  High School  Some college  AA  Bachelor's  Post graduate  
 Access to a computer at home?  Yes/  No Access to internet at home?  Yes/  No

**Instructions:** Check the response that most accurately completes each

A.	Home Domain						
1.	I send email...	<input type="radio"/> Never	<input type="radio"/> A few times a year	<input type="radio"/> A few times a month	<input type="radio"/> Once a week	<input type="radio"/> A few times a week	<input type="radio"/> Daily
2.	I find, open & close files in my computer...	<input type="radio"/> Never	<input type="radio"/> A few times a year	<input type="radio"/> A few times a month	<input type="radio"/> Once a week	<input type="radio"/> A few times a week	<input type="radio"/> Daily
Home Domain Subtotal							
B.	Social Domain						
3.	I send text messages using a smart phone...	<input type="radio"/> Never	<input type="radio"/> A few times a year	<input type="radio"/> A few times a month	<input type="radio"/> Once a week	<input type="radio"/> A few times a week	<input type="radio"/> Daily
4.	I post on social media (e.g., facebook, twitter)...	<input type="radio"/> Never	<input type="radio"/> A few times a year	<input type="radio"/> A few times a month	<input type="radio"/> Once a week	<input type="radio"/> A few times a week	<input type="radio"/> Daily
Social Domain Subtotal							
C.	E-Commerce Domain						
5.	I manage my banking and credit card accounts online...	<input type="radio"/> Never	<input type="radio"/> Tried, but it didn't work	<input type="radio"/> Got help but didn't work	<input type="radio"/> Only with help	<input type="radio"/> Can but prefer not to	<input type="radio"/> Prefer to
6.	I pay bills and make purchases via the internet...	<input type="radio"/> Never	<input type="radio"/> Tried, but it didn't work	<input type="radio"/> Got help but didn't work	<input type="radio"/> Only with help	<input type="radio"/> Can but prefer not to	<input type="radio"/> Prefer to
E-Commerce Domain Subtotal							
D.	Health Care Domain						
7.	I communicate with my doctor or clinic online...	<input type="radio"/> Never	<input type="radio"/> Tried, but it didn't work	<input type="radio"/> Got help but didn't work	<input type="radio"/> Only with help	<input type="radio"/> Can but prefer not to	<input type="radio"/> Prefer to
8.	I communicate with my health insurance company online...	<input type="radio"/> Never	<input type="radio"/> Tried, but it didn't work	<input type="radio"/> Got help but didn't work	<input type="radio"/> Only with help	<input type="radio"/> Can but prefer not to	<input type="radio"/> Prefer to
Health Care Domain Subtotal							
E.	Technical Domain						
9.	I have installed components (monitors, speakers, mice)...	<input type="radio"/> Never	<input type="radio"/> Tried, but it didn't work	<input type="radio"/> Got help but didn't work	<input type="radio"/> Only with help	<input type="radio"/> Myself, with difficulty	<input type="radio"/> Myself easily
10.	I have reset a modem or router in my home...	<input type="radio"/> Never	<input type="radio"/> Tried, but it didn't work	<input type="radio"/> Got help but didn't work	<input type="radio"/> Only with help	<input type="radio"/> Myself, with difficulty	<input type="radio"/> Myself easily
Technical Domain Subtotal							
<b>Total FACETS Score</b>							