Scandinavian Journal of Occupational Therapy. 2007; 14: 126–135

informa
healthcare

ORIGINAL ARTICLE

Development and Rasch analysis of the Assessment of Computer-Related Skills

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Abstract
The purpose of this study is to evaluate the internal scale validity, person response validity, and reliability of the newly developed Assessment of Computer-Related Skills (ACRS). Data from 32 healthy adult participants who performed two to three computer tasks were analysed to determine how well the participants fitted the many-faceted Rasch (MFR) model of the ACRS, as well as how well the ACRS skill items and tasks (a) fitted the MFR model of the ACRS, (b) matched the expectations for hierarchical ordering of their difficulties, and (c) differentiated persons into different levels of ability. Results indicated that with three skill items removed, the remaining 34 skill items, 8 computer tasks, and 30 participants demonstrated goodness-of-fit to the MFR model of the ACRS. The skills and tasks appeared to have logical hierarchical ordering and differentiated participants into at least three levels of ability. The findings affirmed the internal scale validity, person response validity and reliability of the ACRS for assessing persons' computer abilities. Future studies using a larger sample that includes individuals with disabilities and with difficulties with computer use are needed to further evaluate the validity and reliability of the ACRS.

Key words: *Computer ability, evaluation, many-faceted Rasch model*

Introduction

The possibilities for the application of computers in everyday life are numerous, and the number of persons exploring these possibilities is increasing (1–6). For example, in a nationwide survey in Sweden, about 70% of respondents aged 16–84 years indicated that they have used a computer at home, at work, or in school. Of those respondents, the youngest user groups (i.e. aged 16–34 years) were most likely to use computers and receive training in computer use (6, p. 42).

As a result, occupational therapists are more likely to encounter clients who identify that they experience difficulties performing daily life tasks that require the use of a computer. Although several studies have been done related to occupational therapy (OT) interventions, such as assistive technologies, to improve clients' access to computers (7–11), there is little information available to guide occupational therapists in the assessment of persons' abilities to use a computer.

This may be because there are only a few existing instruments designed to evaluate a person's ability to use a computer. These include the Assessment of Computer Task Performance (ACTP) (12,13), the Test of Mouse Proficiency (TOMP) (14,15), and the School Version of the Assessment of Motor and Process Skills (School AMPS) (16). They are, however, limited for use with adults. While the ACTP is designed for use with adults, it is used to evaluate only speed and accuracy in manipulating input devices during computer writing and pointing tasks. The TOMP is a computer-based assessment for children, and is used to evaluate only speed, accuracy, mean error, and dysfluency in mouse manipulation. The School AMPS is also designed for use with children. Among the 21 schoolwork tasks included within the School AMPS, only five involve computer-writing. There is a need, therefore, to develop a more comprehensive instrument that can be used to evaluate the computer abilities of adults.

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(Received 1 February 2006; accepted 30 May 2006)
ISSN 1103-8128 print/ISSN 1651-2014 online
DOI: 10.1080/11038120600840192

In response to this need, the Assessment of Computer-Related Skills (ACRS) was developed to enable occupational therapists to evaluate adults' computer-related skills. Computer-related skills are those skills a person needs to perform occupations that entail the use of a computer. To identify these specific computer-related skills, several items from the Assessment of Motor and Process Skills (AMPS) (20) and the School AMPS (16) that also were developed using MFR models were adapted for specific application to computer use. New skills were identified to address specific computer-related skills that were not included in the AMPS and School AMPS. That is, since the virtual environment is unique to the use of computers, the skills used to interact with such an environment were defined, based on performance analyses (21) of computer-related skills. The skills included in the ACRS, including those derived from the AMPS and School AMPS, are presented in Table I.

When using the ACRS, the occupational therapist observes a client performing two to three computer tasks that are considered relevant to his or her daily life but that offer some challenges. Based on these observations, the client is scored on skill items reflecting the quality of his or her performance. In turn, the client's raw ordinal item scores for all tasks observed are transformed into a single linear estimate of computer ability using a Rasch computer program (17,18). More specifically to the development of the ACRS, the FACETS Rasch computer program (18) was used to create a many-faceted Rasch (MFR) measurement model to describe the linear relationship between the ACRS skill items and tasks, and person responses. Rasch measurement models have been discussed in more detail by Bond & Fox (17) and Fisher (19). The basic assertions of the MFR model of the ACRS can be expressed as:

- The easier the computer-related skill or task, the more likely it is to be performed competently by any computer user.
- The more adept a person is in using a computer, the more likely he or she will competently perform more difficult computer-related skills and tasks compared with less skilled persons.
- The more difficult the computer tasks performed, the more difficult all computer-related skills become.

Following the assertions of the MFR model of the ACRS, we expected the skill items in the ACRS to follow a hierarchy similar to those of the items in the AMPS and the School AMPS upon which they were based. However, just as the AMPS and School AMPS hierarchies vary from each other, the skill item hierarchy of the ACRS was expected to vary somewhat in hierarchical order when compared with the AMPS or School AMPS hierarchies.

In addition to computer-related skills, tasks were also another aspect considered in defining the ACRS scale. According to SCB (6, p. 26), to send and receive email is the most common task that involves Internet use among persons in Sweden aged 16–74 years. In contrast, the tasks of searching for information on products and services, reading the news, and downloading music are less common activities done through the Internet. Furthermore, copying and pasting text within a document is more common than performing simple calculations (6). Among daily computer users, it is expected that tasks that are more commonly done will be easier to perform than tasks that are done less often, and that tasks that

Table I. ACRS items.

Interaction with the physical environment (PE)	Interaction with the virtual environment (VE)	Adaptation (AD)
Positions self*	Directs pointer	Responds to cues*
Regulates position	Locates virtual object*	Modifies behaviour*
Moves self	Selects appropriate virtual object*	Modifies environment*
Locates tools and materials*	Uses virtual object*	Adapts performance*
Selects appropriate tools and materials*	Activates virtual object	
Uses tools and materials*	Inserts object	Temporal organization (TO)
Handles tools and materials*	Provides information	Initiates actions*
Manipulates tools and materials*	Seeks information*	Continues actions*
Moves tools and materials*	Handles virtual object	Sequences actions*
Executes coordinated movements	Manipulates virtual object properties	Terminates actions*
Organizes physical environment*	Moves virtual object	Paces action*
Restores physical environment*	Organizes virtual environment*	
	Restores virtual environment*	Task completion (TC)
		Follows through*
		Maintains focus*
		Sustains effort*

*Skill items adapted from the AMPS (20) and School AMPS (6).

are simple (i.e. have fewer steps and/or use fewer computer commands or displays) will be easier to perform than complex tasks.

Once the scale was developed, the next step in developing the ACRS was to gather and analyse data to determine how well the skills and the tasks fit the MFR model, how well the skills and tasks match the expectations for hierarchical ordering of their difficulties, and how well the skills and tasks differentiate persons into different levels of ability. Therefore, the specific objective of this study was to address the following research questions:

- *Internal scale validity.* Do the skills and tasks demonstrate acceptable goodness-of-fit to the MFR model of the ACRS? Do the skills and tasks demonstrate logical hierarchical ordering, such that the skills and tasks that are expected to be difficult are more difficult to perform, and skills and tasks that are expected to be easier are easier to perform?
- *Person response validity.* Do the participants demonstrate acceptable goodness-of-fit to the MFR model of the ACRS? Do the participants demonstrate logical hierarchical ordering, such that persons who are expected to be more skilled using a computer perform better than persons who are expected to be less skilled using a computer?
- *Reliability.* Are the skill and task difficulty calibrations and computer ability measures of the participants associated with reasonable standard errors? Do the skills and tasks spread people into different levels of ability? Do the participants spread skills and tasks into different levels of difficulty?

Materials and method

Participants

This study involved purposive sampling of 32 participants whose ages ranged from 20 to 54 years ($M = 33.7$, $SD = 7.6$). The participants consisted of 12 males and 20 females who were either instructors or students within institutions of higher learning in Sweden. All participants had used the computer at least once every workday in the last three months prior to the evaluations.

Instrumentation

The ACRS was administered to all participants according to standardized guidelines. The ACRS included 37 skill items divided into five areas (Table I): (a) interaction with the physical environment (PE), (b) interaction with the virtual environment (VE), (c) adaptation (AD), (d) temporal organization (TO), and (e) task completion (TC). The participants were scored on each of the skill items using a four-point rating scale, such that 1 = deficient, 2 = inefficient, 3 = questionable, 4 = competent. Scoring was based on operational definitions for each skill item and score on the rating scale. Background information about the participant, such as his or her age, gender, disposition (i.e. whether he or she felt relaxed, stressed, or tired just before the observation), how often he or she used a computer, as well as general descriptions of the participant's workstation (i.e. sitting, standing, or sit–stand; and fixed or adjustable) and environment (i.e. whether it was organized or disorganized, adequately or poorly lit, and quiet or noisy) were noted. Separate scoring sheets were used for observation of each computer task performance, such that a participant who performed three tasks had three sets of scores, while a participant who performed two tasks had two sets of scores. As discussed earlier, all available scores for a participant were used to estimate the participant's overall measure of computer ability.

Procedure

Upon obtaining informed consent, a short interview was conducted to find out which tasks are necessary to carry out a participant's job. The participant and first author agreed on two to three sufficiently challenging computer tasks among those that were identified that the participant would perform using his or her own workstation and equipment. The computer tasks that were chosen included writing and sending an email; drawing a two- or three-dimensional figure; writing, copying, and/or editing text; searching for an article, program, music, or news on the Internet; preparing and making calculations on a spreadsheet; analysing data; and filling out a form. Once the participant faced the computer monitor, the quality of the participant's computer workstation and environment was noted, and the performance of the chosen tasks was observed. The first author took notes about the quality of the participant's observed behaviours during the performance of each computer task. Each observation ended once the agreed task was completed or when the participant indicated he or she was done. After observing all tasks, the first author then scored the participant on the 37 skill items, once for each task performed.

Data analysis

Using the FACETS computer program (18), the raw scores were used to generate skill item and task difficulty calibrations and person ability estimates, expressed as linearized log odds units, or logits. The FACETS computer program generates not only difficulty calibrations and ability estimates but also goodness-of-fit statistics and standard errors (*SE*). The FACETS program also generates separation indices for persons, skills, and tasks.

Goodness-of-fit statistics were used to evaluate how well the skills, tasks, and participants fit the MFR model of the ACRS. Both infit and outfit mean square residual values (*MnSq*) and the standardized z scores were used (17,22). The criteria for acceptable goodness-of-fit were set as *MnSq* ≤ 1.4 logits (23) and $z < 2.0$ (22) for both infit and outfit. In this phase of our research, we have chosen to target only those with high *MnSq* and z values, as those with low *MnSq* and z values pose less risk to unpredictability in the scores and a distorted measurement system (22). As the goal was to develop and evaluate a single unidimensional scale, skills that did not fit were omitted one at a time from the analysis, beginning with the skill with the highest *MnSq* and z values, and until either all remaining skills fit or the separation of skills, tasks, or persons decreased.

Separation is an index of reliability. The separation of persons signifies the number of levels of ability into which skill items and tasks can differentiate the persons tested. The separation of skills and tasks indicates the number of levels of difficulty into which persons can differentiate skills and tasks (24). In addition to evaluating separation of persons, skills, and tasks, reliability was also evaluated by examining the *SE* values associated with each skill and task difficulty calibration, and person ability measure. The *SE* is an estimate of variation in each skill and task difficulty calibration and person ability measure. Lower *SE* values indicate more precise estimates (25,26). Because no recommended *SE* was found in the literature, *SE* ≤ 0.30 was set as the criterion for an acceptable *SE*.

Results

Internal scale validity

Based on the examination of the goodness-of-fit statistics, three skill items—*Restores physical environment*, *Restores virtual environment*, and *Follows through*—had either infit or both infit and outfit *MnSq* > 1.4 and $z \geq 2.0$. Table II shows the initial goodness-of-fit statistics for all 37 skill items. The initial goodness-of-fit statistics for tasks showed that all eight tasks performed by the participants had *MnSq* ≤ 1.4 and $z < 2.0$, so they were considered to fit the MFR model of the ACRS (Table III). The final values for skill items and tasks, after the step-by-step removal of *Restores physical environment*, *Restores virtual environment*, and then *Follows through*, are presented in Tables IV and V, respectively.

The final 34 skill difficulty calibrations ranged from -3.49 to $+1.75$ logits, $M = 0.00$, $SD = 1.12$ (Table IV). As expected, the ordering of skill items did not strictly follow the hierarchies in the AMPS or School AMPS, but there seemed to be logical similarities in the overall ordering among items. For example, *Uses* and *Moves* are among the easiest items on the School AMPS; *Uses* and *Moves tools and materials* were among the easiest on the ACRS. Likewise, *Positions*, *Accommodates*, and *Benefits* are among the hardest items on the School AMPS, and their ACRS counterparts (*Positions self*, *Modifies behaviour*, and *Adapts performance*) were among the most difficult ACRS skills.

The final eight task difficulty calibrations ranged from -0.67 to $+0.81$ logits, $M = 0.00$, $SD = 0.44$ (Table V). The ordering of tasks appeared logical and seemed to match expectations such that those tasks that were commonly done (e.g. writing and sending an email) or more simple (e.g. two-dimensional drawing) were estimated to be easier than those tasks which were less often done (e.g. searching the Internet for an article or product) or more complex (e.g. three-dimensional drawing).

Person response validity

The goodness-of-fit statistics for persons, after removal of three skill items, revealed that 30 out of 32 persons (93.75%) had *MnSq* ≤ 1.4 and $z < 2.0$. Both participants, whose ACRS measures did not fit, were males and older than the mean age of the sample. The person ability estimates ranged from $+0.92$ to $+3.97$ logits, $M = 2.53$, $SD = 0.70$ (Table VI). When the person ability estimates were compared with the skill and task difficulty calibrations, off-targeting was revealed (Figure 1). The difference between the means of the person ability estimates and the skill and task difficulty calibrations was 2.53 logits.

The ordering of persons appeared logical. As expected, most of the participants who performed better were in their mid-twenties or early thirties. Likewise, participants who had adjustable workstations generally performed better than those persons who had seats with less than two adjustment options (Figure 2).

Table II. Initial item difficulty calibrations.

	Item number	Item	Measure (logits)	Error (logits)	Infit		Outfit	
					MnSq	*z*	*MnSq*	*z*
Hard	PE-2	Regulates position	1.69	0.15	0.64	−2.6	0.69	−2.1
↑	AD-4	Adapts performance	1.49	0.15	0.83	−1.0	0.83	−1.0
	VE-2	Locates virtual objects	1.46	0.16	0.88	−0.7	0.87	−0.7
	PE-1	Positions self	1.32	0.16	0.59	−2.8	0.65	−2.3
	AD-2	Modifies behaviour	0.95	0.17	0.94	−0.2	0.86	−0.7
	TO-2	Continues actions	0.92	0.18	0.80	−1.1	0.80	−1.1
	VE-12	Organizes virtual environment	0.90	0.18	0.96	−0.1	0.98	0.0
	PE-11	Organizes physical environment	0.87	0.18	0.95	−0.2	0.93	−0.3
	TO-4	Terminates actions	0.83	0.20	1.26	1.4	1.00	0.0
	TO-5	Paces actions	0.83	0.18	0.93	−0.3	0.92	−0.3
	AD-3	Modifies environment	0.76	0.19	1.06	0.4	1.04	0.2
	TC-1	*Follows through**	0.70	0.24	*1.62*	*2.9*	1.33	1.6
	TO-3	Sequences actions	0.62	0.19	0.94	−0.2	0.87	−0.5
	TC-2	Maintains focus	0.62	0.21	1.24	1.2	1.13	0.6
	PE-4	Locates tools and materials	0.51	0.20	0.96	−0.1	1.14	0.7
	VE-1	Directs pointer	0.26	0.22	1.07	0.3	0.96	−0.1
	VE-9	Handles virtual objects	0.25	0.22	1.01	0.1	0.91	−0.3
	PE-8	Manipulates tools and materials	−0.08	0.25	1.16	0.7	1.15	0.6
	VE-7	Provides information	−0.11	0.26	1.17	0.8	1.47	1.6
	VE-11	Moves virtual objects	−0.11	0.24	0.95	−0.1	0.95	−0.1
	TO-1	Initiates actions	−0.14	0.25	1.08	0.4	1.09	0.4
	PE-7	Handles tools and materials	−0.20	0.27	1.23	1.0	1.32	1.1
	VE-3	Selects virtual objects	−0.20	0.25	0.89	−0.4	0.95	−0.1
	AD-1	Responds to cues	−0.20	0.25	0.98	0.0	0.76	−0.9
	VE-10	Manipulates virtual objects	−0.23	0.28	1.22	0.9	1.26	0.9
	PE-10	Executes coordinated movements	−0.30	0.26	0.94	−0.1	0.97	0.0
	TC-3	Sustains effort	−0.47	0.27	0.99	0.0	1.08	0.3
	VE-4	Uses virtual objects	−0.54	0.28	0.86	−0.4	1.01	0.1
	VE-5	Activates virtual objects	−0.54	0.28	0.88	−0.4	0.91	−0.1
	VE-8	Seeks information	−0.60	0.29	0.84	−0.5	0.73	−0.8
	PE-3	Moves self	−0.62	0.29	0.86	−0.4	0.95	0.0
	PE-12	*Restores physical environment**	−0.66	0.52	*2.32*	*3.1*	*2.30*	*2.6*
	VE-6	Inserts virtual objects	−0.98	0.33	0.92	−0.1	1.22	0.6
	VE-13	*Restores virtual environment**	−1.12	0.49	*1.99*	*2.5*	1.17	0.5
	PE-9	Moves tools and materials	−1.76	0.46	0.95	0.0	0.64	−0.5
↓	PE-6	Uses tools and materials	−2.71	0.73	1.03	0.2	2.05	1.1
Easy	PE-5	Selects tools and materials	−3.42	1.00	0.97	0.2	0.42	−0.1

*Items with *MnSq* >1.4 and *z* ≥2.0, in either infit or outfit, or both.

Reliability

Among the *SE*s associated with the 34 skill difficulty calibrations, four (11.76%) skill difficulty calibrations had *SE* >0.30. These *SE* values were associated with the skills that were calibrated as easiest (Table IV). All eight (100%) task calibrations had *SE* <0.30 (Table V). On the other hand, four out of 32 (15.62%) person ability measures had *SE* >0.30. These high *SE* values were associated with the ability

Table III. Initial task difficulty calibrations.

	Task	Measure (logits)	Error (logits)	Infit		Outfit	
				MnSq	*z*	*MnSq*	*z*
Hard	Statistical data analysis	0.74	0.14	0.98	−0.1	1.08	0.4
↑	Making, editing a worksheet	0.37	0.10	0.83	−1.8	1.07	0.5
	Writing, copying, editing text	0.17	0.06	0.97	−0.4	1.04	0.4
	Drawing a 3D graphic	0.06	0.18	1.00	0.0	1.06	0.3
	Searching on the Internet	0.01	0.09	1.14	1.6	1.04	0.3
	Drawing a 2D figure	−0.32	0.21	0.92	−0.3	1.08	0.3
↓	Filling, submitting a form	−0.41	0.22	0.75	−1.1	0.74	−0.8
Easy	Writing and sending an e-mail	−0.61	0.08	1.06	0.8	0.98	−0.1

Table IV. Final item difficulty calibrations.

	Item number	Item	Measure (logits)	Error (logits)	Infit		Outfit	
					MnSq	*z*	*MnSq*	*z*
Hard	PE-2	Regulates position	1.75	0.16	0.64	−2.6	0.68	−2.2
↑	AD-4	Adapts performance	1.53	0.16	0.91	−0.5	0.89	−0.6
	VE-2	Locates virtual objects	1.50	0.16	0.96	−0.2	0.95	−0.2
	PE-1	Positions self	1.34	0.17	0.63	−2.5	0.67	−2.2
	AD-2	Modifies behaviour	0.95	0.18	1.00	−0.0	0.91	−0.4
	TO-2	Continues actions	0.92	0.18	0.84	−0.9	0.82	−1.0
	VE-12	Organizes virtual environment	0.90	0.18	1.02	0.1	1.03	0.2
	PE-11	Organizes physical environment	0.86	0.19	1.06	0.3	1.04	0.2
	TO-4	Terminates actions	0.82	0.22	1.37	2.0	1.11	0.6
	TO-5	Paces actions	0.82	0.18	0.97	−0.1	0.94	−0.2
	AD-3	Modifies environment	0.75	0.20	1.14	0.8	1.08	0.5
	TO-3	Sequences actions	0.60	0.20	1.01	0.1	0.91	−0.4
	TC-2	Maintains focus	0.60	0.22	1.33	1.7	1.24	1.2
	PE-4	Locates tools and materials	0.49	0.20	0.99	0.0	1.13	0.7
	VE-1	Directs pointer	0.23	0.22	1.09	0.5	0.97	0.0
	VE-9	Handles virtual objects	0.21	0.22	1.02	0.1	0.90	−0.4
	PE-8	Manipulates tools and materials	−0.13	0.26	1.18	0.8	1.15	0.6
	VE-7	Provides information	−0.16	0.27	1.20	0.9	1.48	1.7
	VE-11	Moves virtual objects	−0.16	0.25	0.94	−0.1	0.92	−0.2
	TO-1	Initiates actions	−0.19	0.26	1.10	0.5	1.09	0.4
	PE-7	Handles tools and materials	−0.25	0.28	1.25	1.1	1.33	1.2
	VE-3	Selects virtual objects	−0.25	0.25	0.92	−0.3	0.99	0.0
	AD-1	Responds to cues	−0.25	0.25	1.01	0.1	0.78	−0.8
	VE-10	Manipulates virtual objects	−0.29	0.28	1.22	0.9	1.23	0.9
	PE-10	Executes coordinated movements	−0.35	0.26	0.94	−0.1	0.96	0.0
	TC-3	Sustains effort	−0.53	0.28	1.03	0.2	1.14	0.5
	VE-4	Uses virtual objects	−0.60	0.28	0.88	−0.4	1.07	0.3
	VE-5	Activates virtual objects	−0.60	0.28	0.87	−0.4	0.88	−0.2
	VE-8	Seeks information	−0.66	0.29	0.86	−0.5	0.74	−0.7
	PE-3	Moves self	−0.68	0.29	0.87	−0.4	0.95	0.0
	VE-6	*Inserts virtual objects**	−1.05	*0.34*	0.92	−0.1	1.23	0.6
	PE-9	*Moves tools and materials**	−1.83	*0.46*	0.95	0.0	0.62	−0.5
↓	*PE-6*	*Uses tools and materials**	−2.79	*0.73*	1.03	0.2	1.99	1.1
Easy	*PE-5*	*Selects tools and materials**	−3.49	*1.00*	0.99	0.3	0.58	0.0

*Items with *SE* >0.30.

measures of participants who were estimated to be highly capable (Figure 1). The separation index for persons was 2.68, which signified that the skills and tasks spread people into at least three distinct levels of ability. The separation indices for skills and tasks were 3.35 and 2.70, respectively, which indicated that there were at least four distinct levels of skill difficulty and three distinct levels of task difficulty (24).

Discussion

The results of this study provide preliminary evidence of internal scale validity, person response

Table V. Final task difficulty calibrations.

	Task	Measure (logits)	Error (logits)	Infit		Outfit	
				MnSq	*z*	*MnSq*	*z*
Hard	Statistical data analysis	0.81	0.14	1.00	0.0	1.07	0.4
↑	Making, editing a worksheet	0.41	0.10	0.85	−1.6	1.11	0.7
	Writing, copying, editing text	0.15	0.07	0.98	−0.3	1.04	0.4
	Drawing a 3D graphic	0.05	0.19	1.00	0.0	1.09	0.3
	Searching on the Internet	−0.04	0.10	1.12	1.3	1.01	0.1
	Drawing a 2D figure	−0.26	0.22	0.95	−0.1	1.11	0.4
↓	Filling, submitting a form	−0.45	0.23	0.77	−1.1	0.76	−0.7
Easy	Writing and sending an e-mail	−0.67	0.08	1.03	0.4	0.94	−0.3

Table VI. Final person-ability estimates.

Participants (gender, age, disposition)		Measure (logits)	Error (logits)	Infit *MnSq*	Infit *z*	Outfit *MnSq*	Outfit *z*
More Able	*M 31 Relaxed*[†]	3.97	*0.38*	0.87	−0.2	0.92	0.0
↑	*F 26 Relaxed*[†]	3.75	*0.37*	1.06	0.2	2.62	1.8
	F 31 Stressed	3.69	0.26	0.86	−0.5	0.92	0.0
	F 31 Relaxed[†]	3.59	*0.38*	0.84	−0.4	0.63	−0.4
	F 30 Tired & Stressed	3.35	0.26	1.08	0.4	0.94	0.0
	F 32 Relaxed[†]	3.24	*0.34*	1.12	0.5	1.23	0.5
	F 41 Relaxed	3.05	0.25	1.10	0.5	1.12	0.4
	M 29 Stressed	3.04	0.22	1.05	0.2	1.01	0.1
	M 26 Tired & Stressed	2.97	0.28	0.82	−0.7	0.67	−0.6
	F 28 Stressed	2.89	0.27	0.76	−0.9	0.66	−0.6
	M 28 Relaxed	2.84	0.20	0.86	−0.7	0.87	−0.3
	M 36 Relaxed	2.78	0.19	0.90	−0.5	0.87	−0.3
	F 30 Relaxed	2.77	0.26	1.14	0.6	1.18	0.5
	F 27 Relaxed	2.71	0.29	1.07	0.3	1.64	1.2
	F 36 Relaxed	2.66	0.26	0.94	−0.1	0.76	−0.4
	M 29 Stressed	2.61	0.22	1.14	0.7	0.96	0.0
	F 39 Tired	2.47	0.25	0.60	−2.0	0.59	−1.1
	M 24 Relaxed	2.39	0.19	0.90	−0.5	1.03	0.2
	M 35 Stressed	2.36	0.18	0.95	−0.2	0.82	−0.6
	F 54 Relaxed	2.22	0.19	0.71	−1.8	0.83	−0.5
	F 36 Tired	2.15	0.21	1.37	2.0	1.06	0.3
	F 27 Stressed	2.13	0.16	0.66	−2.4	0.75	−1.1
	F 52 Relaxed	2.03	0.22	0.84	−0.7	0.76	−0.7
	F 43 Stressed	2.01	0.25	1.05	0.3	0.96	0.0
	F 38 Stressed	1.93	0.22	0.78	−1.0	1.32	1.0
	F 28 Relaxed	1.88	0.17	0.97	−0.1	1.00	0.0
	M 37 Relaxed	1.87	0.23	1.17	0.8	1.30	1.0
	F 38 Relaxed	1.85	0.23	0.65	−1.8	0.67	−1.0
	*M 39 Relaxed**	1.85	0.20	*1.41*	*2.3*	1.35	1.5
	F 20 Tired	1.63	0.16	0.85	−1.0	0.82	−0.8
↓	*M 44 Relaxed**	1.51	0.23	*1.59*	*2.8*	*1.50*	*2.0*
Less able	M 33 Relaxed	0.92	0.15	1.10	0.7	1.04	0.3

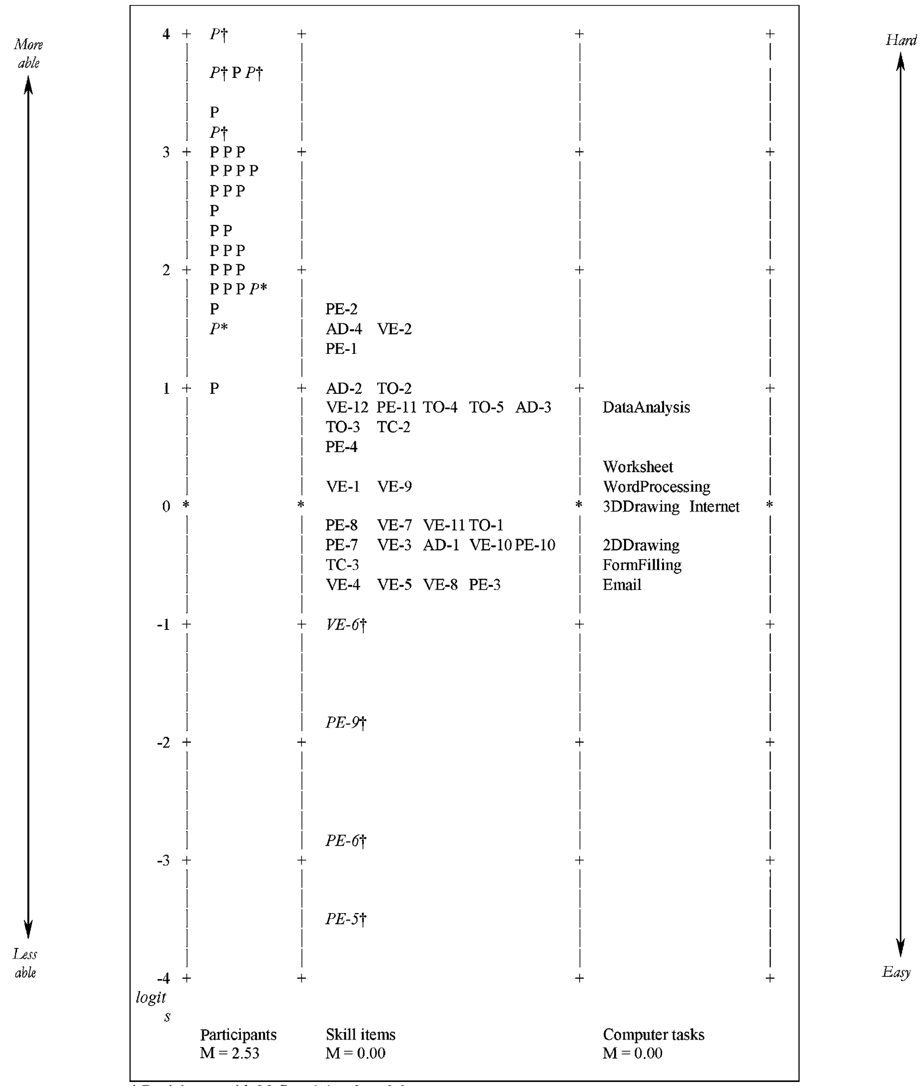
*Participants with *MnSq* >1.4 and *z* ≥2.0, in either infit or outfit, or both. [†]Participants with *SE* >0.30.

validity, and reliability of the ACRS scale. These initial findings affirm that the ACRS has the potential to provide a linearized numerical estimate of a person's ability to use a computer. However with only one rater, inter-rater reliability could not be assessed in this study; thus future studies involving more raters for the ACRS are necessary to determine inter-rater reliability.

Internal scale validity was demonstrated through the goodness-of-fit of the skill items and tasks to the MFR model of the ACRS. The three skill items that did not fit the MFR model of the ACRS (*Restores physical environment*, *Restores virtual environment*, and *Follows through*) showed scoring patterns that had too much variation in the observations related to MFR model expectations, and therefore they probably did not describe the same construct or dimension as did the other 34 ACRS skill items (22). Since the ACRS skill items define an entirely new construct, it is possible that these three items did not fit even though they were also adapted from the AMPS and the School AMPS. These three skill items will, therefore, be removed from the present version of the ACRS and will be not be included in future studies related to the ACRS's development.

The remaining 34 skill items, most of which were adapted from the AMPS and the School AMPS, appeared to define a single construct. There seemed to be no separate construct among the 34 skill items within the five areas of the ACRS: PE, VE, AD, TO, TC. It is interesting to note that the AMPS and the School AMPS define two distinct constructs (motor and process skills) (16,20), while these adapted motor and process skills within the ACRS appear to belong to a single construct. While the hierarchical ordering of the skill items of the ACRS appeared to be logical, when compared with the AMPS and School AMPS, a study on a larger sample is needed to ensure that the estimated hierarchical ordering of the ACRS skill items and tasks is stable. They can then be compared more systematically with the AMPS and School AMPS hierarchies.

Although person response validity was demonstrated through the goodness-of-fit of participants to



* Participants with *MnSq* > 1.4 and $z \geq 2.0$
† Participants and skill items with *SE* > 0.30

Figure 1. Person – Skill Item – Task Map.

the MFR model of the ACRS, two participants did not meet the criteria for goodness-of-fit. It was expected that there would be 5% of the participants who would not fit to the model, and the results were slightly higher (6.25%), which may be due to the small sample size. A study on a larger sample is needed to verify person response validity in the ACRS.

The logic of the hierarchical ordering among the 32 participants was difficult to evaluate because all participants used the computer on a daily basis. It appeared logical that participants who performed better generally belonged to the 25- to 34-year age group, which corresponds to the age group with a higher percentage of persons who received computer training during the last year (when compared with those in the older age groups) (6, p. 42). It was also logical that those participants who had more adjustability features in their workstations performed better than did those persons who had fewer or no adjustability features in the workstations. Neither gender nor dispositions showed any trend that could provide an explanation for the ordering. Future studies need to be done to identify factors that affect people's abilities to use a computer.

Based on the 2.53-logit difference between the means of the difficulty calibrations and ability estimates, there was an off-targeting between the difficulty of skills and tasks, and the computer abilities of the participants. Some skills were too easy for participants with high ability. This is the likely source of high SEs associated with the calibrations of four easier skills and the most skilled participants. However, since the ACRS was intended

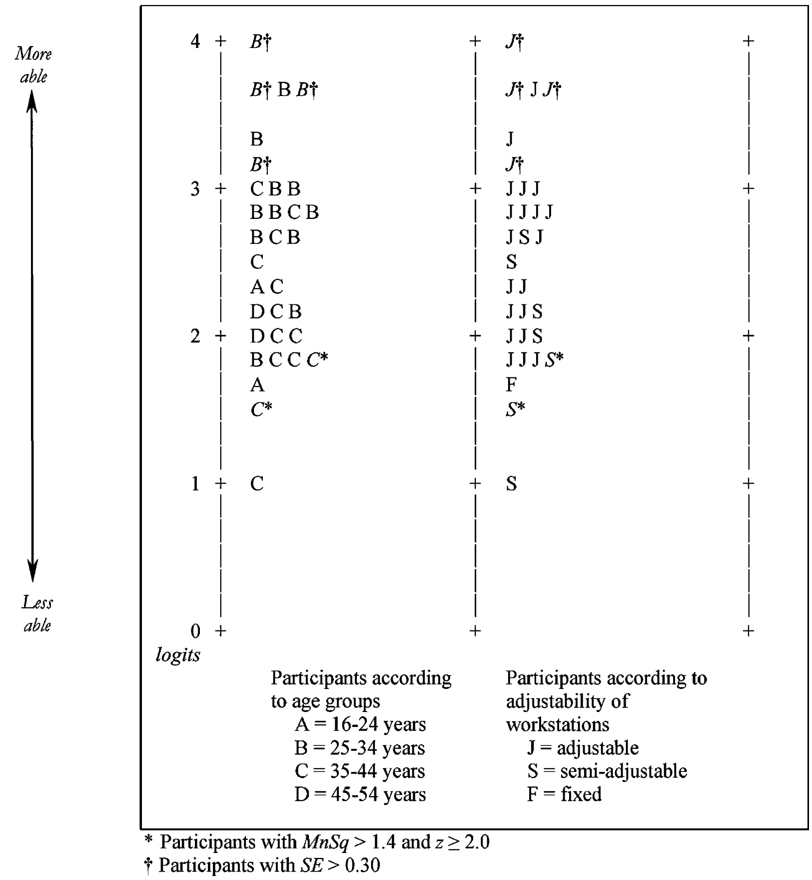


Figure 2. Person-ability estimates according to age group and adjustability of workstations.

for evaluating persons who probably have diminished computer abilities, future studies involving persons with disabilities or lower computer skills may attenuate off-targeting and reduce *SE*s.

Interestingly, the participants were separated into three distinct levels of ability despite the fact that they all were healthy adults. This suggests that the ACRS is sensitive enough to identify different levels of computer ability among persons who use the computer on a daily basis without perceived difficulty, even though there is off-targeting between the scale and the participants.

Implications for practice

The results of this study have positive implications for occupational therapists working with clients who use computers. The ACRS has the potential to be utilized by occupational therapists in assessing their clients' abilities to use computers in relevant tasks and familiar environments. Clients can benefit from a valid and reliable instrument that can generate linearized estimates of ability so that comparisons can be made regarding their performances on computer tasks.

Conclusions

In this paper, the initial steps in the development and validation of the ACRS using a MFR model have been presented. The 34 items and eight tasks in the ACRS define an internally valid and reliable scale for assessing persons' computer abilities, and 30 participants demonstrate the person response validity of the ACRS. More studies involving a broader group of people with difficulties using the computer and a sufficient number of raters are recommended to evaluate for further evidence of validity and reliability and strengthen the usability of the ACRS in research and clinical practice.

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