Disability and Rehabilitation: Assistive Technology, 2012, 1–9, Early Online
Copyright © 2012 Informa UK, Ltd.
ISSN 1748-3107 print/ISSN 1748-3115 online
DOI: 10.3109/17483107.2011.650780

informa
healthcare

RESEARCH PAPER

Assessment of computer task performance (ACTP) of children and youth with intellectual and developmental disability

Alexandra Danial-Saad[1,2], Patrice L. (Tamar) Weiss[1] & Naomi Schreuer[1]

[1]*Department of Occupational Therapy, Faculty of Social Welfare and Health Sciences University of Haifa, Haifa, Israel and* [2]*The Academic Arab College For Education in Israel, Haifa*

The aims of this study were to assess the reliability and validity of the Arabic translation of the Assessment of Computer Task Performance (ACTP) when used for children with Intellectual and Developmental Disabilities (IDD) and to determine the relationship between participants' performance when using an adapted pointing device and the teacher's satisfaction of their performance. Thirty boys and girls, Arabic speakers, 6– 21 years old, who had moderate IDD, participated in the study. Two expert occupational therapists used the ACTP to evaluate the performance of five standardized timed computer tasks. The Quebec User Evaluation of Satisfaction with Assistive Technology was used to evaluate the teachers' satisfaction with the prescribed pointing device. The sample in the current study performed slower than typically developing children and youth, and slower than participants with motor impairments, examined in previous studies. Differences were found in performance time between girls and boys, and between three diagnostic subgroups. The participants' success scores of computer performance correlated significantly with the teacher's satisfaction with the prescribed pointing device. Demonstration of the validity and reliability of the Arabic version of the ACTP-Child enables wider use of this tool which is now available in four languages and diverse cultural settings and disability populations, including children and youth with significant IDD.

Keywords: Assistive technology, intellectual and developmental disabilities, evaluation, outcome measures

Implications for Rehabilitation

- The Assessment of Computer Task Performance (ACTP) Child version found to be a user-friendly, reliable and valid assessment used to examine pointing device performance of children and youth with Intellectual and Developmental Disabilities (IDD).
- The ACTP Child version conducted in a Windows environment was found to be reliable and valid in the Arabic language, in keeping with other languages examined in the past.
- The time of performance of ACTP tasks was found to be sensitive to differences according to gender and diagnostic subgroups.
- The participants' success scores of computer performance correlated significantly with the teacher's satisfaction with the prescribed pointing device but not with performance time.

Introduction

"For most people, technology makes things easier; for persons with disabilities technology makes things possible [1]"

In today's highly technology-oriented world computers are used in education, communication, entertainment and recreation. Assistive Technology (AT) has the potential to reduce the effects of occupational performance limitations on everyday life activities by facilitating and enhancing work performance and social interactions [2,3] for children with disabilities including Cerebral Palsy, Metabolic Disorders, and Intellectual and Developmental Disorders. Well-fitted AT may contribute to the individual's participation, self-esteem and quality of life [4–6].

The literature shows numerous applications of AT for children and adults with IDD. For example, in Alper and Sahoby Raharinirina's [7] review of AT applications, approximately half of the reported studies targeted investigations concerning the effectiveness of AT to improve the skills of users with IDD. Mechling [8] carried out a comprehensive review of applications of AT used to increase the independent, self-management skills of persons with IDD with the aid of

Correspondence: Dr. Naomi Schreuer, Department of Occupational Therapy, Faculty of Social Welfare and Health Sciences, University of Haifa, Mount Carmel, Haifa, Israel, 31905. Tel: 972-4-8389317. Fax: 972-4-8249753. E-mail: schreuernaomi@gmail.com

self-prompting devices, and identified 40 studies that reported positive results when using AT devices toeliciting a target response while reducing the need for instructor prompts.

The process of achieving an optimal match between AT and a person is prolonged and iterative [9]. There exist several models that reflect the complexity of the AT adaptation process and which use different variables to test outcome success (e.g. [10,11]. The first step entails assessment of client needs within the environment in order to optimally adapt AT devices for their use [12] and to enable successful occupational performance [13,14]. This step should include consideration of the emotional state of clients, their preferences and their acceptance of AT [15] by sharing the decision making process, a vital stage in client-centered care [16].

The expert assessment process for the potential AT user is critical [17] because it leads to the provision of required information for users, therapists, parents and teachers, in order to build an appropriate and thorough AT intervention program [18]. The adaptation process depends on evidence-based outcome data that yields accurate and meaningful results [17].

The Assessment of Computer Task Performance (ACTP) was developed to address this requirement [19]. It is a standardized, observation-based assessment of client performance that was originally developed to assist clinicians in measuring the functional ability of children with physical impairments to perform basic computer tasks with assistive devices. It was developed in French and then translated and validated in English. The ACTP includes standard keyboard and pointing device (mouse tasks) used to run typical Microsoft Windows applications. The keyboard tasks include six preliminary screening tasks and five standardized and timed tasks (e.g. typing a short sentence). The ACTP's test-retest reliability, calculated via the Interclass Correlation Coefficient, ranged from 0.60–0.95 for most tasks, and construct validity for a small sample of children with disability was $\alpha = 0.51$[20]. A recent study of 155 children without motor or vision disabilities determined norms, and found moderate to good test-retest reliability, internal consistency, and construct validity of the revised children's version of the ACTP[21]. Results from various studies of the ACTP have been widely published [22–24] and it is included in Abledata, a highly cited web site that provides objective information about AT products and rehabilitation equipment, http://www.abledata.com/abledata.cfm?pageid=160377 &ksectionid=160164&atlitid=183768. The first aim of this study was to assess the inter-rater reliability of the Arabic translation of the ACTP when used for children and youth with IDD, and to determine its internal consistency and sensitivity to differences in gender and type of disability. The use of such a the tool in the Arabic language is important since there is a lack of AT outcome tools for this population despite the great need due to the high percentages of the world's Arabic speaking population who have disabilities. For example, the percentage of people with disabilities is greater in the Arab than in the Jewish sectors in the Middle East due to the high rates of consanguineal marriage, hereditary diseases, women giving birth at a relatively late age, and a general lack of awareness of various genetic problems [25]. The rate of congenital defects among the Arab population and the rate and severity of car accidents resulting in severe injuries in Israel is higher for the Arab speaking population. This further challenges therapists in the rehabilitation at large, and specifically during the AT adaptation process.

A second aim was to determine the relationship between participants' actual performance when using pointing devices that had been prescribed for their use and the teacher's satisfaction of their performance. These aims were accomplished by obtaining four types of AT outcome measures important for assessing the suitability of a pointing device for children and youth with intellectual and developmental disabilities (IDD): frequency of use; success of use; effectiveness in terms of time and errors (assessed by the ACTP); and satisfaction of the teacher (assessed by the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST [26])).

Methods

Participants

A stratified convenience sample of 30 children and youth (14 boys, 16 girls), native speakers of Arabic, who ranged in age from 6–21 years (mean = 11.3 years, SD = 4.1) and had moderate IDD participated in the study. They were selected from a population of 170 students who attended a special education school in Nazareth, Israel. The primary inclusion criterion was children and youth who were referred to occupational therapy in order to adapt a computer via any pointing device, either for the first time, or due to a change in their functional status. The parents of the participants were contacted once approval was received from the Institutional Review Board of the Israeli Ministry of Education. Informed consent was given by each participant's parent.

All of the participants in the study have IDD and some have additional disabilities including sensory, language, and physical disabilities, health problems (e.g. asthma, epilepsy, heart problems), and congenital metabolic syndromes (e.g. hypothyroidism, galactosemia). The sample was divided into three groups in accordance with their diagnoses as documented in the school records: IDD with Cerebral Palsy (n = 11); IDD with Down syndrome (n = 10); and IDD with Metabolic Disorders (n = 9).

The participants' families had a low socio-economic status, and most of them did not have a computer or pointing device adaptations at home; therefore, most of the computer work was performed at school including learning activities, games and communication. The children and youth were dependent in most activities of daily living, except eating. They demonstrated heterogeneous performance when operating a pointing device; some have difficulty with the functions (e.g. left/right click, double click, moving and maintaining the cursor, dragging, dropping and scrolling), either due to physical disability or due to cognitive disability which is manifested by difficulty in learning to improve their use of these functions. Computer programs that suited their abilities were used to practice psycho-motor skills (e.g. clicking, dragging, timing, browsing) or to improve basic cognitive skills (e.g., visual and auditory perception, memory, sequencing) and language and math skills.

All participants used a computer that was adapted to their abilities while learning at school. Twenty-seven of the participants also used it to play games and for leisure activities at school. One used it for communication and five used it to access the Internet. As for the frequency of use, half of the participants used a computer twice a week, and ten used it three to four times a week, for a maximum duration of one and a half hours. All participants needed the teacher's assistance.

Instruments

Demographic data were gathered relevant to three sets of characteristics: participants' background (e.g. age, gender, education), their disability (e.g. diagnosis, functional disabilities), and their experience using computers (e.g. time, frequency, type of software, and AT adaptations).

ACTP, *Child version* 2 [19,20] was described in the Introduction section. The current study examined performance using all 12 pointing device tasks, divided into 31 sub-tasks (Table I). The pointing device tasks included two groups of tasks: seven preliminary screening tasks (CPM-1–CPM-7) with several sub-tasks (e.g. left click, drag, #1–#20), that were scored for success rate only. The remaining five standardized, timed pointing tasks (CM-1–CM-5) with several sub-tasks (Table I, shaded rows: #21–#31), were scored for time of performance, in addition to success. For example, in task CM-1, "pointing and clicking", the child is asked to use the pointing device to make the cursor follow a pathway that consists of four overlapping straight and diagonal lines with icons at the center and at each end. The cursor thus travels back and forth between icons starting each time at the center of the figure. The child is asked to "eat the cheese" by clicking on each cheese icon, and then return towards a mouse trap, without touching or clicking on the trap.

The preliminary tasks are performed first to verify that the setup and function of the equipment are understood. Success of performing the preliminary tasks is scored by rating the quality of performance via a four-point scale (success = 1; success with errors = 2; partial success = 3; and failure = 4). The subsequent ACTP advanced keyboard and pointing device tasks are scored by the same scale, with additional indicators of speed and accuracy. Subjective responses concerning comfort and clinical signs and symptoms (i.e. posture, compensations, pain, trembling, spastic movements and signs of fatigue) are also recorded.

The current study examined only the pointer tasks (also referred to as mouse tasks) of the revised children's version of the ACTP, which was adapted for use by children with motor, perceptual and cognitive skills of pre-school and primary school aged children (up to Grade 3 [20]). In the current study internal consistency of all 12 tasks measured (31 sub-tasks), revealed Cronbach's α equal to 0.93, indicating good internal consistency. However the internal consistency of the five ACTP tasks that were measured by performance time was $\alpha = 0.65$, due to large variability. Inter-rater reliability between the scores of two occupational therapists who conducted the testing was measured with Spearman's correlations coefficient, ranged for most tasks from $r = 0.66$, to $r = 0.99$ indicating moderate to good reliability [27]. In addition to the Spearman's correlations coefficient, the percentage rate of each task was calculated in order to clarify the *rs* outcome (Table I). The values in this table demonstrate that higher agreement between the occupational therapists was achieved during short tasks that entailed one specific mouse function (e.g. left click #1), as opposed to those that required a sequence of several mouse functions (e.g. moving, stopping the pointer and double click # CM-2).

Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) was designed to evaluate a person's or significant caregiver's satisfaction with an AT device and related services [26,28]. User satisfaction is scored on 12 short questions divided into two factors: Satisfaction with Device (eight items, e.g. device durability) and Satisfaction with Service (four items. e.g. efficiency of service). Each item is rated on a five-point scale: very satisfied (5) quite satisfied (4), more or

Table I. Distribution and frequency of computer use by the participants (N = 30).

		Frequency according to group			Total
Variables	Category	IDD & CP N = 11 (36.7%)	IDD & Down synd. N = 10 (33.3%)	IDD & Metabolic N = 9 (30%)	N = 30 (100%)
Age	6–21	9–21	6-12.5	6-16.5	6–21
Gender	Male	5	5	4	14
	Female	6	5	5	16
Computer experience	Play and leisure	11	9	8	27
	Studies	11	10	9	30
	Communication	0	1	0	1
	Internet	3	1	1	5
Mean rate of computer usage at school per week	Once	1	2	3	6
	Twice	4	6	4	14
	Three	1	3	1	5
	Four	4	0	1	5
Length of computer usage at school (min)	30	3	6	4	13
	45	1	1	2	3
	60	5	5	1	11
	90	3	0	0	3

less satisfied (3), not very satisfied (2), not satisfied at all (1). The final part of the questionnaire consists of a list of the 12 satisfaction items of which a client is asked to select the three most important items in order of priority. Internal consistency as measured by Cronbach's α was equal to 0.82 for the entire QUEST, equal to 0.82 for the technology items (n = 8) and equal to 0.76 for the service items (n = 4). Test-retest reliability ranged from 0.41–0.80 [28]. In the current study, teachers responded to the English version of the QUEST since their English language skills were sufficient to not require translation to Arabic. The test of internal consistency, measured with Cronbach's α (α = 0.60) demonstrated a moderate degree of internal reliability for seven items relevant to the participants; five items were not used in the current study (e.g. weight, safety of use). These five items were removed since information related to safety and weight were less relevant to adapted pointing devices than traditional AT such as wheelchairs and walkers.

Procedures

Translation of the ACTP to Arabic followed methods used to translate other AT outcome measure assessments [29,30]. The manual was translated into Arabic by a professional translator and an occupational therapist. In order to validate the translation, three occupational therapists individually translated the Arabic version back into English. A comparison was made of the three translations and between them and the original English version with revisions being made until a consensus was reached. The final Arabic version was then approved.

ACTP performance data were collected during a single 1-h session at the child's computer workstation at school. Participants performed 31 tasks that involved the use of a pointing device. If a child failed to complete a certain ACTP preliminary screening task, the device was replaced to achieve a better match between the child's abilities and the task. The ACTP was then used to rate the child's performance by two expert occupational therapists. The participants were rewarded with a small gift after completing the assessment.

A week later, the computer teacher filled out the modified QUEST questionnaire, having allowed the participants ample training and practice time using the adapted mouse.

Statistical analysis

Statistical analysis was conducted using the SPSS 12 software package. Descriptive statistics were used to characterize the demographic data. Cronbach's α was used to assess internal consistency of the 31 ACTP sub-tasks. Spearman's correlation coefficients were calculated to assess the inter-rater reliability between the ACTP scores obtained by the two occupational therapists, and correlations between satisfaction of computer teacher and the performance of computer tasks. The Mann–Whitney test was used to query differences in performance due to gender and the Kruskal–Wallis test was used to determine differences in performance due to the type of disability.

Results

The ACTP yielded the results on the use of Click, Dragging, Dropping and Scrolling pointing device functions (Table II). In the Click category, all participants, except for one from the Down-syndrome group, had intact performance. In the Dragging category, three had intact performance whereas the performance of twenty was partial and of seven was impaired. In the Dropping category, eight had intact performance, whereas the performance of nineteen was partial and of three was impaired. In the Scrolling category, seven had intact

Table II. Distribution of participants using pointer device functions (N = 30).

		Frequency according to group			Total
Variables	Category	IDD & CP N = 11 (36.7%)	IDD & Down synd. N = 10 (33.3%)	IDD & Metabolic N = 9 (30%)	N = 30 (100%)
Click function	1 = Intact	11	9	9	29
	2 = Partial	0	1	0	1
	3 = Impaired	0	0	0	0
Dragging	1 = Intact	1	0	2	3
	2 = Partial	7	7	6	20
	3 = Impaired	3	3	1	7
Dropping	1 = Intact	4	2	2	8
	2 = Partial	7	6	6	19
	3 = Impaired	0	2	1	3
Scrolling	1 = Intact	2	1	4	7
	2 = Partial	5	1	2	8
	3 = Impaired	4	8	3	15
Adapted pointing device	Mini	2	1	1	4
	Big Tracks	0	5	5	10
	Joystick	2	0	1	3
	Pc-track	3	4	0	7
	3 M Ergonomic	2	0	0	2
	Standard mouse	1	0	2	3
	Standard with adapted switch	1	0	0	1

performance, whereas the performance of eight was partial and of fifteen was impaired.

There was considerable variety in the type of adapted pointing devices chosen for use by the participants (Appendix I). Four used a Standards–Mini (#1), ten Big Tracks (with the largest trackball available, #2), three Joysticks (including a key guard to isolate button and two different handles: a T bar and a soft sponge ball, #3), seven PC-Tracks (with a large ball and large button, #4), two 3M-Ergonomics (a joystick with a vertical grip design, also used as an optical mouse, #5), three Standards (#6) and one Standard with adapted switch (#7).

Table III shows mean success scores for ACTP (n = 30) and demonstrates that some sub-tasks, mainly those that required a sequence of several pointing device functions (3, 6, 7, 11, 15–17, 21–24, 29–31), were difficult to perform. According to the ACTP manual 1 = success in performing the task. In those tasks, participants achieved a mean score higher than 1.5 (range of 1.60 to 3.13), indicating "success with errors" = 2 to "partial success" = 3. For example, Task CM5 (sub task #31) required that the user "Drag and drop" an icon along a right angled path, without touching the lines. Most participants dragged the icon along the path, but frequently could not avoid touching the lines, and dropped the icon a few times along the path, demonstrating difficulty in controlling their movements during clicking and dragging the mouse. The remaining tasks were easier to perform and revealed high levels of success, mainly for the short tasks that include a single specific pointing device function.

In addition, Table III also shows the correlation coefficient (*rs* = 0.66–0.99) between the two occupational therapy raters who observed and scored success and time of performance on

Table III. Success scores for ACTP (N = 30), Spearman correlation coefficient (Rs) and frequency (%) between the scores of two raters.

Task	Sub-task	Description of tasks	Mean success score	Success (1)	Success with errors (2)	Partial success (3)	Failure (4)	Rs	%
Preliminary tasks involving mouse functions									
CPM1	1	Left-click	1.03	29	1	–	–	-	96
	2	Right-click	1.06	28	2	–	–	0.46**	94
	3	Double left-click	1.77	19	3	4	4	0.98**	9
	4	Moving the pointer around the whole screen	1	30	–	–	–	-	100
	5	Drag around the screen	1.17	26	3	1	–	0.85**	96
CPM2	6	Drag and drop (curved path)	1.6	19	6	4	1	0.79**	70
CPM3	7	Drag and drop (right-angled path)	1.8	17	4	7	2	0.90**	80
CPM4	8	Drag and drop (a)	1.13	27	2	1	–	0.86**	94
	9	Drag and drop (b)	1.1	28	1	1	–	0.83**	94
	10	Drag and drop (c)	1.13	27	2	1	–	0.66**	90
CPM5	11	Start the software.	1.83	18	4	3	5	0.99**	96
	12	Move around in the document.	1.5	21	5	2	2	0.94**	96
CPM6	13	Moving around in drop-down menus with the left-mouse button. Method (1).	1.5	22	4	1	3	1.0**	100
	14	Moving around in drop-down menus with the left-mouse button. Method (2).	1.53	22	4	–	4	1.0**	100
	15	Moving around in drop-down menus with the right-mouse button. Method (1).	2.37	14	2	3	11	0.97**	90
	16	Moving around in drop-down menus with the right-mouse button. Method (2).	2.37	13	4	2	11	0.97**	94
CPM7	17	Open a window (double-click).	1.7	21	3	1	5	0.99**	94
	18	Move the window.	1.13	21	2	1	–	0.84**	94
	19	Make the window smaller or bigger.	1.2	27	1	1	1	1.0**	96
	20	Close the window.	1.03	29	1	–	–	1.0**	100
Standardized and timed tasks involving mouse functions									
CM-1	21	Pointing & clicking 1	2.07	16	1	8	5	0.83**	84
	22	Pointing & clicking 2	2.87	4	6	10	10	0.85**	70
	23	Pointing & clicking 3	2.27	13	3	7	7	0.90**	70 80
	24	Pointing & clicking 4	2.93	3	7	9	11	0.90**	
CM-2	25	Moving, stopping the pointer and double clicking 1	1.2	25	4	1	–	0.88**	96
	26	Moving, stopping the pointer and double clicking 2	1.13	27	2	1	–	0.76**	94
	27	Moving, stopping the pointer and double clicking 3	1.2	25	4	1	–	1.0**	100
	28	Moving, stopping the pointer and double clicking 4	1.23	25	3	2	–	0.73**	90
CM-3	29	Changing a window's size using the edges and moving it.	2.43	15	–	2	13	0.97**	94
CM-4	30	Drag and drop (curved path)	3.13	4	3	8	15	0.88**	80
CM-5	31	Drag and drop (right-angled path)	2.17	12	5	9	4	0.91**	70

*p< .05, **p< .01

Table IV. Success and satisfaction with pointing device for all participants (N = 30).

Variable	Instruments	Scale	Mean	SD	Minimum	Maximum
Time taken to perform tasks	ACTP	In seconds	55.7	35.4	20.7	165
Total success score of pupil in the tasks	ACTP	1–4 (1 = success)	1.7	0.51	1.1	2.7
Satisfaction with the adapted mouse	QUEST	1–5	4.8	0.18	4.5	5
Satisfaction with service	QUEST	1–5	4.6	0.36	4	5
Total satisfaction with the adapted mouse	QUEST	1–5	4.7	0.19	4.3	5

Table V. Task CM-1– pointing and clicking.

Time spent in performance task (CM-1)	Mean	Median	Standard deviation	Minimum	Maximum	Number of observations
Current study group	106.15	85	57.6	32	214	27
Group T*	22	20.3	10	8.7	57.5	29
Group F	55.1	56.7	28.2	16	100.7	14
Group A	36.1	37.6	13.5	12.2	57.2	19

*Group T = typically developed children aged 5–9 years; Group F = French speaking children with motor impairment; Group A = Canada with English speaking children with motor impairments.

all 31 sub-tasks. In several sub-tasks (e.g. 1 & 4) no significant correlations were found. Five sub-tasks (13, 14, 19, 20, 27) revealed correlation rates of $r = 1$. An additional indication of agreement between the two raters was examined by calculating the percent agreement for the performance of all 30 participants in all 31 sub-tasks.

Table IV lists the five main study variables, their measurement scales and descriptive data regarding the performance of 31 sub-tasks (time and success measured by the two occupational therapists using the ACTP), and satisfaction from the pointer device (device, service and total teacher's satisfaction, using the QUEST). The mean time (± 1 standard deviation) to perform the five ACTP tasks (CM1–CM5) via an adapted pointing device = 55.7 ± 35.4 s. Note the large variation in participants' performance speed. The mean success score for all ACTP tasks = 1.7 ± 0.51 with a range from 1.1 to 2.7; thus all participants obtained scores higher than "partial success" (3) and most of them achieved "success with errors" (2). Finally, the teacher's satisfaction with the pointing device = 4.7 ± 0.2, a very high value.

The first row in Table V presents the results of the time measures for an example of a relatively easy task of pointing and selecting with a single click (CM-1) when participants used an adapted mouse to follow a marked path. The task was completed by 27 of the 30 participants with a mean time of 106.1 seconds (SD = 57.6); three participants were unable to complete the task.

The results of this study were compared to the norms obtained by the assessment's developers [20] on Canadian English speaking children with motor impairments (A), with French speaking children with motor impairment (F), and typically developing children, aged 5–9 years, for the five pointing device tasks in which performance time was measured. See, for example, the results for task CM-1 in Table III: point and click (CM-1); move, stop the pointer in an exact location and double click (CM2); change window size through dragging its edges (CM3); dragging and releasing a symbol in a convoluted path (CM4); drag and release of a symbol in a right-angled path (CM5). The sample in the current study performed slower than the two Canadian groups with motor impairments and the typically developing children.

Discriminant validity of the ACTP was confirmed in the current study by the differences found in performance time between girls and boys as well as performance between the three diagnostic subgroups. Results of the Mann–Whitney test showed statistically significant gender differences in performance time ($U = 57$, $P < .05$), with boys performing more quickly (mean = 42.1 ± 24.0 s) than girls (mean = 71.2 ± 40.6 s). Results of the Kruskal–Wallis test indicated significant differences between task success according to type of disability (H (2) = 7.335, $p < 0.05$). A Mann–Whitney test indicated statistically significant differences between success on the tasks ($U = 13$, $p < 0.01$) for children and youth with Down syndrome (mean = 1.96 ± 0.49) and metabolic syndromes (mean = 1.35 ± 0.44); participants in the metabolic syndrome group have higher cognitive and motor function and achieved higher scores than the children and youth with Down syndrome.

Success of computer performance as assessed by the ACTP correlated significantly with the teacher's total satisfaction of the AT adapted device as measured by the QUEST ($r = -0.639$, $p < 0.01$(. In contrast, performance time did not correlate with the teacher's satisfaction.

Discussion

The ACTP was designed originally for children with motor disabilities, with or without mild intellectual impairments [20]. The current study confirmed that the ACTP-Child revised version is a reliable assessment of the ability of children and youth with IDD to use an adapted pointing device. It also demonstrated that the tool is suitable for use in Arabic as previously shown for other western languages. The relatively high mean success scores achieved by participants with IDD indicate that the tasks used during the ACTP were feasible and user-friendly, entailing only minor adaptations and mediation; they may be used even if the children have only minimal previous computer experience. The current study demonstrated that the ACTP adds to the repetoire of reliable and valid tools applicable to assess diverse populations, even in challenging contexts.

The tool appears to be beneficial due to its compatibility for use with any adapted computer, the variety of tasks, the clarity of its manual, the availability of norms, and its suitability for different populations and gender. Hence, differences were found between girls and boys in the performance time of ACTP tasks. This suggests that the ACTP can discriminate gender with regard to the performance time variable, in keeping with other studies that showed gender differences when performing tasks that involve dexterity and balance [30,31] and visual spatial memory and language [33]. In the current study, ACTP performance time also discriminated between groups of disabilities, as shown previously by its authors [21].

Comparison of the results of the current study with data from previous studies confirmed that performance time of the ACTP tasks was sensitive to significant differences among children with and without disabilities [21]. Performance time was the most reliable measure in the current study, a variable that has previously been shown to be a good predictor for the degree of participation of people with disabilities in society [34]. Furthermore, the ACTP standardized mouse tasks yielded significant correlations between the total mean of success scores (given by each of the two occupational therapists) and the mean of performance time. The high internal consistency found in the current study signifies that participant's ability to perform the various ACTP standard tasks was consistent. These results among children and youth with IDD indicates that the use of a small subset of tasks out of the whole set may be feasible if necessary when used to asses for children with a short attention span or behavioral problems.

The level of client satisfaction with computer adaptations is an integral component in measuring the success of an intervention program according to the Assistive Technology Outcomes Measurement (ATOM) framework [8,9]. In the current study, the QUEST was used to examine the teacher's satisfaction with the adapted pointing device as used by the children with IDD. Satisfaction with AT device usage by the teachers was examined in the current study due to the central role they play at school in the realm of technology usage serving as a link between the professional team and the pupil's needs [35]. Their satisfaction and positive expectation is often an essential factor that affects the success of the intervention program and the retention of its use [36,37]. In the current study, the teacher's satisfaction correlated significantly with the children's success in accomplishing the tasks, but not with performance time. This apparent inconsistency may be due to the emphasis that teachers of children with IDD place on basic successful completion of tasks, rather than on the achievement of a functional pace [38].

The clinical implications of the current study relates primarily to the use of ACTP as an outcome measure for individual intervention. It may be used by clinicians during the adaptation process, to provide feedback and to document performance in real time. The ability of these results to demonstrate the successful use of well-adapted pointing devices may also encourage therapists and educators to consider their usage among children and youth with IDD, who had previously relied on switch based activation. Of course, the suitability of a pointing device versus switches for any given student must be supported by individualized clinical assessment and training.

It also allows the comparison of performance results obtained with various assistive devices to determine the effect of practice, or the contribution of different assistive devices. As such, the ACTP complies with the ATOM conceptual framework, the Matching Person and Technology model [5,39] and the model of outcomes measurement [40] which aim to improve the AT adaptation process [34].

The ACTP was designed to be used on any computer without special software, and without having to modify the existing interface. In the case of participants with IDD, many of whom have low intrinsic motivation [41] and low expectations of success when engaging in a new task [42], there is a need for a more motivating learning environment, rich with positive reinforcement [43]. In the current study, small gifts were given to the participants to motivate them to complete the tasks. They would have benefited from the use of software that provides positive feedback during performance (e.g. animating the mouse route, automatic timing of the performance).

Recommendations for future research include the collection of data from a larger sample that is more homogenous with respect to its level of intellectual and motor function. This will enable selection of a subset of tasks best able to predict performance and thus lead to a shorter assessment for participants with limited attention span. This process for children with severe physical disabilities is already underway by examining AT provided for them by the state [44].

In summary, the ACTP has been shown to be a reliable and sensitive outcome measure when used in the Arabic language to assess the ability of children with IDD to use an adapted pointing device. The results of this study thus extend and reinforce the usefulness of this tool for enhancing the AT process.

Acknowledgments

We are very grateful to the administration of the Holy Family Center for Special Education in Nazareth, Israel, who recruited the parents, children and multi-disciplinary staff. We thank the Center's computer teachers and occupational therapists for translating the Arabic version of the ACTP back into English, collecting data and for filling in the questionnaires. We also sincerely thank the Karten Clinical Laboratory for Assistive Technology at the University of Haifa for generously lending equipment throughout the research period. The authors are very grateful to Claire Dumont and Barbara Mazer for their help and advice in

preparing this tool for translation to Arabic and for updates regarding the ACTP literature.

Declaration of interest

The authors report no declarations of interest. The first author worked prior the current study in the school where the children and youth were recruited.

References

1. Bryant BR, Seay PC. The Technology-Related Assistance to Individuals with Disabilities Act: relevance to individuals with learning disabilities and their advocates. J Learn Disabil 1998;31:4–15.
2. Edyburn D, 2007. Re-examining the role of assistive technology in learning. Closing the Gap 25:5. Available at: https://pantherfile.uwm.edu/edyburn/www/ATinDepth.pdf. Accessed on 16 April 16, 2011.
3. Smith O. Measuring the outcome of assistive technology: a challenge and innovation. Assist Technol 1996;8:71–81.
4. Lund ML, Nygard L. Incorporating or resisting assistive devices: different approaches to achieving a desired occupational self-image. Occup Ther J Res 2003;3:67–75.
5. Scherer MJ, editor. Assistive technology matching device and consumer for successful rehabilitation. Washington DC: APA Books; 2002.
6. Schreuer A, Sachs D, Rimmerman A. Adjustment to severe disability: constructing and examining a cognitive and occupational performance model. Int J Rehabil Res 2006;29:201–207.
7. Alper S, Raharinirina S. Assistive technology for individuals with disabilities: a review and synthesis of the literature. J Spec Educ Tech, 2006;21:47–64.
8. Mechling LC. Assistive technology as a self-management tool for prompting students with intellectual disabilities to initiate and complete daily tasks: a literature review. Educ Train Dev Disabil, 2007;42:252–269.
9. Scherer M, Jutai J, Fuhrer M, Demers L, Deruyter F. A framework for modelling the selection of assistive technology devices (ATDs). Disabil Rehabil Assist Technol 2007;2:1–8.
10. Weiss-Lambrou R. Satisfaction and comfort. In: Scherer MJ, editors. Assistive technology matching device and consumer for successful rehabilitation. Washington DC: APA Books; 2002.
11. Smith RO. 2005. Integrated multi-intervention paradigm for assessment and application of concurrent treatments, (IMPACT2) Model. Available at: http://www.r2d2.uwm.edu/archive/impact2model.html. Accessed on 16 April, 2011.
12. Petty LS, McArthur L, Treviranus J. Clinical report: use of the Canadian Occupational Performance Measure in vision technology. Can J Occup Ther 2005;72:309–312.
13. Vrkljan BH, Miller-Polgar J. Meaning of occupational engagement in life-threatening illness: a qualitative pilot project. Can J Occup Ther 2001;68:237–246.
14. Hastings-Kraskowsky L, Finlayson M. Factors about older adults' use of adaptive equipment: Review of the literature. Am J Occup Ther 2001;55:303–310.
15. Kraskowsky LH, Finlayson M. Factors affecting older adults' use of adaptive equipment: review of the literature. Am J Occup Ther 2001;55:303–310.
16. Ruland CM, White T, Stevens M, Fanciullo G, Khilani SM. Effects of a computerized system to support shared decision making in symptom management of cancer patients: preliminary results. J Am Med Inform Assoc 2003;10:573–579.
17. Matson L, Mayville B, Laud B. A system of assessment for adaptive behavior, social skills, behavioral function, medication side-effects, and psychiatric disorders. Res Dev Disabil 2003;24:75–81.
18. Ottenbacher KJ, Msall ME, Lyon N, Duffy LC, Granger CV, Braun S. Measuring developmental and functional status in children with disabilities. Dev Med Child Neurol 1999;41:186–194.
19. Dumont C, Vincent C, Mazer B. Development of a standardized instrument to assess computer task performance. Am J Occup Ther 2002;56:60–68.
20. Dumont C, Mazar B. Assessment of Computer Task Performance (ACTP), Version 2. 2003. Québec: Institute de réadaptions en déficience physique, and Université LAVAL
21. Dumont C, Mazer B. Validation of the revised child version of the Assessment of Computer Task Performance. Phys Occup Ther Pediatr 2008;28:235–251.
22. Vincent C, Bisson J, Langlois É, Cantin JF. Utilisation d'une interface cerveau-ordinateur par un client présentant un traumatisme craniocérébral. Can J Occup Ther 2010;77:100–112.
23. Dumont C, Durand A. Rapport de recherche: Finalisation de la standardisation de la version pour enfants du Test du rendement dans l'utilisation de l'ordinateur. Université du Québec à Trois-Rivières; 2011.
24. Ming-Chung C, Ling-Fu M, Cheng-Feng H, Ting-Fang W, Chi-Nung C, Tien-Yu L. Computerized Assessment Tool for Mouse Operating Proficiency, Lecture Notes in Computer Science 2004; 3118:849–856.
25. Sandler-Loeff A, Shahak Y. Research report. People with disabiities in Arab society in Israel: An opportunity for social change. JDC ISRAEL The Unit for Disabilities and Rehabilitation, 2006. Retrieved from the World Wide Web 23-10-2011. Available at: http://www2.jdc.org.il/files/disability/publications/arab-disability-english.pdf
26. Demers L, Wessels R, Weiss-Lambrou R, Ska R, &De Witte L. An international content validity of Quebec User Evaluation of Satisfaction with assistive technology (QUEST). Occup Ther Int 1999; 6: 159–175.
27. Portney, LG, Watkins MP. Foundations of Clinical Research: Applications to Practice (2nd Ed.). 2002 Upper Saddle River, NJ: Prentice Hall.
28. Demers L, Ska B, Giroux F, Weiss Lambrou R. Stability and reproducibility of the Quebec User Evaluation of Satisfaction with assistive technology (QUEST). J Rehabil Outcomes Measure 1999;3:42–52.
29. Demers L, Monette M, Descent M, Jutai J, Wolfson C. The psychosocial impact of assistive devices scale (PIADS): Translation and preliminary psychometric evaluation of a Canadian-French version. Qua Life Res 2002;11:583–592.
30. Hsieh YJ, Lenker JA. (2006). The Psychosocial Impact of Assistive Devices Scale (PIADS): Translation and psychometric evaluation of a Chinese (Taiwanese) version. Disabil Rehabil Assist Technol 2006;1:49–57.
31. Krombholz H. (2006). Physical performance in relation to age, sex, birth order, social class, and sports activities of preschool children. Perceptl Mot Skills 2006;102:477–484.
32. Rigal RA. Which handedness: Preferences or performance? Percept Mot Skills 1992;75:851–866.
33. Bohgi A, Rasetti R, Avidano F, Manzone C, Orsi L, D'Agata F, Caroppo P, et al. The effect of gender on planning: An FMRI study using the Tower of London task. NeuroImage 2006;33:999–1010.
34. Schreuer N. Accommodations outcomes and the ICF framework. Assist Technol 2009;21:94–104.
35. Reiter S. The learning environment as a challenge enhancing development. Issues SpecEduc Rehabil 2003;18:87–93.
36. Gierach J. (2009). Assessing students need for assistive technology, editor. Milton, WI:CESA 2. Available at: http://www.wati.org .Accessed 2011 April 16.
37. Jussim L, & Harber K. (2005). Teacher expectations and self-fulfilling prophecies: Knowns and unknowns, resolved and unresolved controversies. Pers Soc Psychol Rev 2005;9:131–155.
38. Ronen C. Mental Retardation. Kiryat-Byalik: Ach. (Hebrew); 2005.
39. Scherer MJ. Living in the state of stuck: How technologies impact the lives of people with disabilities. Cambridge. MA: Brookline Books; 1993.
40. DeRuyter F. Evaluating outcomes in assistive technology: do we understand the commitment? Assist Technol 1995;7:3–8; discussion 9.
41. Switzky HN, & Greenspan S. 2003. What is mental retardation? ideas for an evolving disability. Washington, DC: American Association on Mental Retardation. Available at: http://www.disabilitybooksonline.com. Accessed on 16 April, 2011.
42. Zigler E, Bennett-Gates D, Hodapp R, Henrich CC. Assessing personality traits of individuals with mental retardation. Am J Ment Retard 2002;107:181–193.
43. Tomporowski PD, Tinsley V. Attention in mentally retarded persons. In: W. MacLean, editor, Ellis' Handbook of mental deficiency, psychological theory and research (3rd ed.). Mahwah, NJ: Lawrence Erlbaum. 1997. pp. 219–244.
44. Schreuer, N., & Sachs, D, (2009).The use of computers as facilitators for leisure and social participation of children with disabilities: An outcome study of a national project. Jerusalem: Ashalim, The Jewish Joint Distribution Committee, Israel, (in Hebrew; to be published in English).

Appendix I: Pointing devices.

<table>
<tr>
<td>1. Standard – Mini: Chester Mouse

Retrieved from: http://www.ablenetinc.com/</td>
<td>2. Big Track

Retrieved from: www.infogrip.com</td>
</tr>
<tr>
<td>3. Joystick

Retrieved from: http://www.traxsys.com/</td>
<td>4. PC-Track

Retrieved from: http://www.enablemart.com/Catalog/Trackballs-Joysticks/PC-Trac-Trackball</td>
</tr>
<tr>
<td>5. 3M-Ergonomics

</td>
<td>6+7. Standard with adapted switch
</td>
</tr>
</table>

Figure 1. Appendix I: Pointing devices.