"Matching Person & Technology (MPT) Model" for Technology Selection as Well as Determination of Usability and Benefit from Use

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ABSTRACT
Technologies have become smarter, smaller, more portable or wearable, and more adaptable. This has led to more choice and, in many cases, complexity in decision-making about selecting the best device and features for a given user. A good match of person and technology requires attention to (a) aspects of and resources in the environments in which the technology will be used, (b) the needs, expectations and preferences of the user, and (c) the functions and features of the technology and service delivery process. If the match is not a quality one from the standpoint of the end user, and the user experience (UX) is not satisfactory, then the technology may go unused, or may not be used optimally. There is a need for an improved person-AT matching and outcomes assessment process because studies and reports show in general that there is a high level of dissatisfaction and nonuse or discard of technology by consumers. Psychologists are uniquely qualified to partner with technology developers in implementing an assessment process that inquires into the potential technology user's predisposition to use a particular technology by addressing, subjective view of current capabilities, view of achievements as well as needs in key life domains of activities and participation, and ratings of fundamental personal factors such as mood status, support from others, engagement in therapy activities and desire to use technology. Utilization of the MPT model and accompanying assessment process has been proven to result in enhanced technology use and goal achievement.

Author Keywords
User Experience; technology adoption; technology integration, outcomes

ACM Classification Keywords
H.1.2 User/Machine Systems, J.4 Social and Behavioral Sciences, K.4.2 Social Issues

ADDITIONAL DESCRIPTION

Research increasingly highlights the fact that consumers are less likely to use recommended devices when their needs are neither fully addressed nor understood during the technology selection process.

A user's perspective of their needs and preferences may be obtained by having them identify and prioritize their desired outcomes and then rate progress in achieving them. This approach was used in developing the Matching Person and Technology measures and has also been used in developing Such a person-centered approach allows outcomes to be measured in reference to changes in a person's *satisfaction* in achieving desired goals, not merely their functional ability to achieve them. An idiographic evaluation is used (i.e., the person is the unit of analysis and serves as his or her own control), not a normative one (i.e., the person is compared to his or her peers). An idiographic evaluation best captures a consumer-directed and social model perspective of outcomes assessment.

Many studies have examined the psychometric qualities and usefulness of the Matching Person and Technology measures. Below is the most recent data on one MPT measure, the Assistive Technology Device Predisposition Assessment (ATD PA), from a study done in the country Greece (Koumpouros et al. 2017; n=115)

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- Excellent **interrater reliability** (ICC=0.981, ranging from 0.973-0.987)
- Adequate **internal consistency** (Cronbach's alpha =0.701, ranging from 0.605-0.701)
- Adequate-Excellent **construct validity** for items in the Adaptablility subscale (r=0.537 to 0.783)
- Excellent **construct validity** for items in the Fit to Use subscale (r= 0.691 to 0.801)
- Adequate-Excellent **construct validity** for items in the Socializing (r= 0.498 to 0.767)
- Low correlation coefficients between each subscale, indicating subscales measure unique constructs

Improvements in person-centered assistive technology services and outcomes assessment are needed, given reports of a high level of dissatisfaction and nonuse of technology by consumers. It is important to ensure an evidence-based, client-centered assessment for determining the match of individuals with the most appropriate technologies for their use. Achieving a desired outcome begins at the point of technology consideration and then progresses to product selection.

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Cognitive impairment often results in a range of functional and lifestyle changes for many individuals. This article discusses the development and evolution of a multidisciplinary model of cognitive rehabilitation outpatient practice that integrates technology to improve patient outcomes. The described interdisciplinary treatment approach highlights the need for collaboration by treating providers; focuses on the individual being an active participant in treatment; and discusses the value that assistive technology can bring to cognitive rehabilitation work as it relates to patient success, functional improvement, and implementation of appropriate and patient specific technological strategies.

Author Keywords

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ADDITIONAL DESCRIPTION

In 2011, a multidisciplinary team of professionals from the University of Rochester Medical Center recognized the need for an enhanced program to better manage the functional needs of individuals with mild to moderate cognitive impairments. At that time, there was a notable gap in the identification of individuals with subtle cognitive needs, despite the significant impact that these deficits were having on their daily functioning and ADL’s. The *Integrative Cognitive Rehabilitation Program (ICRP)* was developed to initiate a more effective interdisciplinary approach aimed at providing function-based, compensatory interventions. The ICRP is an interdisciplinary program focusing on assessment and treatment of individuals with mild to moderate cognitive impairments through the collaboration of Speech Language Pathology (SLP), Occupational Therapy, and Neuropsychology. The clinic highlights the need to integrate specialized and everyday/mainstream technologies within cognitive rehabilitation strategies to leverage improved patient outcomes.

NEED FOR COLLABORATION IN COGNITIVE REHABILITATION

Current models of cognitive rehabilitation support the efficacy of interdisciplinary approaches to assessment and treatment of individuals with mild to moderate cognitive impairments (Cicerone et al., 2011). Typically, delivery of therapeutic services to individuals with mild to moderate degrees of cognitive impairment have been segmented into a silo-based approach without interdisciplinary collaboration between the multiple disciplines who assess and treat cognitive impairments (Politis, 2014; Ylvisaker, 2005). The importance of collaboration multidisciplinary collaboration is essential to provide cost effectiveness and improved access to specialty care. Further, interdisciplinary teams promote opportunities for shared learning, shared decision-making and improved general continuity of care across time (White et al., 2012).

Research has shown that the maintenance and generalization of benefits from cognitive rehabilitation are the greatest when treatment is provided over a period of time, when efforts are made to individualize interventions to the functional needs and personal priorities of the patient, when patients take responsibility for their own recovery, and when patients are able to take advantage of compensatory strategies to facilitate greater independence in their daily functioning (Cicerone et, al., 2000). These compensatory strategies can include internal strategies such as management of fatigue or the use of external aids, including assistive technology.

According to Behm & Gray (2012), in an interdisciplinary team, the patient and team identify, set and work toward mutually agreed upon goals. A tailored approach that emphasizes patient centered care and patient specific goal planning is an integral part of cognitive rehabilitation programs (MacDonald & Wiseman-Hakes, 2010; Sohlberg et al, 2003; Cicerone et al, 2005, 2011). As part of the ICRP framework, emphasis is placed on the individual’s active role in goal development and achievement. Further, the ICRP approach also attempts to integrate caregivers/family members into treatment in an effort to promote rehearsal, practice, and generalizability within the individuals’ home environment.

DEFINITION OF ASSISTIVE TECHNOLOGY

The World Health Organization (WHO) views assistive technology as an umbrella term covering the systems and

services related to the delivery of assistive products and services. Assistive technology products are what individuals use, and assistive technology systems and services are how they obtain them. According to the WHO:

- Assistive products maintain or improve an individual's functioning and independence, thereby promoting their well-being.
- Hearing aids, wheelchairs, communication aids, spectacles, prostheses, pill organizers and memory aids are all examples of assistive products.
- Globally, more than 1 billion people need 1 or more assistive products.
- With an ageing global population and a rise in noncommunicable diseases, more than 2 billion people will need at least 1 assistive product by 2050, with many older people needing 2 or more.
- Today, only 1 in 10 people in need have access to assistive products.

http://www.who.int/mediacentre/factsheets/assistive-technology/en/

Cognitive Support Technologies

The term *cognitive support technologies (CST)* refer to a special class of assistive technology products designed to increase, maintain, or improve functional capabilities for individuals whose cognitive challenges limit their effective performance of daily activities. CSTs have become more commonplace and diverse (Scherer, 2012)).

In the relevant literature, we can encounter a confusing array of terminology used to refer to specialized devices for cognitive needs. In addition to cognitive support technology, they include:

- cognitive orthotics or orthoses
- cognitive assistive technology
- assistive technology for cognition
- cognitive aids
- memory aids

Broadly defined, CST refers to very familiar, basic products used by people with and without disabilities to support memory, organization or other cognitive functions, such as planner books, calendars, labels and post-it notes placed strategically, wristwatches and shopping lists. Simple and low-cost devices like magnifying lenses, index cards and timers/alarm clocks can promote independence and improve the individual's quality of life. Technologies supporting interaction with people or information (telecommunication technologies) are also important resources for individuals with cognitive disabilities and they include smartphones, pagers, and the Internet.

There are also specialized CST products designed expressly for use by individuals with cognitive disabilities and their caregivers. These specialty products have features that can:

a) maintain, organize, and facilitate access to information;
b) present suggestions, instructions or corrections to the
c) user either on demand or at prescribed times;
d) assume responsibility for task components that have
e) proven too complex for an individual to complete independently, so that activities in which those components are embedded can be successfully completed;
f) provide more comprehensive interactive guidance for tasks that are too difficult for the user to initiate or perform, even with other types of modifications and compensatory strategies; and
g) monitor the quality of the user's task performance so errors can be tracked and the CST intervention subsequently modified in an attempt to reduce those errors (Scherer, Hart, Kirsch & Schulthesis, 2005).

As Scherer (2012) suggests, integrating assistive technology into cognitive rehabilitation can be an important means of individualizing the rehabilitation intervention process by pairing patients with tools that allow them to interact with their environment with improved independence. ICRP routinely utilizes technology as a mode to deliver intervention strategies and these are recommended according to individuals' preferences and current capacities. While high-tech solutions (e.g., smartphones and tablets) are explored for some individuals, low-tech options such as paper-based memory aids may be the most accessible for others. Use of technology is pervasive today and allows a vast array of compensatory strategies to be cultivated and developed. This flexibility offered by assistive technology (everyday and specialized technologies) creates personalized and motivating interventions that are framed by the function-based approach to cognitive rehabilitation that the ICRP practices.

CURRENT CLINIC MODEL

The ICRP clinic was developed to service individuals with mild to moderate levels of acquired cognitive impairment. Examples of individuals served in the program include those with neurodegenerative diseases, acquired brain injury, brain tumors, stroke, cognitive impairments due to various medical conditions, and cognitive impairments due to mental health diagnoses.

The inclusion criteria for the ICRP program include: 1) individuals ages 18 and over; 2) mild to moderate levels of cognitive impairment, with no specifications related to diagnoses or duration post injury; 3) the presence of intact insight and awareness into their cognitive deficits or the capacity to develop this insight and awareness with education; and 4) the ability to learn compensatory strategies for cognitive skills. Exclusion criteria for ICRP include individuals with: 1) individuals under age 18; 2) severe cognitive impairments; 3) inability to gain insight into their cognitive deficits; 4) untreated mental health

presentation that interferes with ability to access information and meaningfully participate; 5) inability to identify goals for rehabilitation, despite guidance from the ICRP therapists and/or family.

Participation in ICRP begins with an initial evaluation by each specific discipline with a focus toward an integrative approach to consider the individual's personal and environmental factors, cognitive functioning, activities/ participation, and the functional impact within that individual's daily life. The Neuropsychologist (NP), Speech Language Pathologist (SLP) and Occupational Therapist (OT) each complete individualized assessments, with the underlying goal of gathering information related to how an individual functions in their home or daily environment, as well as, a formal assessment of cognition.

Formal assessments as part of the evaluation component of the program include the Repeatable Battery of Assessment of Neuropsychological Status (RBANS) (Randolph, 1998) administered by the Neuropsychologist, the Cognitive-Linguistic Quick Test (CLQT) (Helm-Estabrooks, 2001) administered by Speech Language Pathology, and the Cognitive Assessment of Minnesota (CAM) (Rustard et al., 1993) administered by Occupational Therapy. The RBANS assesses five cognitive domains, including immediate and delayed memory, visuo-construction skills and visuo-perception ability, attention, and language functioning (Randolph, 1998), and yields a summary measure of overall cognitive functioning. The CLQT contains several subtests that target attention, memory, executive function, language and visuospatial skills. A cognitive domain score is derived and is linked to a severity rating in each domain. The severity ratings for each domain are used to calculate a composite severity rating. The CAM is a standardized assessment developed by Occupational Therapists. It follows a cognitive hierarchy that is broken into four sections; acquiring/storing information, manipulation of old information, social awareness/judgment and abstract thinking. Each section produces a score that correlates with mild/no deficit, moderate, or severe deficits.

The information that is obtained by each discipline is shared with the team as a whole, with the goal of identifying the specific needs/weaknesses of the individual and the best approach to implementing cognitive rehabilitation strategies. An essential component of this team-based approach is obtaining a complete understanding of the individuals' experience and/or comfort with specific technology aids and identifying tailored and specific strategies that would fit the specific needs of the person. A significant aspect of this model is the provision of education about assistive technology and the value that it can bring to cognitive rehabilitation.

MATCHING PERSON AND TECHNOLOGY (MPT) MODEL

Individuals with cognitive disabilities as a group may be characterized as needing memory aids; however, each individual person with a cognitive disability does not have precisely the same memory challenge and thus does not need the same identical memory aid. However, while individual needs may vary, it is possible to develop standard guidelines to ensure that individual needs and preferences are identified.

The Matching Person and Technology (MPT) model and accompanying assessment process offers one such standard approach. It emerged from a grounded theory research and was first presented in 1989 (Scherer & McKee, 1989). The MPT Model focuses on three primary areas known to most differentiate technology users and non-users: (a) personal and psychosocial characteristics, needs and preferences; (b) milieu/ environmental factors; and (c) functions and features of the technology being evaluated. An assessment process consisting of several instruments was developed through participatory action to operationalize the model and theory. Table 1 gives examples of items that differentiate characteristics of the actual experiences of users and non-users, which have held up well in additional research studies.

	Person	***Milieu/Environment***	**Technology**
Good Match	• Comfort with using device • Motivated to use device • Technology use fits with lifestyle • Has the skills to use the device • Perceives discrepancy between desired and current situation • Realistic expectations of use	• Support from key others • Realistic expectations of key others • Setting/environment both supports and rewards use • Availability of assistance for selection, maintenance, repairs	• No pain, fatigue or stress with use • Compatible with/ enhances the use of other supports • Is safe, reliable, easy to use and maintain • Has the desired transportability • No better options currently available

Poor Match	• A thorough assessment was not done • Person doesn't want device • Does not experience benefits from use • Embarrassed to use device • Use requires many changes in routine/lifestyle • Does not have skills for use • Changes in priorities or needs	• Lack of support from key others • Unrealistic expectations of others • Assistance not available • Setting/environment discourages or prevents use or makes it awkward • Lack of adequate training for use	• Too much effort or discomfort with use • Requires a lot of set-up • Device is inefficient • Perceived or determined to be incompatible with the use of other supports • Too expensive • Long delay for delivery • Is difficult to use • Repairs/service not timely or affordable • Other options are preferred

Table 1. The MPT Model's three primary areas known to most differentiate technology use and non-use
Source: Scherer, 2012, Scherer & Federici, 2015

Application of the MPT Model

Both formal and informal assessments related to technology are also administered as part of the ICRP clinic day. The Device and Person Match measure (Scherer, 2003) is part of the Matching Person & Technology Model and Assessment portfolio (2005). It is utilized initially and at follow-up to assess expectations of benefit from recommended technologies and then realization of benefit from use of obtained products. At baseline, it is also used to compare cores of competing products or forms of support. With the ICRP program, the OT therapist is assigned to obtain this information and share it with the team members.

Together, the qualitative and quantitative information derived from each discipline specific assessment is utilized to collaboratively establish an intervention approach and determine the preferred functional compensatory strategies with the individual. Although the evaluation process is focused primarily on cognition and related functional activity, specific attention is also paid to communication, learning and participation variables. Specifically, the individual's technology comfort level, family, cultural, physical, and sensory factors are also considered in the evaluation and in the selection of treatment strategies.

TREATMENT STRATEGIES

The use of strategies and the use of assistive technologies, especially in regards to their use for cognitive supports, are not instinctual and require training. This type of training, while different from provider to provider and individualized to each participant, needs to be systemic in nature and include practice. This necessitates use in sessions and application in daily life. Sohlberg and Turkstra's (2011) breakdown of systematic instruction for facts and concepts is utilized to complete this. The acquisition phase of training through ICRP begins with the initial evaluation where individuals are asked a series of questions to determine willingness to use a variety of global and specific interventions. This also allows for explanation of the rationale for use of the strategies. Once this is established, clinicians begin with an explanation of the process to use the strategy through written steps, verbal explanations, and task breakdown into small, repeatable steps.

This breakdown allows each participant to proceed at their own pace. It also allows for individualized training based on each person's learning strengths and needs, repeated practice in the clinic, and commencement of practice in ecologically valid locations. The process continues by chaining together the steps to be able to fully utilize the entire strategy. Once learning of the strategy has occurred, transition to the mastery and generalization phase of training begins. During this phase, focus shifts to applying the strategies in daily life, and technology is further applied.

INTEGRATION OF TECHNOLOGY

Use of technology is pervasive today and allows a vast array of compensatory strategies to be cultivated and developed (Baecker, 2008). Existing literature supports the use of cognitive support technologies as interventions for improved performance with functional activities for individuals with cognitive impairments (de Joode, van Heugten, Verhey, & van Boxtel, 2010; Gentry, Wallace, Kvarfordt, & Lynch, 2008). A recent review by Charters et al. (2015) assessed the efficacy of electronic portable assistive devices (PDAs), such as mobile phones and smartphones, for individuals with acquired brain injury. Overall, findings supported the efficacy of compensatory reminders for supporting functional performances across a range of activities (Charters et al., 2015).

Technology offers a current and socially acceptable way to bundle many strategies into one system. For example, an individual can implement strategies involving: calendar use, task management, information management, and auditory cues into a single device that is available all day. The use of technology allows strategies to be set up automatically to increase usability.

The ICRP often utilizes technology as a mode to deliver intervention strategies that are recommended according to individuals' preferences and current capacities. While high-tech solutions (e.g., smartphones and tablets) are explored for some individuals, low-tech options such as paper-based tools may be the most accessible for others. Use of high tech options is not a requirement for all individuals participating in the program. Determining whether the individual would most benefit from high tech vs. low-tech options requires education, demonstration and a discussion between the individual and clinician (Scherer, 2012).

FUTURE DIRECTIONS

Technology can be empowering, and it can also be frustrating and stigmatizing when it is complicated to use and when users perceive that their devices look different from what other people use. For example, operating an iPhone and all its applications requires the ability to sequence and to make decisions and selections. As stated in Scherer (2017):

AT users may be satisfied with the clinic's services, have the necessary funding for the device, received a product that is usable, looks good, functions well and meets all safety standards, and helped them achieve functional gain – but if it is a hassle to use, set-up and maintain, if it doesn't fit with their needs/preferences/lifestyle, if they feel self-conscious using it, insecure with use even though it is safe, if they are socially and physically and emotionally uncomfortable with use, then they are not realizing benefit from use and will not use it. It is not a good match of person and AT. Ultimately, it is the user experience (UE) and realization of benefit that drives and determines whether or not a device is used, for how long, what percent of the time and in which environments (p.1).

CST selection needs to start early in cognitive rehabilitation, be constantly re-evaluated, and evolve with the person as their needs change. The MPT assessment process and forms have been designed to guide the individual and professional in gathering the most useful information and can be repeated periodically to determine if needs have changed. Measures to guide CST decision-making that both provide guidance for selection and also enable baseline and outcome data collection when repeated over time, or when used initially and at follow-up, are not used as frequently as they should.

The ICRP is a model that attempts to comprehensively multiple domains, including technology, to guide cognitive rehabilitation and improve outcomes. The goal of the clinic is to maximize treatment effects, identify appropriate resources, integrate caregiver/family support into the treatment process, and reduce treatment lengths.

In summary, the above highlights the need for further implementation of multidisciplinary approaches to cognitive rehabilitation, as well as the value, in integrating technology as an important treatment modality in individuals with mild to moderate cognitive impairment.

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