Evidence-Based Practice Recommendations for Working with Individuals with Dementia: Computer-Assisted Cognitive Interventions (CACIs)

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The Dementia Practice Guidelines (DPG) Writing Committee was formed to develop clinical practice guidelines for speech-language pathologists (SLPs) working with individuals who have dementia. This committee performed a systematic and thorough review of the literature related to assessment and management of individuals with dementia of the Alzheimer type, followed by an examination and classification of the literature based on predetermined criteria (see Frattali et al., 2003 for an in-depth discussion of best practice guidelines in speech-language pathology). In this clinical report, the level of scientific evidence related to computer-assisted cognitive interventions (CACIs) is examined, with findings and recommendations summarized. The three studies reviewed were judged to provide Class II evidence supporting the use of CACIs for persons with dementia. This article contains information about the characteristics of study participants, the nature and format of CACIs implemented, outcomes of the interventions, methodological limitations, data trends across studies, recommendations for clinical practice, and future research directions.

The Academy of Neurologic Communication Disorders and Sciences (ANCDS), the American Speech-Language-Hearing Association (ASHA), its Special Interest Division 2 (SID-2: Neurophysiology and Neurogenic Speech and Language Disorders), and the Veterans Administration (VA) collaborated to

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establish evidence-based practice guidelines to be used by speech-language pathologists who work with individuals with dementia of the Alzheimer's type (DAT). A writing committee was formed that generated a technical report with evidence tables, based on a systematic review and classification of the literature related to use of direct and indirect interventions with individuals who have DAT. In this article, one in a series of reports, evidence related to the use of computer-assisted cognitive interventions (CACIs) for persons with dementia is reviewed.

Dementia has been defined as an acquired, persistent, and progressive deterioration of multiple cognitive domains including memory, orientation, language, attention, executive function, and visuospatial abilities (Cummings & Benson, 1983). Alzheimer's disease (AD) accounts for more than 50% of all persons receiving a clinical diagnosis of dementia (Katzman & Bick, 2000). There are currently four FDA-approved drugs available for amelioration of symptoms resulting from AD; however, they provide only limited benefits in terms of cognitive function. Moreover, recent findings from a study conducted by Chapman, Weiner, Rackley, Hynan, and Zientz (2004) suggest that persons with DAT who receive pharmacological treatment along with cognitive-communicative interventions demonstrate better outcomes than those receiving drug treatment alone. As the population ages and the number of older adults increases exponentially, more people are being diagnosed with and living with AD or related dementias. These demographic trends, in turn, demand greater attention to effective and efficacious assessment and clinical management methods.

Behavioral interventions are increasingly being used with dementia patients, and much evidence has accumulated that persons with AD benefit from such interventions by improving their functioning and acquiring behaviors that enhance their performance on activities of daily living. Personal computers are ubiquitous and offer a versatile, low-cost medium to assist in delivering some of these interventions directly to persons with dementia or to their caregivers (Czaja & Rubert, 2002). Given the rapidly increasing numbers of computer-literate older adults and the growing adaptability of computer technology, using computers to aid therapy with dementia patients is practical and timely. In this clinical article, computer-assisted cognitive interventions or CACIs are described as consisting of interactive, programmed computer technology as a tool for teaching individuals with AD information and skills. CACIs have a rich history of applications for persons with communicative and cognitive disorders including amnesia (Brooks et al., 1999; Glisky, 1995), traumatic brain injury (Lynch, 2002) and aphasia (Petheram, 2004; Katz & Hallowell, 1999; Katz & Wertz, 1997). By comparison, the use of computer technology for developing interventions for persons with dementia is a relatively new area of investigation.

In a document titled "Knowledge and Skills Needed by Speech-Language Pathologists Providing Services to Individuals with Cognitive-Communication Disorders" (ASHA, 2005), ASHA recognizes that speech-language pathologists (SLPs) should know about and be able to apply appropriate technologies, including computers, for the assessment and management of persons with cognitive-communication disorders. Similarly, in a recent Position Statement on the "Role of Speech-Language Pathologists in the Identification, Diagnosis, and Treatment of Individuals with Cognitive-Communication Disorders," ASHA stipulates that SLPs should address certain critical aspects in intervention for clients with cognitive-communication disorders. These include "training discrete cognitive processes, teaching specific functional skills, and developing compensatory strategies and support systems" (p. 2). CACIs can be successfully used to address each of these important aspects of intervention. Thus, it is timely that SLPs focus on applying computer technology to implement interventions for persons with dementia.

Implementing a CACI typically involves adapting hardware and software devices for persons who have dementia. There are many advantages to using CACIs. The low cost of computer hardware, easy availability of commercial software programs, user-friendly interfaces, and ergonomic accessories allow interventions to be individualized and appropriately administered for persons with dementia who often have sensory or motor deficits. Further, computers provide consistent task environments and repeated practice opportunities and can easily be set up with databases to track response accuracy and latency across tasks and treatment sessions. Such features make CACIs potentially cost-effective therapies that can provide persons with dementia and their caregivers greater access to interventions.

PROCEDURES

Review of the Literature

An exhaustive literature search was conducted in several electronic databases: Medline (1966-August

2002), CINAHL (1982-August 2002), HealthSTAR (1980-August 2002), PsycINFO (1967-August 2002), EBM Reviews, Cochrane Database of Systematic Reviews, Health Reference Center (1980-August 2002), ERIC via EBSCO Host (1966-August 2002), and the Social Sciences Citation Index (1969-August 2002). Manual searches were conducted of relevant textbooks, journals not available electronically, review articles, and book chapters. The following search terms were used: *computer-based cognitive interventions, computerized cognitive training, computer training, computer-assisted, computer-based rehabilitation, computer applications, software applications, software products, microcomputers, technology, dementia, Alzheimer's disease, dementia of the Alzheimer's type,* and *senile dementia.* Seven articles were identified as being related to these search terms.

Of these seven articles, four were excluded from classification and review. One was a comprehensive review of different types of direct interventions for AD participants, including computer-based interventions (Mahendra, 2001). The second excluded study (Butti, Buzzelli, Fiori, & Giaquinto, 1998) only had participants with a diagnosis of vascular dementia. A third study (Fisher, 1986) was a preliminary report based on behavioral observations of participants' reactions to a computer introduced in an adult daycare center. This study was excluded because no data were reported on the type of observations conducted, and limited information was provided about the participants (many of whom were reported to have non-AD etiologies). In the fourth excluded study (Groves & Slack, 1994), the authors conducted a pilot study to assess the feasibility of teaching nursing home residents how to use a specific computer program. This study was excluded because no information on participant characteristics such as age, gender, diagnosis, or presence/absence of cognitive impairments was provided. After excluding these studies, the three remaining ones were identified as meeting the inclusion criteria for review (Hofmann, Hock, Kuhler, & Muller-Spahn, 1996; Hofmann, Hock, & Muller-Spahn, 1996; Schreiber, Schweizer, Lutz, Kalveram, & Jancke, 1999).

CLASSIFYING THE EVIDENCE

The DPG writing committee developed an evidence table template for classifying all research evidence contained in articles reviewed on assessment and management of persons with dementia by SLPs. Each study was evaluated and classified based on several parameters including the purpose of the study; characteristics of enrolled participants; factors affecting internal, external, and content validity; dose-response characteristics (frequency, intensity, and duration) of the treatment; methodological issues; treatment outcomes; and outcome measures used to document treatment effects.

To ensure reliability of the coding, two DPG committee members rated the studies independently. In this clinical article, the outcomes of CACIs for persons with AD and associated dementia are examined. Five key questions were used to frame the evidence being evaluated, consistent with the work of Sohlberg et al. (2003) and Hopper et al. (2005). These questions are:

1. Who are the participants who received the CACIs?
2. What does a CACI consist of?
3. What are the outcomes of CACIs?
4. What are key methodological concerns in implementing CACIs?
5. Are there clinically applicable trends across studies in which CACIs were implemented?

SUMMARY OF EVIDENCE FOR CACIS

Who are the Participants Who Received CACIs?

Twenty-four individuals (17 AD participants, 7 controls) participated in the three studies, 11 women and 6 men whose ages ranged from 49 to 90 years. All were diagnosed with probable Alzheimer's disease (pAD), based on widely accepted clinical criteria established by the National Institute on Neurologic Communication Disorders and Stroke and/or the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA; McKhann et al., 1984) or the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IIIR; American Psychiatric Association, 1987). In addition to these criteria, participants in the three studies had extensive medical assessments, including CT scans (Schreiber et al., 1999), MRI scans, laboratory tests, and a lumbar puncture (Hofmann, Hock, & Muhler-Spahn, 1996; Hofmann, Hock, Kuhler, & Muller-Spahn, 1996). Hofmann, Hock, and Muller-Spahn (1996) reported on four participants with AD (3 men, 1 woman) and also included these individuals in a subsequent study (Hofmann, Hock, Kuhler, & Muller-Spahn, 1996) with six additional AD participants.

Participants in the three studies had mild to moderate severity of cognitive symptoms associated with dementia, based on their Mini-Mental State Exam scores (MMSE; Folstein, Folstein, & McHugh, 1975) ranging from 12 to 26 out of 30. Additionally, in two out of three studies, ratings on the Clinical Dementia Rating Scale (CDR; Hughes, Berg, Danzinger, Coben, & Martin, 1982) were included and ranged from 0.5 to 2 in the study by Hofmann, Hock, Kuhler, and Muller-Spahn (1996) and from 1 to 2 in the Hofmann, Hock, and Muller-Spahn (1996) study. In these two studies, the authors provided estimated time since disease onset and classified participants as having early or late onset AD (Hofmann, Hock, Kuhler, and Muller-Spahn 1996; Hofmann, Hock, & Muller-Spahn, 1996). Similarly, Schreiber et al. (1999) provided the mean duration in number of weeks that participants exhibited dementia symptoms.

Participants in both Hofmann et al. studies all lived in their own homes and had a close relative or caregiver to look after them. Schreiber et al. (1999) stated that study participants were "non-hospitalized" but additional information on residence was not provided. No information on participants' ethnicity was available in any of the studies, nor was screening for or assessment of auditory or visual acuity mentioned. Schreiber et al. (1999) stated that none of their participants had sensory deficits, but did not provide information about how this determination was made. Both studies conducted by Hofmann et al. included information about depression, as measured on the Montgomery-Asberg Depression Rating Scale (MADRS; Montgomery & Asberg, 1979). Although the participants were generally well-specified, complete information on ethnicity, sensory function, prior level of computer exposure, and so forth was unavailable in the articles.

What Does a CACI Consist of?

The primary purpose of the three studies was to investigate the effects of CACIs on the ability of persons with dementia to remember information or to perform everyday functional tasks. The three studies varied in the type of computer program employed, the format of the CACI, specific task/information being trained, dose-response characteristics of the CACI, and the type of outcome measures used to document treatment effects. Hofmann, Hock, and Muhler-Spahn (1996) and Hofmann, Hock, Kuhler, and Muhler-Spahn (1996) focused on training AD participants to perform "everyday tasks of functional relevance" such as learning a route (e.g., finding the way to the bakery or to a caregiver's apartment in the same neighborhood), shopping for specific items from a list, and so forth. Successive stages of these tasks were simulated and trained on a PC touch screen using many photographs of each participant's surroundings and local environment. Schreiber et al. (1999) used an interactive, four-stage, computerized memory training program, to train real-life household tasks (e.g., locating objects in a room, or the route to a room within an apartment) in a virtual, three-dimensional apartment to enhance immediate and delayed recall of objects and routes. Participants had to respond by moving a joystick to a target object or along a target route followed by pressing a button.

Schreiber et al. (1999) used a commercially available, menu-driven PC software program called MULTITASK, containing pictures from commercially available graphic libraries to teach participants to locate the same objects and routes within a "virtual" apartment. These researchers adjusted their training tasks to participants' individual levels of performance by manipulating the number of target objects/routes being trained and the amount of prompting/instruction provided to participants during training. Hofmann and colleagues used an unspecified PC presentation software program in which successive steps in a to-be-trained task were illustrated using 50–150 scanned photographs from each participants' local and social environment. These investigators individualized training by selecting treatment tasks that were identified by participants and their caregivers and using personally relevant photographic stimuli.

Other aspects of the treatment context that differed across the studies included instructions given to participants and the ability of the computer program to allow variation in complexity of trained information. Hofmann, Hock, and Muhler-Spahn (1996) and Hofmann, Hock, Kuhler, and Muller-Spahn (1996) instructed their AD participants to perform the tasks as quickly as possible and with as little assistance as possible. Schreiber et al. (1999) imposed no time limits for the completion of training tasks and administered their computerized training at three levels of difficulty (defined by the amount of information, in this case the number of targets trained).

The authors of the studies did not provide specific information about who administered the computer-assisted treatment to dementia participants. In each study, the authors reported that a "therapist" (Schreiber et al., 1999) or "instructor" (Hofmann, Hock, & Muhler-Spahn, 1996; Hofmann, Hock, Kuhler, & Muhler-Spahn, 1996) supplemented the computer-assisted intervention by providing instructions, redirection, or prompting to facilitate task completion, if needed. However, it was unclear if these therapists or instructors were research staff, clinical staff, or the authors themselves, and no information was provided about their qualifications, experience, or training.

The frequency, intensity, and duration of treatment sessions or the dose-response characteristics varied across studies. Dose-response characteristics are important determinants of treatment effects and have implications for the feasibility of administering an intervention in real-world clinical settings. Therefore, these characteristics must be carefully analyzed when interpreting data on intervention outcomes, their maintenance, and generalization to untreated tasks or behaviors. Schreiber et al. (1999) conducted their study over a 2-week period, in which all participants received five treatment sessions per week, with each session lasting 30 minutes. Hofmann, Hock, and Muller-Spahn (1996) conducted their study over a 12-week period consisting of two treatment phases, each lasting 4 weeks, separated by a 4-week interval with no training. During each 4-week treatment phase, participants received three to four sessions per week. In their second study, Hofmann, Hock, Kuhler, and Muhler-Spahn (1996) administered one 3-week treatment phase, with three to four sessions per week. No information on duration of treatment sessions was provided in these two studies.

What Are the Outcomes of CACIs?

Outcome measures used in the three studies were of two types:

1. scores on standardized psychometric tests (such as the Rivermead Behavioral Memory Test) or their subtests, and
2. indices of behavioral task performance (such as the amount of time participants took to complete tasks, number of errors made, number of times a therapist had to assist participants).

Given that CACIs were conducted over short periods of time ranging from 2 to 4 weeks in the studies reviewed here, statistically significant improvements often did not occur on psychometric tests; however, performance on the behavioral tasks reflected positive changes in response to the CACIs.

Hofmann, Hock, and Muller-Spahn (1996) used six psychometric tests (including the MMSE) and scales (including the MADRS) to document cognitive performance, state of mood, and performance on activities of daily living (ADLs) before and after each 4-week training phase. No significant changes in performance were observed on any of the six measures after training. Hofmann, Hock, Kuhler, and Muller-Spahn (1996) used the MMSE, the MADRS, and the Interview for the Deterioration in Daily Living Activities in Dementia (IDDD; Teunisse & Derrix, 1991) and reported no significant difference in posttreatment scores compared to pretreatment scores on these measures. In both of these studies, data were gathered on the amount of time taken to complete tasks, the number of errors, and the number of times prompting or other assistance was required to complete target tasks.

Hofmann, Hock, and Muhler-Spahn (1996) reported significant reductions in all three measures during the two 4-week training phases, with three of four participants showing the effects of training 4 weeks later. Hofmann, Hock, Kuhler, and Muller-Spahn (1996) observed that when participants' performance was compared from baseline to the posttraining probes, as a group, AD participants significantly reduced the amount of time they took to complete tasks and the number of times they needed advice immediately and 3 weeks after training ceased. Further, the group showed a tendency for reduced number of errors immediately and three weeks after training than at baseline; however, this reduction in number of errors was not statistically significant. Specifically, 8 of the 10 AD participants in this study demonstrated reduced number of errors, and all 10 participants took less time and required advice fewer times to complete tasks after training than at baseline.

Schreiber et al. (1999) used three subtests of the Rivermead Behavioral Memory Test (RBMT; Wilson, Cockburn, & Baddeley, 1985) and two subtests of the Nuremberg Aging Inventory (NAI; Oswald & Fleischmann, 1982) as outcome measures. The authors did not report any behavioral task-related data such as number of errors or amount of time taken to complete a task. Their results indicated that compared to individuals in the control group (not receiving CACIs), individuals in the experimental group improved in immediate recall of visual information and delayed recall of topographical information (routes), as measured by scores on the NAI Picture Test and the RBMT Route Learning subtests, respectively.

To document the effects of CACIs, it is crucial to assess maintenance and generalization of treatment outcomes. Authors of the three studies reported assessing maintenance of trained information and skills, immediately after training ceased and after a delay of 3 to 4 weeks with no further training in the interim. A critical question about using CACIs that remained unanswered in the three studies with dementia patients was whether there is generalization from computer-trained tasks to analogous real-world tasks.

What Are the Key Methodological Concerns in Implementing CACIs?

Methodological concerns about internal, external, and construct validity were raised by review committee members.

Internal Validity

Internal validity relates to ensuring that changes in a dependent variable result only from manipulation of the independent variable and not because of alternative explanations such as maturation, test-retest effects, differential subject selection, and so forth. One of the most robust methods of enhancing internal validity in a research design is randomization of participants to treatment and control groups. In two studies (Hofmann, Hock, & Muhler-Spahn, 1996; Hofmann, Hock, Kuhler, Muller-Spahn, 1996), a single group, within-subjects design was used with pre- and posttesting on selected outcome measures, following intervention. Schreiber et al. (1999) employed a quasiexperimental design, with equal numbers of participants alternately assigned to a treatment group (receiving CACIs) and a control group (participating in conversations with a psychologist to control for social stimulation). Random assignment was applicable only to the study conducted by Schreiber et al. (1999), who cited recruitment reasons (with one subject being recruited every few weeks) that made randomization impossible. Missing data, due to subject attrition, were reported by Hofmann, Hock, and Muller-Spahn (1996) for one individual who was unwilling to participate in posttraining test probes. These studies all had small samples and are best characterized as pilot studies in which researchers reported preliminary findings.

External Validity

External validity relates to the extent to which treatment effects reported in a study can be generalized to other populations or settings. Factors affecting external validity include replicability, treatment fidelity, and sample and causal generalizability. Based on information provided in the three studies, reviewers rated the Schreiber et al. (1999) study as being more replicable than the other two studies. In this study, a commercially available software program (MULTITASK) was used to deliver the intervention. This program consisted of four stages that varied depending on the target stimulus (objects or routes) and whether participants had to recall stimuli immediately only or immediately and after a delay. Stage 1 of the program targeted immediate retention of objects, Stage 2 targeted immediate and delayed retention of objects, Stage 3 targeted immediate retention of routes, and Stage 4 targeted immediate and delayed retention of routes. Further, the level of difficulty within each stage could be adjusted by manipulating the number of targets being trained (one, three, or five objects in Stages 1 and 2 and one, two, or three rooms in Stages 3 and 4). Information was also provided about task instructions. The task used in the two studies by Hofmann and colleagues was complex and highly individualized. However, the authors did not provide detailed information about the treatment protocol. Without specific information about implementation or task instructions, the ability to replicate these studies is limited.

Treatment fidelity was rated on a 4-point scale (Bayles et al., 2005) where a rating of:

a. 0 indicated poor treatment fidelity with little or no information about the treatment,
b. 1 indicated some effort to provide all participants with the same treatment but no manipulation checks,
c. 2 indicated that investigators had attempted to provide all participants the same treatment and one or more manipulation checks, and
d. 3 indicated excellent treatment fidelity with a clearly detailed treatment and a manual or treatment guide plus one or more manipulation checks.

Reviewers rated treatment fidelity as 1 for both studies by Hofmann and colleagues and as 2 for the Schreiber et al. (1999) study. No manipulation checks or reliability estimates were reported in any of the studies.

Sample generalizability was judged as very good for all three studies because of the use of NIH nationally recognized criteria to establish diagnosis of probable AD. Whereas Hofmann and colleagues provided no information on exclusionary criteria in their studies, Schreiber et al. (1999) listed sensory deficits, psychiatric/neurological disease, and unwillingness to participate as exclusionary criteria.

Causal generalizability refers to "whether there was a causal relation between treatment and outcome" (Bayles et al., 2005, p. xxi) and was evaluated on a 3-point scale where 0 indicated the definite presence of one or more confounding variables influencing treatment outcomes, 1 indicated the possibility that a confounding variable existed, and 2 indicated that there were no discernible confounding variables. The studies by Hofmann and colleagues received a rating of 1 because of small and heterogeneous participant groups consisting of early and late-onset AD patients, the lack of a control group, and the intervention not being described in adequate detail. Schreiber et al.'s study (1999) received a rating of 2 because they used a control group that was not significantly different from the treatment group on MMSE on age, gender, MMSE scores, and time since onset of symptoms. Further, participants were alternately assigned to treatment or control groups in order of recruitment, and the treatment was specified in detail.

Construct Validity

Construct validity relates to the appropriateness of outcome measures used to quantify therapeutic effects. Given that the reviewed studies were conducted over a relatively short period of time, and the same psychometric tests were administered multiple times to participants with mild to moderate dementia, one concern was whether improvements in scores resulted from test-retest effects. However, Hofmann and colleagues reported no significant changes in psychometric test data post-CACIs in either of their studies, and Schreiber et al. (1999) demonstrated that only participants assigned to the treatment group demonstrated improved psychometric test performance after 10 sessions of CACIs, with the control group showing no improvement.

Are There Clinically Applicable Trends Across Studies in Which CACIs Were Implemented?

The findings of these studies suggest that AD participants with mild to moderate dementia can participate in CACIs. Across studies, participants showed improvements in performing specific tasks trained using a computer (i.e., participants demonstrated fewer errors, took less time, and required fewer prompts to successfully complete target tasks).

WHAT CAN BE LEARNED FROM THIS REVIEW OF THE EVIDENCE ON CACIS?

All three studies reviewed were classified as providing Class II evidence in support of the use of CACIs with dementia patients. However, considerable research is needed before making stronger conclusions about the strengths and limitations of CACIs. Future research in this area can establish stronger reliability and validity by including more details about the characteristics of computer programs that produce positive outcomes, tracking performance, instructions and prompts, methods for individualizing programs for users, and the necessary hardware and software. Based on the preliminary evidence contained in the studies reviewed here, some recommendations for future research on CACIs, relative to determining candidacy for CACIs, implementing computerized interventions, and reasonable expectations for treatment outcomes are provided below.

Candidacy for CACIs

Participants with dementia who would be optimal candidates for CACIs include:

- Individuals with episodic memory impairments resulting from dementia and relatively spared motor learning skills or procedural memory ability
- Individuals with mild to moderate dementia severity and the ability to attend to and participate in intervention sessions
- Individuals with vision and hearing within normal limits with adaptive equipment (visual impairments might particularly affect response to CACIs and it is likely that hearing impairments, motor control of hand and fingers (to manipulate a keyboard or joystick), and eye-hand coordination abilities also would affect response to CACIs). Individuals with severe impairments are not optimal candidates for CACIs.

Implementing CACIs for Persons with AD and Other Dementias

Clinicians and researchers investigating CACIs with dementia participants should:

- Screen for visual and auditory impairments and document eye-hand coordination and motor control of hands/fingers.

- Document prior exposure to and use of computers and willingness to use a computer during treatment sessions.
- Begin treatment studies or sessions by familiarizing participants with a computer in the context of manipulating the keyboard or joystick, and document reactions to using a computer.
- Obtain repeated measures in the baseline phase of performance on to-be-trained tasks in real-life situations and in simulated, computer-based contexts.
- Provide practice trials on prototypical tasks used in treatment sessions.
- Administer short sessions multiple times a week, as tolerated by participants.
- Focus on treatment tasks that are functional and likely to make a difference in the individual's everyday functioning (e.g., learning the route from his or her room to the dining area).

Anticipated Outcomes of CACIs for Persons with Dementia

Based on the studies reviewed, persons with dementia may likely demonstrate the following outcomes in response to CACIs:

- Improvement in the acquisition and retention of trained information and skills.
- Generalization of computer-trained tasks to analogous real-world tasks and to related tasks/behaviors.
- Enhanced ability to perform trained tasks in a lesser amount of time, with fewer errors committed, and reduced need for assistance/prompts.
- Retention of trained information over several weeks after training has ceased.
- Little to no change in global cognitive functioning as measured by performance on standardized tests of memory or general cognition as a result of training.

CURRENT AND FUTURE RESEARCH DIRECTIONS ON CACIS

CACIs present a new and promising area of investigation for researchers and clinicians who work with dementia patients and their caregivers. Acknowledging the tremendous potential of CACIs, the Alzheimer's Association and the Intel Corporation announced the Everyday Technologies in Alzheimer Care (ETAC) Initiative in 2003, a research funding effort focused on the development of new technologies to compensate for functional impairments, enhance treatment strategies, foster independence, and improve the quality of life for people with dementia and their caregivers.

During the time of the literature review and classification of the evidence relating to CACIs, some additional studies on the effects of CACIs were published. These studies were not included in the evidence table for the technical report and were not rigorously reviewed by the committee. However, the studies are described here in order to include the most current findings on CACIs.

Alm et al. (2004) conducted a pilot study on the suitability of using a multimedia, LCD touch-panel display as part of reminiscence therapy with six individuals with dementia (3 men, 3 women) and their caregivers. Participants ranged in age from 57 to 95 years, with mild to moderate dementia, measured by MMSE scores between 10 and 25. Participants and caregivers rated the multimedia interface with regard to the auditory/visual characteristics of stimuli, ease of using the touch screen display, preference for pictures with or without text, picture size, and duration of audio and video clips. Based on their feedback, the multimedia display was modified, and nine different participants with dementia (4 men, 5 women) and their caregivers participated in a single multimedia reminiscence session. These nine participants ranged in age from 65 to 95 years, and had MMSE scores between 8 and 22. The descriptive results revealed that dementia patients enjoyed the multimedia reminiscence session, had no difficulty adapting to and using the LCD-touch screen, and self-reported wanting to participate in additional reminiscence sessions. Caregivers also provided positive feedback and suggestions for improving the reminiscence interface by using a greater variety of and more personalized stimuli. These data provide preliminary support for the feasibility of computer-assisted reminiscence training for persons with dementia.

Gunther, Schafer, Holzner, and Kemmler (2003) reported the outcomes of a CACI for 19 participants (15 women, 4 men) aged 75 to 91 years, diagnosed with age-associated memory impairments (AAMI). Participants received a pretest consisting of the NAI and the California Verbal Learning Test, prior to once-a-week sessions of computer-assisted cognitive training for 14 weeks. Participants received two posttests: one at the end of 14 weeks and another 5 months after training had ceased. Results indicated significant improvements from pretest to both posttests in verbal and visual working memory, information-processing speed, learning, and reduced tendency for interference. Immediately after training, participants exhibited improved retention of visual information (pictures) and enhanced learning of word pairs and word lists. These improvements were maintained 5 months after training, indicating that the effects of training were relatively long lasting. No changes in self-reported mood or ability to carry out ADLs were reported as a result of the CACI implemented. Although this study was not conducted with persons with dementia, and therefore, would not meet the criteria for committee review, it is described here because these findings have implications for designing and implementing CACIs for dementia patients. There is substantial evidence in the literature that persons with AAMI show higher rates of conversion to dementia than older adults with no cognitive impairments.

The results of these recent studies, though preliminary, are encouraging and justify future research on the use of CACIs with dementia patients. Some important objectives of future research should be to:

- Investigate types of tasks that can be adequately trained using computer programs.
- Empirically validate the specific types of modifications that would facilitate the use of computers by individual with dementia (e.g., using a touch screen as opposed to a mouse, a larger monitor, voice-activated computers, a keyboard with fewer keys, etc.).
- Study the duration for which information learned by using CACIs can be retained by AD participants.
- Compare treatment outcomes in individuals who differ in age, gender, ethnicity, dementia severity, and type of dementia.
- Compare treatment outcomes in individuals who differ in prior level of exposure to computers.
- Compare effectiveness of teaching the same information to persons with dementia using computerized versus noncomputerized approaches.
- Compare different doses of intervention to determine their impact on treatment outcomes.
- Investigate the potential of caregivers being trained to administer cognitive interventions using a computer.

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