Assistance for Asperger Syndrome from Communications Technology Developed through an Integrated Projects Curriculum

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Abstract: Asperger Syndrome (AS), classified among neurodevelopmental disabilities better known as autism spectrum disorders, affects 1 in every 150 children in the United States[1]. Adults with AS experience impaired social interactions with tendency toward restricted and repetitive patterns of behavior, though gifted with average to above-average intellect. While neither specific cause (although genetics is suspected) nor cure is known for AS at this time, social coaching for the purpose of job training and successful independent living may be facilitated by wireless communications technology. A prototype for such an assistive technology, known as Wireless Enabled Remote Co-presence™ (WERC), has been developed by undergraduate students and faculty at the Messiah College Collaboratory, in partnership with The SymBionyx Foundation[2] (TSF), over the past year. WERC enables a coach to talk to a selected AS client, such as on a job site, and receive audio-visual feedback via a micro-camera device worn by the client. A pair of students under the supervision of faculty and TSF staff initially configured and tested WERCware with funding by a PA Keystone Innovation Zone Grant, during the summer of 2008. Further research and development has been conducted by two junior engineering students, through the Integrated Projects Curriculum (IPC) first implemented in spring 2007, by the Engineering Department at Messiah College. The IPC includes a four-semester Project sequence, providing students a more sustained experience than the traditional senior project course, and allowing vertical integration of incoming lower level students on project work. Assessed by portfolio, IPC helps students learn project management and leadership skills, while receiving the benefits of addressing a real-world engineering problem. This paper will describe how the IPC facilitates efforts of students in developing WERC, so as to ease the transition of people with AS into the mainstream of a suitable job and more independent living.

I. Introduction

Asperger Syndrome (AS), a form of high functioning autism, affects 1 in every 150 children in the United States[1]. While AS individuals may benefit from social services and special education provided during primary schooling, they often lack adequate assistance later in making the transition to an adequate job and more independent living. The SymBionyx Foundation (TSF) seeks to bridge this gap by providing social services such as job coaching together with assistive technology that connects the AS client with a social coach off-site[2]. To develop a prototype of the assistive technology known as Wireless Enabled Remote Co-presence (WERC), TSF has partnered with the Messiah College (MC) Collaboratory[3], since 2007. To initiate WERC prototype development, the author of this paper, faculty advisor of the Collaboratory Communication Group, secured a grant from the Keystone Innovation Zone of Pennsylvania to support research during

the summer of 2008, as conducted primarily by two MC undergraduate students. These students were supervised in part by the author, together with an interdisciplinary team consisting of TSF personnel, and Dr. Nancy J. Patrick, Coordinator of Special Education and Assistant Professor of Education at Messiah College. At the end of the summer research, students had drafted a job-coach training manual, assembled a proof-of-concept WERC prototype, and gathered preliminary testing results with WERC from trials by neurotypical volunteers acting as client, and faculty volunteers acting as coach.

Following up on the initial summer research, and its preliminary results, two engineering students have been exploring improvements to WERC, as the focus of their Project I-IV course sequence. This credited four-semester project course sequence, a key part of the Messiah College Engineering Department's Integrated Project Curriculum[4] (IPC) implemented Fall 2007, allows the WERC students to evaluate state-of-the-art developments such as in portable phone, camera, PDA, and blue-tooth technologies, to evaluate potential use for the WERC application, in light of cost-benefit, and feasibility issues. As juniors completing the Project II course this spring, these two students have another full school year remaining to devote to the project, providing more continuity than a traditional senior project, and during their senior year will pass on knowledge of the WERC project to upcoming students, to follow up on future work. Besides research and development on WERC, the two current engineering students have also assisted as equipment specialists and technical observers during a five-week qualitative study, designed to get more extensive test results with WERC from actual AS subjects.

A qualitative testing phase of WERC has been conducted in cooperation with the Capital Area Intermediate Unit (CAIU #15) of Pennsylvania, at its new Hill Top Academy. This testing has involved five AS high school student volunteers participating in the role of the client and five corresponding CAIU educational consultants participating in the role of the coach. The trials for each client and coach were conducted once a week, over a five week period during March 2009, supported by a grant from the Pennsylvania Department of Education secured by TSF through CAIU.

Section II of this paper identifies methods: A) used by the IPC in conjunction with the Messiah College Collaboratory that facilitate student learning while making progress on the WERC project (and others like it), and B) employed in qualitative testing of WERC. Section III summarizes results of WERC testing obtained. Section IV draws conclusions about these results and experience with IPC for future work and broader application.

II.A. Methods: Messiah College Collaboratory and Integrated Projects Curriculum

The Messiah College Collaboratory for Strategic Partnerships and Applied Research, a center in the School of Mathematics, Engineering and Business (MEB) since 2000,

maintains a vision of "increasing hope and transforming lives through education, collaboration, innovation and service."[3] This vision fits well with TSF's goal of helping AS clients achieve more independent living, via assistive technology, since TSF desires to develop WERC by means of students and faculty who collaborate, as they share specialized interdisciplinary expertise. Thus, the Collaboratory Communications Group, focused on wired and wireless communication technology for service applications, has enjoyed a productive partnership with TSF over the past two years, not only due to matching vision, but also due to a working relationship with TSF that satisfies the broader Collaboratory mission "to partner with organizations, businesses and communities in our region and […] for projects in […] information sciences, engineering, and business that serve disadvantaged people…"[3] The Collaboratory provides a weekly formal opportunity for students and faculty from across campus to meet, in an interdisciplinary setting, during a larger gathering of all Collaboratory groups on Monday nights, and an informal opportunity for smaller project groups to meet afterwards. Beyond the weekly meeting of its members, the Collaboratory has its own administrative structure that sets and enforces policy, oversees the financial accounting of group and project budgets, provides for communication through a wiki, and processes decisions as needed. While this support proves beneficial for Collaboratory members across various disciplines, the Engineering Department has also developed a curriculum innovation that capitalizes on Collaboratory support for engineering student projects.

The Messiah College Engineering Department first implemented its Integrated Projects Curriculum[4] (IPC) in Fall 2007, so as to improve upon and phase out the traditional two-semester senior project. By means of a four-semester project sequence, preceded by a one-semester group orientation typically in the second semester sophomore year, the IPC increases project continuity and longevity, while providing engineering students with more credited opportunities to practice leadership and project management skills, as they advance to senior level and pass on project specific knowledge to lower class students.

The IPC synthesizes "cognitive, affective, and behavioral education through a seminar series and project courses. It embeds the organizational structure, educational vision, and program strategies of the Collaboratory into a series of courses that both draw from and serve the rest of the curriculum. Traditional course work continues as the essential backbone of the curriculum, providing specialization that narrows students' attention to foster depth of inquiry, and focuses their time and work to develop professional competencies. The IPC helps students learn how to use special knowledge to tackle real problems. Seminar discussions run parallel to project engagement, both informing the work of project teams and drawing on them for reflection. This curriculum builds on service-learning pedagogy, and it embodies the three modes of learning required for service-learning: content, engagement, and reflection."[4] All IPC project courses meet once a week for a three hour time period, like a traditional lab. Project I and II periods coincide with Project III and IV periods, during the fall and spring semesters respectively, to facilitate teamwork between junior and senior students.

To evaluate student work throughout the Project I-IV sequence, a portfolio method has been selected as the main assessment tool, supplemented by periodic logbook checks, and

various other assignments specific to a particular group. The portfolio enables students to document examples of how project work has best illustrated various attributes embodied in IPC objectives, including teamwork, project management, client interface, research, analysis/testing, design, economic analysis, prototype implementation, documentation, and dissemination. A complete description of these attributes, with instructions for assembling the working and show-case portfolios, is linked to the IPC wiki page.[4] As the Project I-IV sequence progresses, students consult with a faculty advisor of their group to identify the subset of course objectives addressed during the current phase of the project, as a focus for progress on their portfolio during that semester. By the end of Project IV, students are expected to have addressed all course objectives, as illustrated by best practices in their showcase portfolio.

II.B. Methods: Qualitative Testing of Wireless Enabled Remote Co-presence (WERC)

The purpose of the qualitative testing study was to determine if usage of the prototype WERCware device and supporting systems (remote coaching and scripts for tasks completion) in a controlled environment for simulated work experiences provided positive support. Of the questions (hypotheses) that guided the study, the ones most relevant to engineering aspects were: Is the WERCware device physically comfortable and unobtrusive enough that the wearing of the device does not detract unduly from the completion of 1) a simple task and 2) a complex task in a simulated job coaching application? Are the scripted verbal directions transmitted by remote coaches through WERCware viewed as positive by the job coach and participant in communicating critical information for successful completion of 1) a simple assembly type task and 2) a complex sort and categorizing task? After each participant separately completed the simple and complex tasks according to a set procedure, they answered a questionnaire. For each trial, the AS participant sat at a table in an empty classroom, and communicated with a coach participant in a separate room via WERCware. For the simple assembly task, the table was prepared with several assorted office items, including paper clips, zip lock bags, pens, highlighters, file folders, pads of paper, sticky notes, and colored paper to be placed in a cardboard box. Once the items were properly assembled, and the first box was filled according to the scripted procedure dictated by the coach, the whole procedure was repeated again two more times. The simple assembly task took around 15-20 minutes, after which both the AS and coach participants completed a questionnaire.

Following the simple assembly task, and a short break, the AS and coach participants returned to their stations to complete a more complex sorting and categorizing task. The scripted procedure involved filing paper materials by color and shape, by opening and emptying the contents of an envelope into a wire basket, filing the envelope, locating the sticker on a piece of paper, matching the sticker on the paper to a corresponding one on the file folder, filing the paper in the matching file folder, and repeating the process for other items in four other envelopes. This task activity also took a total of about 15-20 minutes, after which both the AS and coach participants completed another questionnaire.

The WERC prototype consists of a micro-camera and wireless transmitter carried by the client, sending audio and video to the coach via an internet-connected base. The remote

coach wears a headset, monitors images of the client on a local PC, and completes a return audio link via internet, heard by the client on a pair of wireless earphones.

While observing the coach during the study, the WERC team evaluated quality of the video image at the coach end, as compared to the video image produced by a standard security camera system. The security system included camera lenses mounted in the ceiling of the classroom where the AS participant completed tasks.

III. Results: Qualitative Testing of WERC

The questionnaire completed by each AS participant, after finishing the simple assembly and more complex filing tasks, surveyed their satisfaction with WERCware, as related to the hypotheses identified in section II. B. The responses of the five AS participants to the items most related to engineering aspects have been summarized in Table 1 below.

Item description	After simple task	After complex task
1. The ear phone was physically comfortable to wear.	2 strongly agree (SA); 3 agree (A)	3 strongly agree (SA); 2 agree (A)
2. The camera device was physically comfortable to wear.	3 SA; 2 A	3 SA; 2 A
3. The WERCware got in the way when I was completing a task.	1 SA; 1 A; 1 disagree (D); 2 strongly disagree (SD)	2 strongly disagree (SD); 3 disagree (D)
4. I felt embarrassed when I wore the WERCware in front of other people.	4 SD; 1 D	3 SD; 2 D
5. I felt completely comfortable while wearing the WERCware knowing that I was being observed.	2 SA; 3 A	2 SA; 2 A; 1 SD
6. The WERCware was easy to use.	4 SA; 1 A	3 SA; 2 A
7. Directions from the remote coach through the earphone were easy to hear.	2 SA; 2 A; 1 D	2 SA; 3 A
8. Directions from the remote coach through the earphone hurt my ears.	4 SD; 1 D	4 SD; 1 D
9. Directions from the remote coach were easy to understand.	1 SA; 3 A; 1 Uncertain (U)	2 SA; 2 A; 1 Uncertain (U)
15. Overall, I liked wearing the WERCware technology for this task.	3 SA; 2 A	2 SA; 2 A; 1 U
16. Overall, I liked the experience of completing the	3 SA; 2 A	2 SA; 3 A

assembly/filing task when given directions from a remote coach using WERCware technology.		

Table 1. Responses by five AS participants to questionnaire items after completing simple and complex tasks

Each remote coach participant, representing CAIU educational consultants, responded to a different questionnaire. Responses of the five remote coaches to the items most related to engineering aspects have been summarized in Table 2 below.

Item description	After simple task	After complex task
1. The WERCware technology was easy to turn on and off.	3 Strongly Agree (SA); 1 Uncertain (U); 1 No basis for opinion	3 Strongly Agree (SA) 1 Agree (A) 1 No basis for opinion
2. The head set was comfortable.	4 SA; 1 A	4 SA; 1 A
3. The microphone was easy to use.	5 SA	3 SA; 2 A
4. I was able to see all of the work station throughout the entire assembly/filing task.	2 A; 1 U; 1 disagree (D); 1 strongly disagree (SD)	1 SA; 1 A; 1 U; 2 D
16/17. Overall, the WERCware was physically comfortable.	2 SA; 3 A	3 SA; 2 A
18/19. Overall, I like the experience of coaching a student participant through an assembly/filing task using WERCware.	4 SA; 1 A	4 SA; 1 A

Table 2. Responses by five coach participants to questionnaire items after directing simple and complex tasks

Technical observers noted early in the study that the video image from the security camera was vastly superior to the image provided by the portable camera worn by the client, in terms of clarity, scope and independence of movement. Thus, the security camera image was added to the remote coach's monitor, for the duration of the study, to supplement the image received by the wireless camera. Although this observation came as a result of conducting the study, and modified the methods used in the procedure, it also may suggest an enhanced version of how WERCware will be employed in the future.

IV. Conclusions and Future Work

As an assistive technology for Asperger Syndrome (AS), a WERCware prototype has been recently developed and tested by a team of Messiah College students and faculty, in partnership with The SymBionyx Foundation. Progress on the WERC project has been hosted by the Communications Group of the Messiah College Collaboratory, and facilitated by the Integrated Projects Curriculum (IPC), an innovation of the Engineering Department that capitalizes on Collaboratory resources. The results of a qualitative

study recently conducted with the participation of AS high school students and educational consultants at the CAIU's Hill Top Academy seem to show that a broader, more extensive study may be worthwhile.

Responses of the five AS participants and remote coaches seemed very positive, overall. The AS participants unanimously agreed, that the earphone and camera devices were physically comfortable to wear. In the setting of this study, they unanimously disagreed that WERCware made them feel embarrassed to wear in front of other people. Rather, most of them indicated they felt completely comfortable with WERCware, knowing they were being observed. They unanimously agreed that WERCware was easy to use, and mostly agreed that directions from the remote coach were easy to hear through the earphone, without hurting their ears. Most of them found directions from the remote coach easy to understand. Although responses seemed to be mixed as to whether WERCware got in the way after completing the simple assembly task, all the participants disagreed that it interfered with the filing task. It may be inferred that WERCware needs an improved, less obstructive method of attachment to the client's clothing, or perhaps that the client learns how to keep it from interfering after sufficient experience. Overall, with the exception of one response after the filing task, all AS participants said they liked wearing WERCware, and the experience of completing tasks from a remote coach with it.

A majority of the remote coach participants agreed that WERCware was easy to turn on and off from their end. However, they unanimously agreed that the headset was comfortable, and the microphone easy to use. Ability to see the whole workstation during the assembly and filing tasks proved to be a problem for some, due to limitations of the portable camera. This has been partially resolved by adding the security camera view to the coach's monitor, but it also suggests that a better, more wide-angle, camera lens for the portable wireless camera of WERC may improve it. Overall, the remote coach participants unanimously agreed that WERCware was not only physically comfortable, but that they liked coaching student participants through the tasks with it.

These results have encouraged the WERC project team to continue its study, on a broader scale. While the Messiah College Collaboratory facilitates the interdisciplinary cooperation and corporate partnership aspects of the project, the IPC provides a credited way for engineering students to devote a longer term effort than the traditional two-semester senior project would. In the current semester, due to the phase of the project, WERC students have plenty of portfolio material to illustrate the testing objective. Through working on such a real world problem, these junior students have not only laid a more solid foundation for future design work during their senior year, they have also gained valuable experience preparing for occupation after graduation. Further progress with WERCware should help ease the transition of people with AS into the mainstream of a suitable job and more independent living, as well.

Bibliography

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