Creating an Idioculture to Promote the Development of Children Who Have Suffered Cerebral Palsy or Traumatic Brain Injury

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There is a major problem in the broad range of efforts to design interventions for promoting cognitive and social development in children with various kinds of disabilities such as mild mental retardation to ADHD, cerebral, and traumatic brain injury. The predicament is that intervention procedures specifically targeted at the presumed deficits, while producing changes in the target behavior, fail to generalize beyond the specific conditions of training (Brown, Campione, & Murphy 1977; Tharp & Gallimore, 1985; Ylvisaker, Turkstra, & Coehlo, 2005).

These results are complimented by a long tradition of research on transfer between problem isomorphs among normal adults. Studies have shown extraordinarily limited transfer unless appropriate generalizations among problem types are built into the training regimes themselves (Gick and Holyoak, 1983).

These sorts of findings have led to the conclusion, in the words of Tharp and Gallimore, that in order for remedial training procedures to be useful, “tasks must be learned in the contexts of eventual application.”(p. 455). Or, as Ylvisaker (2006) phrases the issue, one should engage in context-sensitive rehabilitation or remedial instruction based upon forms of activity that are of particular interest and concern to the affected individuals.

An important implication of this line of research and theory is that remedial, rehabilitation training that appears to be appropriate to the specific form of disability under investigation and is targeted at a relevant, real world form of activity, will be primarily, or only, effective within the context of that particular activity or setting. Such an approach, although clearly preferable to training on isolated or decontextualized tasks that will serve no useful purpose, requires that the investigator identify a very large set of important real world activities and provide highly specific, labor-intensive training regimes for each one! Consequently, it would be highly desirable, on both practical and theoretical grounds, if it were possible to design remedial/rehabilitative activities which are relatively bounded but which could induce more general change in the affected populations.

The aim of this paper is to report on one promising approach to designing rehabilitation activities that can be engaged in simultaneously by several people, and which produce cognitive and social effects that generalize beyond any specific tasks that constitute elements of the activity setting. Briefly stated, our strategy is to create a socially organized idioculture saturated with a wide variety of cognitive tasks in which the norms of social interaction serve as media for the generalization of the information and modes of behavior

appropriate to the constituent tasks. The specific, component, tasks in this specially organized system of activities are often in the form of games, where undergraduate students with little or no specific training in remedial/rehabilitative techniques engage with children in a complex playworld. This playworld simulates, in many respects, a microculture with rules, obligations, divisions of labor, tool use, friendship formation, and multiple forms of communication among all variety of participants—the children, undergraduate students, and staff. Participation in such a playworld, our evidence indicates, produces cognitive and social changes that generalize broadly to cognitive tasks and social behaviors that are not an explicit part of the playworld within which they are encountered. That is, the playworld serves as a medium for the generalization to a large ensemble of cognitive tasks and social behaviors that are not explicitly the object of training.

A Description of the Original Playworld:

The model for the playworld that we have adapted for use with children in this research is called The Fifth Dimension. The Fifth Dimension was originally designed as an activity system for children from marginalized social groups in the United States who were performing poorly in school. Its goal was to serve both as a medium for diagnosing specific learning deficits that individual children might display and as an environment rich in opportunities for cognitive and social re-mediational potential (Cole & the Distributed Literacy Consortium, 2006).

An essential feature of The Fifth Dimension is its adaptability to specific local conditions. Nonetheless, there are similarities across implementations which make it useful to provide a provisional description for purposes of understanding how and why the specific adaptations described in the current research came about.

The following is a normative description based upon several years of research in the United States in a variety of socio-ecological circumstances:

The is an educational activity system that offers school-aged children a specially designed environment in which to explore a variety of off-the-shelf computer games and game-like educational activities during the after school hours. The computer games are a part of a make-believe play world that includes non-computer games like origami, chess and boggle and various other artifacts. "Task cards" or "adventure guides" written by project staff members for each game are designed to help participants (both children and undergraduate students) orient to the game, to form goals, and to chart progress toward becoming an expert. The task cards provide a variety of requirements to externalize, reflect upon and criticize information; to write to someone; to look up information in an encyclopedia; and to teach someone else what one has learned, in addition to the intellectual tasks written into the software or game activity itself.

As a means of distributing the children's and undergraduates' use of the various games, the Fifth Dimension contains a maze consisting of some 20 rooms, ordinarily in the form of a wooden or cardboard box placed on a table top or pictured on a wall chart. Each room provides access to two or more games, and the children may choose which games to play as they enter each room, depending upon what games they have played before and what is available at the moment.

There is an electronic entity (a wizard/wizardess) who is said to live in the Internet. The entity writes to (and sometimes chats with) the children and undergraduates via the Internet. The children and undergraduates often write back. In the mythology of the wizard/ess, he/she acts as the participants' patron, provider of games, mediator of disputes, and the source of computer glitches and other misfortunes.

Because it is located in a community institution, the activities require the presence of a local "site coordinator" who greets the participants as they arrive and supervises the flow of activity in the room. The site coordinator is trained to recognize and support the pedagogical ideals and curricular practices that mark as "different"-- a different way for kids to use computers, a different way of playing with other children, and a different way for adults to interact with children.

The presence of university and college students is a major draw for the children. The participating college students are enrolled in a course focused on fieldwork in a community setting. At UC San Diego, an institution that emphasizes research, the university course associated with student participation is an intensive, six unit class that stress deep understanding of basic developmental principles, the use of new information technologies for organizing learning, and writing field notes and research papers. The undergraduates write papers about the development of individual children, the educative value of different games, differences in the ways that boys and girls participate in the play world, variations in language use and site culture, and other topics that bring regular course work and field observations together.

In short, considered in its community context, The Fifth Dimension is organized to create an institutionalized version of the form of interaction that Vygotsky (1978) referred to as a zone of proximal development. From time to time there is creative confusion about who the more capable peers might be (for example, when novice undergraduates encounter children highly skilled in playing educational computer games about which they know nothing). But the general cultural of collaborative learning that is created serves the development of all.

Summary Results of the Fifth Dimension Implementations

Because the foundation money that supported early Fifth Dimension research was focused on academic achievement and the potential supporting role of computer technologies, most of the quantitative results indicating its effects involve measures of changes in reading, writing, arithmetic, the ability to follow written instructions, and computer literacy. A summary of major results from a variety of Fifth Dimension evaluation studies based on experimental or quasi-experimental studies carried out in a variety of sites around the United States are seen in Table 1.

INSERT TABLE 1 HERE (M. Cole)

One of the remarkable feature of the results shown in Table 1, in addition to the variety of cognitive skills providing evidence that children's academic/cognitive achievement is enhanced by participation is that the number of sessions required to produce such results was relatively small, sometimes as few as 15-20 1 ½- 2 hour sessions of participation spread over many weeks.

From qualitative analysis based upon video-taped interactions among participants during Fifth Dimension sessions and detailed clinical fieldnote records provided by undergraduate participants, it appears that the social interactions among the children and the undergraduates and the children, as well as the among the children themselves, play a central role in amplifying the cognitive/academic impact of participation. Lively chatter and cross-talk, sharing of expertise, intense engagement in dyads and triads, are ubiquitous features of Fifth Dimension settings wherever they are encountered, appear to be the process characteristics of activities that induce the cognitive/affective results in a relatively short period of time.

Less well documented, but widely reported by implementers of Fifth Dimensions is that the forms of agentive engagement that prevail there have a socially mediated influence that goes beyond participation at the sites themselves. For example, Kris Guttierez (Ref), who has long guided a Fifth Dimension activity system in a Los Angeles school populated primarily by recently arrived migrant Latino (largely Mexicano) children, reports that teachers note marked changes in classroom behaviors, part of them associated with easy expertise in the use of computers, part of it associated with spontaneous helping behaviors in the classroom, behaviors that were approved of but never taught or introduced as a classroom practice.

Adapting the Fifth Dimension Model to Children with Special Needs:
As noted above, by and large the Fifth Dimension was designed as an after school program for children from marginalized groups, often from relatively poor families of Latino and African American origin in the United States, who are under-represented in higher education, as a means of providing them educational enrichment that could enhance their prospects of moving on to higher education.

However, because Fifth Dimensions are generally located in community institutions that are by their nature inclusionary, it was common to have special needs children participating along with other children. The nature of these special needs varied widely: some children were on medication designed to ameliorate symptoms of hyperactivity or ADHD. Some children were mentally retarded. At least one child suffered severe Asperger's syndrome. Over many such cases, spread over several years and numerous instantiations of the Fifth Dimension, informal evidence accrued that such children benefited from Fifth Dimension participation no less than their peers who were not identified as having special needs beyond the needs for academic enrichment.

In 2002, the current authors met and became acquainted with each other's work at a memorial conference for Alexander Luria and his work on rehabilitation of people who had suffered some form of traumatic brain injury. Lucia Willadino Braga, a Brazilian neuroscientist whose clinical and research focuses are on the rehabilitation of children with cerebral palsy and traumatic brain injury, became interested in the way Michael Cole was using ideas inspired by Luria (1973) and Vygotsky (1978) to organize educational enrichment for children. Cole, who had been a post-doctoral student of Luria's, began to think about the potential of using the Fifth Dimension as a medium for rehabilitation of special needs children, based upon the fragmentary evidence of such efficacy from the prior experience that he and his colleagues had using the program with a variety of children. From this mutual interest, the current project was born. The central question we sought to address was whether the basic Fifth Dimension model could be adapted for use

in a rehabilitation hospital where, heretofore, remediation was carried out only by trained professionals and where the idea of creating an entire rehabilitation regime on a large group basis using principles of cultural-historical psychology had not been attempted.

We entered the project fully aware that even for the populations for which it had been designed, the Fifth Dimension varied widely in the details of its idiocultural implementations, so that we would, in effect, be creating a really new idioculture under unprecedented conditions. It had long been demonstrated that the model could be used effectively in a wide variety of cultural milieus outside of the United States, having been adopted successfully in Russia, Finland, Mexico, and Brazil on prior occasions. (See www.uclinks.org for further information of such generalizations of the activity system across national cultural boundary lines).

The Fifth Dimension at the SARAH Network of Neurorehabilitation Hospitals in Brasilia, Brazil

The SARAH Network of Neurorehabilitation Hospitals consists of nine fully operational hospital facilities dedicated primarily to the treatment of neurological problems in children and adults. The Network also includes two International Center for Neurosciences and Neurehabilitation and the SARAH University for Rehabilitation Sciences. Last year alone, the SARAH Network saw over two million patients and rendered close to 19 million medical and paramedical procedures. SARAH patients come from the four corners of Brazil, with widely varying socio-economic and educational backgrounds. In addition to neurological disorders, the Network also treats numerous other pathologies in children, such as pre- and perinatal stroke, schizencephaly, encephalomalacia, low birth weight, cerebral palsy (athetoid, spastic and ataxia), hydrocephaly, traumatic brain injury (TBI), tumors, epilepsy and spina bifida. Because of the large pediatric patient population with cerebral palsy and traumatic brain injury, who come for consultations and stay for ongoing therapy in the various subspecialties dedicated to childhood brain injury and its attendant manifestations, the physical facilities at SARAH have been designed with this patient population in mind, with open child-friendly gymnasiums, playrooms, pools and rehabilitation halls. The Network also counts on an extensive infrastructure for surgical, rehabilitation, imaging, and research activities, such as fMRI scanners and movement laboratories. (For further information see www.sarah.br).

The Fifth Dimension project at SARAH takes place at the International Center for Neurosciences in Brasilia, located several miles from the large SARAH hospital. The Center concentrates on strategies for long-term rehabilitation. The Fifth Dimension project began in March 2006 with 11 children with cerebral palsy (CP), most with a diagnosis of spastic diplegia. Strategically, the neuropsychological disorders in this group of children were very heterogeneous. This was due in part to one of the project's main objective of fostering different levels of cooperation among the children and providing opportunities for experience-sharing and support among the families; and also, because of the difficulties of obtaining a homogenous sample of brain injured children, given that clinical etiological criteria are commonly applied, despite recovery being an individual process that depends on social, familial and educational factors. These goals reflect the basic theoretical principles of the SARAH Rehabilitation Method (Braga & Campos da Paz, 2008; Braga, Campos da Paz & Ylvisaker, 2005).

The college undergraduates for the Fifth Dimension at the SARAH Network are selected from various universities in Brasília. Students apply and are selected based on their knowledge of child development, education and learning, as well as their own personal experiences and formal education. The students receive no academic credit from their universities for their participation in the program, which lasts six months; however, they receive a certificate for having completed the course. Elements of the Fifth Dimension at SARAH mirror the Network's multidisciplinary team approach to rehabilitation, in which professionals from different areas participate in the rehabilitation of each patient. Because in cerebral palsy many developmental areas may be affected, such as motor function, cognition, and language, better outcomes are obtained from having integrated teams comprised of professionals from different specialties. Thus, over time, students from various majors have been accepted into the program, such as speech therapy and education, in addition to those studying psychology. This plurality permits enriched understanding of the social interactions of brain injured children and helps integrate knowledge from various fields at an early stage of the students' academic careers. To date, 88 students have participated in the 5D at SARAH. They are, on average, 20 years old, and in their freshman or sophomore years of college.

Given the original goals and structure of the Fifth Dimension model, the program needed to undergo some adjustments, not only because of the special nature of the subject population (children with brain injury) but also due to the program's location in a rehabilitation hospital rather than at a community-based after school program (although the program is run after school). The first adjustments made for children with cerebral palsy included:

1. **Computers**: New software, with a special voice mail feature, was developed. Geared towards children with motor or cognitive writing deficits, these changes facilitate their communication with the Wizard, which can be written and sent by e-mail or voice mail. The font size was made larger to accommodate possible vision problems, and new interfaces were created to help those with difficulties using traditional keyboards due to motor disorders.

2. **Individual projects:** The performance level, limits and potential of children with brain injury vary widely, and are associated with biological, cultural and epistemic factors. Some children with brain injury are unable to attain particular levels of performance in a given task, e.g., a child with cognitive dysfunction may not be able to progress to the advanced phases of a video game. In this sense, adjustments needed to be made and strategies reworked, such as the degree of difficulty in the labyrinth, the nature of the children's participation in the program, and the roles that each took on within the microculture of the project.

3. **Family participation**: Since the SARAH Network's entire pediatric rehabilitation process is founded on a context-sensitive, family-based approach, the family's role in this playworld model had to be taken into account. Unlike prior Fifth Dimension projects, the children treated at SARAH do not live nearby, have problems getting around, and depend on their families to bring them to the rehabilitation center. So

children always come in the company of their parents. This initially raised the question of what role the parents should play during Fifth Dimension time.[1]

At the beginning, the parents would arrive at the Fifth Dimension room, located in a specially designed rehabilitation area, eager to participate in the child's activities with the undergraduates. This parental reaction is perfectly normal because they had grown accustomed to the difficulties that their child had interacting with strangers; the parents wished simply to help their son or daughter make the most of the experience. Interestingly, they soon noticed that the children were quickly developing relationships with the undergraduate students, and saw that they were capable of participating without their help. Some of the children even began asking their parents to wait outside.

To accommodate this new situation, the research team created a specially designed set of routines. When the parents and children arrive at the Fifth Dimension site at SARAH, they are greeted by some of the project staff. The children then go off with the researchers and undergraduates while the parents gather in another room, where they can read, chat, or watch television while their child goes about their Fifth Dimension activities. At the end of each session the children and undergraduates meet the parents and SARAH staff in a hall where snacks are provided and where the program participants can chat informally about what the children have been up to, both inside and outside of the Fifth Dimension context.

At the start of the program, a special parent discussion session was held every other week. During these sessions, led by staff psychologists who also participated in the Fifth Dimension, the families talked about their lives at home, their feelings and ideas about the project, changes they are noticing in their children, suggestions they have for the program. Other issues are also addressed in the group, such as development, rehabilitation, learning, and ways of coping.

Over time, these adjustments have resulted in a schedule of two weekly sessions for the children and one monthly meeting for the parents.

4. **The course for undergraduates:** The course is organized into three modules each semester. The group is heterogeneous in its level of experience and participation in the Fifth Dimension. The new students (Module I) are given basic responsibilities, such as activities with the children, field notes, debates, discussions, system changes, and so forth. The responsibilities of the more experienced students are expanded (Modules II and III) to include tasks such as writing the Wizard's replies to the children's e-mails, coordinating discussions, and overseeing plans. Every semester, each group has an average of 11 to 16 students.

[1]It also raised issues of transportation. Many of these parents do not drive or own cars. A special bus service was organized so that parents could bring their children to the SARAH hospital in downtown Brasilia, from which they are bussed to the rehabilitation center on the lake, several miles away. Consequently, children and their parents often travel as much as two hours each way to get to the Fifth Dimension. We are studying the possibility of organizing this transportation without the presence of the parents. An aim, then, is to expand the interactions that children have with each other and with the program professionals. This would facilitate the natural exploration that children engage in during later childhood.

All of the students note down the day's activities in a structured report (Field Journal). Initially, the report was done on the same day, right after the children left. A website created specifically for this purpose (http://www.sarah.br/projeto5d) permitted individualized reports. Each field journal is read and commented on by the whole team, fostering a direct pathway to guiding each student's learning process. The students currently have the chance to comment on their peers' field notes, and answer comments online. The site also helps organize the bibliography and relevant links, as well as the debates, discussions, reports about what the children are doing, and an e-mail for internal communication.

Each time a new Fifth Dimension session begins, the SARAH research team and the undergraduates meet beforehand to discuss various theoretical and practical issues, and then again, afterwards, to discuss problems and plan modifications. There is no pre-established reading list. Instead, reading topics are selected for further study as the need arises, based on the students' increasingly complex interactions with the children.

One of the central questions that we sought to address pertains to the information given to the undergraduates. Information about each child's individual problems, specific neurological exam data, diagnostic imaging results and development are not addressed directly; the undergraduates use principles of cultural-historical psychology to interact with the children with TBI but are not given specific prior information. First, each undergraduate converses with the child and tries to understand his/her motivations; then, based on this information, proposes different activities related to the child's interests, and tasks likely to occasion meaningful challenges. As the undergraduates share the child's specific developmental processes within a system of close interaction, they register their impressions and thoughts in the field journal. They also discuss and share theoretical-practical information with the rehabilitation team and with their peers about the child's cognitive, behavioral or etiological development.

As can be seen even from this cursory account of modifications, both the technical and social infrastructures of the SARAH Fifth Dimension were in several respects unique at SARAH , quite apart from the particular characteristics of the children. Most important, in our view, is not only the fact that the children interacted with the undergraduates and staff, but that the undergraduates and the staff, in an informal manner, interacted with the parents in the presence of the children and in the general context of the Fifth Dimension.

The children's program of activities run parallel to the Brazilian school calendar, with sessions from March through June, a break during July (winter vacation in Brazil); sessions start again in August and end in early December. Children have three months' vacation per year – both in school and in the program. On average, each child participates in 57 hours of activity per semester, spread over two afternoon periods per week.

The group of 11 children with cerebral palsy that launched the first Fifth Dimension project at SARAH in May 2006, were between the ages of 8 and 12 years (52% of the children were between 8 and 10 years old, and 48% between 11 and 12 years old). Most of them had little access to video or computer games, and limited knowledge of email, web search engines and text editing. Several had contact with some of these tools in school, and five children had computers at home but rarely used them. Of all the tools, this group had had the most access to video games, but even then, only on occasion, such as when visiting

relatives or a neighbor's house. Only two children from this group had a videogame at home.

As far as neurodevelopment is concerned, all of these children had varying muscle tonus and motor disorders (mixed tetraplegia, spastic triplegia, spastic diplegia and spastic hemiplegia). Levels of motor independence ranged from unassisted gait to assisted wheelchair use and from relatively normal upper body and fine motor control of the hands and fingers to more or less severe difficulties with these functions. From a cognitive point of view, formal WISC tests showed IQ scores between 61 and 120 (8% high average; 50% average; 31% low average and 12% borderline) but these averages mask the fact that for every child in the group, verbal scores were higher than performance scores (68% of the children have, on average, a 29-point performance difference between the verbal and the executive). In general, the group's linguistic abilities, lexical knowledge and facility for elaborating speech were above the expected average for their age bracket. The same is true for their ability to establish logical relationships, and forge verbal concepts or categories. On the other hand, in the performance scales, the group demonstrated significant difficulties with skills related to perceptive discrimination, anticipating and planning a given activity, and organizing a whole from disparate parts. These performance difficulties were not directly related to movement disorders. In addition to these challenges, some children had attention deficits and visual impairment, i.e., strabismus, problems with acuity and hemianopsia. The families' socio-economic levels varied greatly. Also, while some of the parents had high school diplomas, college degrees or Doctorates, others had not finished grade school.

Procedure

The 11 children with CP were assessed before starting the Fifth Dimension, and, depending on how long they remained in the program, re-evaluated after six, 12 and/or 18 months. Some who entered the program when it was initially implemented at SARAH continued on, while others were unable to remain for various reasons, e.g., the family's inability to bring them to the center twice a week, the family's relocation to another city, or, because of changes in school schedules. Parents whose children were in the program for at least six months, were interviewed 24 months after the start of the Fifth Dimension.

During the project's first stage at SARAH, we chose to work with different types of analyses, which we believe are relevant to the rehabilitation of a child with cerebral palsy, and which could provide information – or hypotheses – about the transference of the newly acquired skills to different settings and activities. The following were analyzed in CP children: self-concept; the project's effects on the child's social interactions at home and in school, and how they felt about it; development of academic skills; parents' accounts of changes in behavior; and the impact of the undergraduates' participation.

Means of assessment

Quantitative data:

Self-image: We evaluated the children's self-image using the 4 domains (self-concept, familial, social and scholastic) of the *The Self-Image Scale for Children and Adolescent*] previously standardized on and recreated for the Brazilian population (Sisto, and Martinelli,

2004). Children were administered the *EAC-IJ* scale at the start of the program and after six, 12 and/or 18 months in the program.

Interaction/independence: The children, parents and teachers each answered the same questionnaire with 26 items about child's interaction with the family, at school, and in the Fifth Dimension program. They were all instructed to base their answers on how often they felt a given situation occurred in their daily interactions with the child, during the semester's activities, as compared to the period before the child started the program. The aim was to gauge the impact that the child's experiences in the Fifth Dimension environment had on their interactions in different settings. This information was complemented by some of the undergraduates' observations, made during discussions at the end of the day's activities.

Qualitative Data:

Academic skills: We conducted a qualitative analysis of each CP child's reading and writing skills, prior to the start of the Fifth Dimension activities, and again 12 months after beginning the program. The first evaluation took place during the individual clinical check-up that each child underwent before the program. Two educational domains guided the analysis of academic skills: reading fluency and writing system, with the *Avaliação Diagnóstica da Alfabetização* [Diagnostic Evaluation of Reading and Writing] test (BATISTA, et al) as a reference. This tool qualitatively assesses the skills that the child acquired during the first three grades of elementary school. We also conducted qualitative evaluations of the child's proficiency in computer commands, knowledge of technical jargon, use of web search engines, and ability to manage email. After 12 months, we ran the same tests, and used the undergraduates' field note reports for analysis of the child's progress in computer literacy. Accounts from parents and teachers complemented the analysis.

Discussions with parents: At the end of 24 months of the activities with the parents, (based upon discussion groups, sharing of experiences, conversations with the undergraduates, and observation of the child in the program), the team, consultants and family met to openly discuss the parents' opinions and feelings about the project. These sessions were filmed and transcribed. The transcribed data were read by four Psychology undergrads and grouped into three different domains: 1) Changes in the children's development; 2) the importance of the undergraduates; and 3) parent group.

Undergraduate Questionnaire: Each undergraduate answered an open-ended questionnaire about their participation in the project, at six and 12 months after starting the course. The objective was to analyze how interacting with the children impacted the undergraduate's development.

Results:

- Self-Image: In the group of 11 children with cerebral palsy who participated in the first stage of the program, we did not find any significant deficits in self-concept before starting the project. Similar findings were reported in a comparative analysis of estimated performance in children, adolescents and adults with CP (Souza, 2002). However, a comparative analysis of pre- and post-test quartiles revealed a tendency

towards improvement in overall self-image and in the social domain, especially in children whose pre-test scores had been in the first or second quartile.

- Interaction/independence: The results showed that, with time, there was substantial improvement in the children's independence levels both within the 5D and in their interaction with others in different settings. The questionnaires answered by the children, parents and teachers, showed that the adults observed significant improvement in the child's independence and interactions. Nonetheless, the scores that the children obtained were different and higher than the ones ascribed by the adults who evaluated them. The children felt more self-confident, took more initiative, believed more in themselves, and, note, they are the ones who are perceiving this – more than any adult. Table X presents improvements in the child's social skills after starting the 5D program (Tab X. Fifth Dimension Studies on the Development of Social Skills in Children with Cerebral Palsy).

  School teachers also provided very interesting accounts. For example, one teacher told a SARAH staff member who was conducting a routine visit to the child's school: "Keila was a very quiet, introverted girl. I called her Lika, her classmates did too, and she never corrected us. When I got the official student roster I saw that there was in fact no one named Lika there was, rather, an "Keila". But she'd never said anything ..."

  "...Keila started the 5th Dimension program and, after about two weeks, she started to speak up, started showing us the problems she was having, the things that she was interested in, started interacting more with her classmates, became empowered in her learning. Now she asks questions, is more responsible with her work and her growth has been excellent…"
  "...Keila stopped being a spectator and became a participant, began socializing. All this started happening rather quickly…" *Statements by Keila's teacher (3rd grade, 10 years old)*

TAB. X. Fifth Dimension Studies on the Development of Social Skills in Children with Cerebral Palsy

Category	Categories and topics addressed	Advantage from fifth Dimension?
Shared learning	Reciprocity Shares interests Trades information Solves problems together with other children	Yes
Social interaction	Communication and expression Takes initiative in the interaction with intergenerational peers Engages in cooperative group activities Develops models of interpersonal relationships: assistance, attention and trust Expanded communication with family members	Yes

- Academic skills: It is well known that many children with cerebral palsy have difficulties learning to read and write (Lebeer & Rijke, 2003; Peeters & van Balkom,

2008). However, despite the fact that developing a child's reading and writing skills is not one of the project's fundamental goals, literacy is essential to the child's ability to share experiences in the program and these skills naturally come into play when searching for solutions to problems with the Wizard through e-mail exchanges, or even while performing basic computer tasks. Throughout the sessions, both undergraduates and children shared various tasks that involved reading and writing, and they adjusted the level of assistance that ultimately contributed to better knowledge about grammar.

Most of the virtual messages exchanged throughout the semester were sent to the Wizard (89.29%), stimulated by the task card challenges. The messages contained either suggestions of activities that could be used for the benefit of the whole group, or proposals for changes in the labyrinth, such as adding a game or a room. At the same time, it was based on these observations sent by the children, the Wizard was able to see the interests and concerns of the individuals and the group, thereby associating reading and writing with an activity that is meaningful to the child. Table Y summarizes the development of reading, writing and computer literacy skills after starting the program (Tab Y. Fifth Dimension Studies on the Development of Academic Learning Process of Children with Cerebral Palsy).

TAB Y. Fifth Dimension Studies on Reading and Writing Development in Children with Cerebral Palsy

Skill	Topics	Positive Influence of Participation in 5th Dimension"?
Computer Literacy	Recognizes and uses computer commands as shortcuts in different programs (save, copy, paste, attach ...) as well as the functions of peripheral tools (mouse, keyboard, speakers...). Views technology and its jargon as a commonplace, modern possibility. Familiarity with e-mail and access to online website.	Yes
Reading fluency	Incorporates rhythm and intonation. Understands and interprets texts, enabling identification of central themes and textual genres. Capacity for inference (non-explicit information) and faithful retelling of the original.	Yes
Writing system	Enriched writing. Punctuation, placement of accents, and division into syllable segments. Broadened understanding of agreement between grapheme and phoneme. Developed effective strategies for more concise writing.	Yes

- Discussion with parents: After observing their child's increased independence, improved interactions and self-images, a number of parents said that they were

seeing how much their child was really progressing. They talked about changes, about how much their child is evolving. In this category, the parents cite factors related to their child's independence and self-confidence. One mother said: *"My daughter was stagnated but has grown so much now. She's more independent and was even able to travel by herself during her recent vacation. She is self-confident enough to make new friends."* Another mother stressed: "*My son has changed a lot – and so have I. Before, he was really dependent on me, and now I let him go some places by himself. Now I have more confidence in what he is able to do."* One mother talks about an important situation involving self-image*: "[My son] was playing basketball with some normal kids. His team was losing so he called one of his teammates over. He said to him, 'Take my place, you can play better than I can.' His teacher praised him for resolving the situation without feeling diminished. I owe this change in attitude to the program."*

Parents also acknowledge the importance of the undergraduates, especially with regards to the intergenerational aspect: "*The fact that there are college kids around helped my son become more centered and focused…they're closer in age to the children".*

Finally, the parents' accounts underscore the importance of sharing experiences with other families: "*When we hear another mother talking about what she is going through, we see that it's not just our kid who has problems; it's all of them. So you stop treating your kid like he's different, because you see that he's like many other children."*

- Undergraduate Questionnaire: The results showed that length of time in the project and the quality of the interactions are important factors in how they establish connections between their exchanges with children at the Fifth Dimension and theories of child development. The undergraduates' main observations are grouped into three categories: 1.) sharing common interests with the children; 2.) various dimensions of interaction within the setting; and 3.) how they learn things they did not expect to, the theoretical-practical associations that they were able to make, and information from the other students' transcribed accounts.

  1. Throughout the process of experiencing and sharing common interests with the children, the undergraduates begin to grasp the project's educational goals: "*Since the undergraduates are much younger, we have a lot more in common with the children, in terms of what's going on in the world, pop culture, games, ways of thinking."*

  2. They perceive the various dimensions of interaction within the setting: "*One of the things that makes Fifth Dimension very important is its setting – the hospital, the treatment - where a child oftentimes does not have a voice. Here, children can say what they like and don't like; they can be themselves without having to squeeze into a pre-established mold – they can learn about who they are as individuals. They take this new knowledge to school, to their families, to their interactions with friends. So children also feel happier, because they feel freer."*

3. They understand the child's involvement in motivational, challenging activities; and, in this context, learn to establish associations between theories of development and social interaction and learn things they do not expect to: *"I'd never met anyone with cerebral palsy before, so we get here thinking 'I wonder what we're going to come up against...' Then we started the program and we meet these amazing kids! We give these marvelous children a little of ourselves and they give us so much more back to us. So I think that the project has been really good for both us students and the children, because we grow right alongside them and are able to watch them grow too. I have learned on a personal level…-changes that I saw happening to me, things I will take with me into the future."*

Creating an Idiocultural to Promote the Development of Children Who Have Suffered Cerebral Palsy or Traumatic Brain Injury

There is a major problem in the broad range of efforts to design interventions for promoting cognitive and social development in children with various kinds of disabilities such as mild mental retardation to ADHD, cerebral, and traumatic brain injury. The predicament is that intervention procedures specifically targeted at the presumed deficits, while producing changes in the target behavior, fail to generalize beyond the specific conditions of training (Brown, Campione, & Murphy 1977; Tharp & Gallimore, 1985; Ylvisaker, Turkstra, & Coehlo, 2005).

These results are complimented by a long tradition of research on transfer between problem isomorphs among normal adults. Studies have shown extraordinarily limited transfer unless appropriate generalizations among problem types are built into the training regimes themselves (Gick and Holyoak, 1983).

These sorts of findings have led to the conclusion, in the words of Tharp and Gallimore, that in order for remedial training procedures to be useful, "tasks must be learned in the contexts of eventual application."(p. 455). Or, as Ylvisaker (2006) phrases the issue, one should engage in context-sensitive rehabilitation or remedial instruction based upon forms of activity that are of particular interest and concern to the affected individuals.

An important implication of this line of research and theory is that remedial, rehabilitation training that appears to be appropriate to the specific form of disability under investigation and is targeted at a relevant, real world form of activity, will be primarily, or only, effective within the context of that particular activity or setting. Such an approach, although clearly preferable to training on isolated or decontextualized tasks that will serve no useful purpose, requires that the investigator identify a very large set of important real world activities and provide highly specific, labor-intensive training regimes for each one! Consequently, it would be highly desirable, on both practical and theoretical grounds, if it were possible to design remedial/rehabilitative activities which are relatively bounded but which could induce more general change in the affected populations.

The aim of this paper is to report on one promising approach to designing rehabilitation activities that can be engaged in simultaneously by several people, and which produce cognitive and social effects that generalize beyond any specific tasks that constitute elements of the activity setting. Briefly stated, our strategy is to create a socially organized idioculture saturated with a wide variety of cognitive tasks in which the norms of social interaction serve as media for the generalization of the information and modes of behavior appropriate to the constituent tasks. The specific, component, tasks in this specially organized system of activities are often in the form of games, where undergraduate students with little or no specific training in remedial/rehabilitative techniques engage with children in a complex playworld. This playworld simulates, in many respects, a microculture with rules, obligations, divisions of labor, tool use, friendship formation, and multiple forms of communication among all variety of participants—the children, undergraduate students, and staff. Participation in such a playworld, our evidence indicates, produces cognitive and social changes that generalize broadly to cognitive tasks and social behaviors that are not an explicit part of the playworld within which they are encountered. That is, the playworld serves as a medium for the generalization to a large ensemble of cognitive tasks and social behaviors that are not explicitly the object of training.

A Description of the Original Playworld:

The model for the playworld that we have adapted for use with children in this research is called The Fifth Dimension. The Fifth Dimension was originally designed as an activity system for children from marginalized social groups in the United States who were performing poorly in school. Its goal was to serve both as a medium for diagnosing specific learning deficits that individual children might display and as an environment rich in opportunities for cognitive and social re-mediational potential (Cole & the Distributed Literacy Consortium, 2006).

An essential feature of The Fifth Dimension is its adaptability to specific local conditions. Nonetheless, there are similarities across implementations which make it useful to provide a provisional description for purposes of understanding how and why the specific adaptations described in the current research came about.

The following is a normative description based upon several years of research in the United States in a variety of socio-ecological circumstances:

The is an educational activity system that offers school-aged children a specially designed environment in which to explore a variety of off-the-shelf computer games and game-like educational activities during the after school hours. The computer games are a part of a make-believe play world that includes non-computer games like origami, chess and boggle and various other artifacts. "Task cards" or "adventure guides" written by project staff members for each game are designed to help participants (both children and undergraduate students) orient to the game, to form goals, and to chart progress toward becoming an expert. The task cards provide a variety of requirements to externalize, reflect upon and criticize information; to write to someone; to look up information in an encyclopedia; and to teach someone else what one has learned, in addition to the intellectual tasks written into the software or game activity itself.

As a means of distributing the children's and undergraduates' use of the various games, the Fifth Dimension contains a maze consisting of some 20 rooms, ordinarily in the form of a wooden or cardboard box placed on a table top or pictured on a wall chart. Each room provides access to two or more games, and the children may choose which games to play as they enter each room, depending upon what games they have played before and what is available at the moment.

There is an electronic entity (a wizard/wizardess) who is said to live in the Internet. The entity writes to (and sometimes chats with) the children and undergraduates via the Internet. The children and undergraduates often write back. In the mythology of the wizard/ess, he/she acts as the participants' patron, provider of games, mediator of disputes, and the source of computer glitches and other misfortunes.

Because it is located in a community institution, the activities require the presence of a local "site coordinator" who greets the participants as they arrive and supervises the flow of activity in the room. The site coordinator is trained to recognize and support the pedagogical ideals and curricular practices that mark as "different"-- a different way for kids to use computers, a different way of playing with other children, and a different way for adults to interact with children.

The presence of university and college students is a major draw for the children. The participating college students are enrolled in a course focused on fieldwork in a community setting. At UC San Diego, an institution that emphasizes research, the university course associated with student participation is an intensive, six unit class that stress deep understanding of basic developmental principles, the use of new information technologies for organizing learning, and writing field notes and research papers. The undergraduates write papers about the development of individual children, the educative value of different games, differences in the ways that boys and girls participate in the play world, variations in language use and site culture, and other topics that bring regular course work and field observations together.

In short, considered in its community context, The Fifth Dimension is organized to create an institutionalized version of the form of interaction that Vygotsky (1978) referred to as a zone of proximal development. From time to time there is creative confusion about who the more capable peers might be (for example, when novice undergraduates encounter children highly skilled in playing educational computer games about which they know nothing). But the general cultural of collaborative learning that is created serves the development of all.

Summary Results of the Fifth Dimension Implementations

Because the foundation money that supported early Fifth Dimension research was focused on academic achievement and the potential supporting role of computer technologies, most of the quantitative results indicating its effects involve measures of changes in reading, writing, arithmetic, the ability to follow written instructions, and computer literacy. A summary of major results from a variety of Fifth Dimension evaluation studies based on experimental or quasi-experimental studies carried out in a variety of sites around the United States are seen in Table 1.

INSERT TABLE 1 HERE (M. Cole)

One of the remarkable feature of the results shown in Table 1, in addition to the variety of cognitive skills providing evidence that children's academic/cognitive achievement is enhanced by participation is that the number of sessions required to produce such results was relatively small, sometimes as few as 15-20 1 ½- 2 hour sessions of participation spread over many weeks.

From qualitative analysis based upon video-taped interactions among participants during Fifth Dimension sessions and detailed clinical fieldnote records provided by undergraduate participants, it appears that the social interactions among the children and the undergraduates and the children, as well as the among the children themselves, play a central role in amplifying the cognitive/academic impact of participation. Lively chatter and cross-talk, sharing of expertise, intense engagement in dyads and triads, are ubiquitous features of Fifth Dimension settings wherever they are encountered, appear to be the process characteristics of activities that induce the cognitive/affective results in a relatively short period of time.

Less well documented, but widely reported by implementers of Fifth Dimensions is that the forms of agentive engagement that prevail there have a socially mediated influence that goes beyond participation at the sites themselves. For example, Kris Guttierez (Ref), who has long guided a Fifth Dimension activity system in a Los Angeles school populated primarily by recently arrived migrant Latino (largely Mexicano) children, reports that teachers note marked changes in classroom behaviors, part of them associated with easy expertise in the use of computers, part of it associated with spontaneous helping behaviors in the classroom, behaviors that were approved of but never taught or introduced as a classroom practice.

Adapting the Fifth Dimension Model to Children with Special Needs:
As noted above, by and large the Fifth Dimension was designed as an after school program for children from marginalized groups, often from relatively poor families of Latino and African American origin in the United States, who are under-represented in higher education, as a means of providing them educational enrichment that could enhance their prospects of moving on to higher education.

However, because Fifth Dimensions are generally located in community institutions that are by their nature inclusionary, it was common to have special needs children participating along with other children. The nature of these special needs varied widely: some children were on medication designed to ameliorate symptoms of hyperactivity or ADHD. Some children were mentally retarded. At least one child suffered severe Asperger's syndrome. Over many such cases, spread over several years and numerous instantiations of the Fifth Dimension, informal evidence accrued that such children benefited from Fifth Dimension participation no less than their peers who were not identified as having special needs beyond the needs for academic enrichment.

In 2002, the current authors met and became acquainted with each other's work at a memorial conference for Alexander Luria and his work on rehabilitation of people who had suffered some form of traumatic brain injury. Lucia Willadino Braga, a Brazilian neuroscientist whose clinical and research focuses are on the rehabilitation of children with

cerebral palsy and traumatic brain injury, became interested in the way Michael Cole was using ideas inspired by Luria (1972) and Vygotsky (1978) to organize educational enrichment for children. Cole, who had been a post-doctoral student of Luria's, began to think about the potential of using the Fifth Dimension as a medium for rehabilitation of special needs children, based upon the fragmentary evidence of such efficacy from the prior experience that he and his colleagues had using the program with a variety of children. From this mutual interest, the current project was born. The central question we sought to address was whether the basic Fifth Dimension model could be adapted for use in a rehabilitation hospital where, heretofore, remediation was carried out only by trained professionals and where the idea of creating an entire rehabilitation regime on a large group basis using principles of cultural-historical psychology had not been attempted.

We entered the project fully aware that even for the populations for which it had been designed, the Fifth Dimension varied widely in the details of its idiocultural implementations, so that we would, in effect, be creating a really new idioculture under unprecedented conditions. It had long been demonstrated that the model could be used effectively in a wide variety of cultural milieus outside of the United States, having been adopted successfully in Russia, Finland, Mexico, and Brazil on prior occasions. (See www.uclinks.org for further information of such generalizations of the activity system across national cultural boundary lines).

The Fifth Dimension at the SARAH Network of Neurorehabilitation Hospitals in Brasilia, Brazil

The SARAH Network of Neurorehabilitation Hospitals consists of nine fully operational hospital facilities dedicated primarily to the treatment of neurological problems in children and adults. The Network also includes two International Center for Neurosciences and Neurehabilitation and the SARAH University for Rehabilitation Sciences. Last year alone, the SARAH Network saw over two million patients and rendered close to 19 million medical and paramedical procedures. SARAH patients come from the four corners of Brazil, with widely varying socio-economic and educational backgrounds. In addition to neurological disorders, the Network also treats numerous other pathologies in children, such as pre- and perinatal stroke, schizencephaly, encephalomalacia, low birth weight, cerebral palsy (athetoid, spastic and ataxia), hydrocephaly, traumatic brain injury (TBI), tumors, epilepsy and spina bifida. Because of the large pediatric patient population with cerebral palsy and traumatic brain injury, who come for consultations and stay for ongoing therapy in the various subspecialties dedicated to childhood brain injury and its attendant manifestations, the physical facilities at SARAH have been designed with this patient population in mind, with open child-friendly gymnasiums, playrooms, pools and rehabilitation halls. The Network also counts on an extensive infrastructure for surgical, rehabilitation, imaging, and research activities, such as fMRI scanners and movement laboratories. (For further information see www.sarah.br).

The Fifth Dimension project at SARAH takes place at the International Center for Neurosciences in Brasilia, located several miles from the large SARAH hospital. The Center concentrates on strategies for long-term rehabilitation. The Fifth Dimension project began in March 2006 with 11 children with cerebral palsy (CP), most with a diagnosis of spastic diplegia. Strategically, the neuropsychological disorders in this group of children were very heterogeneous. This was due in part to one of the project's main objective of

fostering different levels of cooperation among the children and providing opportunities for experience-sharing and support among the families; and also, because of the difficulties of obtaining a homogenous sample of brain injured children, given that clinical etiological criteria are commonly applied, despite recovery being an individual process that depends on social, familial and educational factors. These goals reflect the basic theoretical principles of the SARAH Rehabilitation Method (Braga & Campos da Paz, 2008; Braga, Campos da Paz & Ylvisaker, 2005).

The college undergraduates for the Fifth Dimension at the SARAH Network are selected from various universities in Brasília. Students apply and are selected based on their knowledge of child development, education and learning, as well as their own personal experiences and formal education. The students receive no academic credit from their universities for their participation in the program, which lasts six months; however, they receive a certificate for having completed the course. Elements of the Fifth Dimension at SARAH mirror the Network's multidisciplinary team approach to rehabilitation, in which professionals from different areas participate in the rehabilitation of each patient. For example, in cerebral palsy, since many developmental areas may be affected, better outcomes are obtained from having integrated teams comprised of professionals from different specialties. Thus, over time, students from various majors have been accepted into the program, such as speech therapy and education, in addition to those studying psychology. This plurality permits enriched understanding of the social interactions of brain injured children and helps integrate knowledge from various fields at an early stage of the students' academic careers. To date, 88 students have participated in the 5D at SARAH. They are, on average, 20 years old, and in their freshman or sophomore years of college.

Given the original goals and structure of the Fifth Dimension model, the program needed to undergo some adjustments, not only because of the special nature of the subject population (children with brain injury) but also due to the program's location in a rehabilitation hospital rather than at a community-based after school program (although the program is run after school). The first adjustments made for children with cerebral palsy included:

5. **Computers**: New software, with a special voice mail feature, was developed. Geared towards children with motor or cognitive writing deficits, these changes facilitate their communication with the Wizard, which can be written and sent by e-mail or voice mail. The font size was made larger to accommodate possible vision problems, and new interfaces were created to help those with difficulties using traditional keyboards due to motor disorders.

6. **Individual projects:** The performance level, limits and potential of children with brain injury vary widely, and are associated with biological, cultural and epistemic factors. Some children with brain injury are unable to attain particular levels of performance in a given task, e.g., a child with cognitive dysfunction may not be able to progress to the advanced phases of a video game. In this sense, adjustments needed to be made and strategies reworked, such as the degree of difficulty in the labyrinth, the nature of the children's participation in the program, and the roles that each took on within the microculture of the project.

7. **Family participation**: Since the SARAH Network's entire pediatric rehabilitation process is founded on a context-sensitive, family-based approach, the family's role in this playworld model had to be taken into account. Unlike prior Fifth Dimension projects, the children treated at SARAH do not live nearby, have problems getting around, and depend on their families to bring them to the rehabilitation center. So children always come in the company of their parents. This initially raised the question of what role the parents should play during Fifth Dimension time.[2]

At the beginning, the parents would arrive at the Fifth Dimension room, located in a specially designed rehabilitation area, eager to participate in the child's activities with the undergraduates. This parental reaction is perfectly normal because they had grown accustomed to the difficulties that their child had interacting with strangers; the parents wished simply to help their son or daughter make the most of the experience. Interestingly, they soon noticed that the children were quickly developing relationships with the undergraduate students, and saw that they were capable of participating without their help. Some of the children even began asking their parents to wait outside.

To accommodate this new situation, the research team created a specially designed set of routines. When the parents and children arrive at the Fifth Dimension site at SARAH, they are greeted by some of the project staff. The children then go off with the researchers and undergraduates while the parents gather in another room, where they can read, chat, or watch television while their child goes about their Fifth Dimension activities. At the end of each session the children and undergraduates meet the parents and SARAH staff in a hall where snacks are provided and where the program participants can chat informally about what the children have been up to, both inside and outside of the Fifth Dimension context.

At the start of the program, a special parent discussion session was held every other week. During these sessions, led by staff psychologists who also participated in the Fifth Dimension, the families talked about their lives at home, their feelings and ideas about the project, changes they are noticing in their children, suggestions they have for the program. Other issues are also addressed in the group, such as development, rehabilitation, learning, and ways of coping.

Over time, these adjustments have resulted in a schedule of two weekly sessions for the children and one monthly meeting for the parents.

8. **The course for undergraduates:** The course is organized into three modules each semester. The group is heterogeneous in its level of experience and participation in the Fifth Dimension. The new students (Module I) are given basic

[2]It also raised issues of transportation. Many of these parents do not drive or own cars. A special bus service was organized so that parents could bring their children to the SARAH hospital in downtown Brasilia, from which they are bussed to the rehabilitation center on the lake, several miles away. Consequently, children and their parents often travel as much as two hours each way to get to the Fifth Dimension. We are studying the possibility of organizing this transportation without the presence of the parents. An aim, then, is to expand the interactions that children have with each other and with the program professionals. This would facilitate the natural exploration that children engage in during later childhood.

responsibilities, such as activities with the children, field notes, debates, discussions, system changes, and so forth. The responsibilities of the more experienced students are expanded (Modules II and III) to include tasks such as writing the Wizard's replies to the children's e-mails, coordinating discussions, and overseeing plans. Every semester, each group has an average of 11 to 16 students.

All of the students note down the day's activities in a structured report (Field Journal). Initially, the report was done on the same day, right after the children left. A website created specifically for this purpose (http://www.sarah.br/projeto5d) permitted individualized reports. Each field journal is read and commented on by the whole team, fostering a direct pathway to guiding each student's learning process. The students currently have the chance to comment on their peers' field notes, and answer comments online. The site also helps organize the bibliography and relevant links, as well as the debates, discussions, reports about what the children are doing, and an e-mail for internal communication.

Each time a new Fifth Dimension session begins, the SARAH research team and the undergraduates meet beforehand to discuss various theoretical and practical issues, and then again, afterwards, to discuss problems and plan modifications. There is no pre-established reading list. Instead, reading topics are selected for further study as the need arises, based on the students' increasingly complex interactions with the children.

One of the central questions that we sought to address pertains to the information given to the undergraduates. Information about each child's individual problems, specific neurological exam data, diagnostic imaging results and development are not addressed directly; the undergraduates use principles of cultural-historical psychology to interact with the children with TBI but are not given specific prior information. First, each undergraduate converses with the child and tries to understand his/her motivations; then, based on this information, proposes different activities related to the child's interests, and tasks likely to occasion meaningful challenges. As the undergraduates share the child's specific developmental processes within a system of close interaction, they register their impressions and thoughts in the field journal. They also discuss and share theoretical-practical information with the rehabilitation team and with their peers about the child's cognitive, behavioral or etiological development.

As can be seen even from this cursory account of modifications, both the technical and social infrastructures of the SARAH Fifth Dimension were in several respects unique at SARAH , quite apart from the particular characteristics of the children. Most important, in our view, is not only the fact that the children interacted with the undergraduates and staff, but that the undergraduates and the staff, in an informal manner, interacted with the parents in the presence of the children and in the general context of the Fifth Dimension.

The children's program of activities run parallel to the Brazilian school calendar, with sessions from March through June, a break during July (winter vacation in Brazil); sessions start again in August and end in early December. Children have three months' vacation per year – both in school and in the program. On average, each child participates in 57 hours of activity per semester, spread over two afternoon periods per week.

The group of 11 children with cerebral palsy that launched the first Fifth Dimension project at SARAH in May 2006, were between the ages of 8 and 12 years (52% of the children were between 8 and 10 years old, and 48% between 11 and 12 years old). Most of them had little access to video or computer games, and limited knowledge of email, web search engines and text editing. Several had contact with some of these tools in school, and five children had computers at home but rarely used them. Of all the tools, this group had had the most access to video games, but even then, only on occasion, such as when visiting relatives or a neighbor's house. Only two children from this group had a videogame at home.

As far as neurodevelopment is concerned, all of these children had varying muscle tonus and motor disorders (mixed tetraplegia, spastic triplegia, spastic diplegia and spastic hemiplegia). Levels of motor independence ranged from unassisted gait to assisted wheelchair use and from relatively normal upper body and fine motor control of the hands and fingers to more or less severe difficulties with these functions. From a cognitive point of view, formal WISC tests showed IQ scores between 61 and 120 (8% high average; 50% average; 31% low average and 12% borderline) but these averages mask the fact that for every child in the group, verbal scores were higher than performance scores (68% of the children have, on average, a 29-point performance difference between the verbal and the executive). In general, the group's linguistic abilities, lexical knowledge and facility for elaborating speech were above the expected average for their age bracket. The same is true for their ability to establish logical relationships, and forge verbal concepts or categories. On the other hand, in the performance scales, the group demonstrated significant difficulties with skills related to perceptive discrimination, anticipating and planning a given activity, and organizing a whole from disparate parts. These performance difficulties were not directly related to movement disorders. In addition to these challenges, some children had attention deficits and visual impairment, i.e., strabismus, problems with acuity and hemianopsia. The families' socio-economic levels varied greatly. Also, while some of the parents had high school diplomas, college degrees or Doctorates, others had not finished grade school.

Procedure

The 11 children with CP were assessed before starting the Fifth Dimension, and, depending on how long they remained in the program, re-evaluated after six, 12 and/or 18 months. Some who entered the program when it was initially implemented at SARAH continued on, while others were unable to remain for various reasons, e.g., the family's inability to bring them to the center twice a week, the family's relocation to another city, or, because of changes in school schedules. Parents whose children were in the program for at least six months, were interviewed 24 months after the start of the Fifth Dimension.

During the project's first stage at SARAH, we chose to work with different types of analyses, which we believe are relevant to the rehabilitation of a child with cerebral palsy, and which could provide information – or hypotheses – about the transference of the newly acquired skills to different settings and activities. The following were analyzed in CP children: self-concept; the project's effects on the child's social interactions at home and in school, and how they felt about it; development of academic skills; parents' accounts of changes in behavior; the impact of the undergraduates' participation and perception of the development of the child with brain injury. **What does this phrase mean?**

Means of assessment

Quantitative data:

Self-image: We evaluated the children's self-image using the 4 domains (self-concept, familial, social and scholastic) of the *The Self-Image Scale for Children and Adolescent*] previously standardized on and recreated for the Brazilian population (Sisto, and Martinelli, 2004). Children were administered the *EAC-IJ* scale at the start of the program and after six, 12 and/or 18 months in the program.

Interaction/independence: The children, parents and teachers each answered the same questionnaire with 26 items about child's interaction with the family, at school, and in the Fifth Dimension program. They were all instructed to base their answers on how often they felt a given situation occurred in their daily interactions with the child, during the semester's activities, as compared to the period before the child started the program. The aim was to gauge the impact that the child's experiences in the Fifth Dimension environment had on their interactions in different settings. This information was complemented by some of the undergraduates' observations, made during discussions at the end of the day's activities.

Qualitative Data:

Academic skills: We conducted a qualitative analysis of each CP child's reading and writing skills, prior to the start of the Fifth Dimension activities, and again 12 months after beginning the program. The first evaluation took place during the individual clinical check-up that each child underwent before the program. Two educational domains guided the analysis of academic skills: reading fluency and writing system, with the Avaliação Diagnóstica da Alfabetização [Diagnostic Evaluation of Reading and Writing] test (BATISTA, et al) as a reference. This tool qualitatively assesses the skills that the child acquired during the first three grades of elementary school. We also conducted qualitative evaluations of the child's proficiency in computer commands, knowledge of technical jargon, use of web search engines, and ability to manage email. After 12 months, we ran the same tests, and used the undergraduates' field note reports for analysis of the child's progress in computer literacy. Accounts from parents and teachers complemented the analysis.

Discussions with parents: At the end of 24 months of the activities with the parents, (based upon discussion groups, sharing of experiences, conversations with the undergraduates, and observation of the child in the program), the team, consultants and family met to openly discuss the parents' opinions and feelings about the project. These sessions were filmed and transcribed. The transcribed data were read by four Psychology undergrads and grouped into three different domains: 1) Changes in the children's development; 2) the importance of the undergraduates; and 3) parent group.

Undergraduate Questionnaire: Each undergraduate answered an open-ended questionnaire about their participation in the project, at six and 12 months after starting the course. The objective was to analyze how interacting with the children impacted the undergraduate's development.

Results and discussion:

- Self-Image: In the group of 11 children with cerebral palsy who participated in the first stage of the program, we did not find any significant deficits in self-concept before starting the project. Similar findings were reported in a comparative analysis of estimated performance in children, adolescents and adults with CP (Souza, 2002). However, a comparative analysis of pre- and post-test quartiles revealed a tendency towards improvement in overall self-image and in the social domain, especially in children whose pre-test scores had been in the first or second quartile. Shared cooperative activity is a strategy that allows the child to improve self-image, especially in those children who do not have a good opinion about their abilities. **shouldn't this remark go in the discussion?**
- Interaction/independence: The results showed that, with time, there was substantial improvement in the children's independence levels both within the 5D and in their interaction with others in different settings. The scores that the children obtained were different and higher than the ones ascribed by the adults who evaluated them. The children felt more self-confident, took more initiative, believed more in themselves, and, note, they are the ones who are perceiving this – more than any adult.*Elsewhere you say that adults also saw their children being more independent. ?? Table X presents improvements in the child's social skills after starting the 5D program (Tab X. Fifth Dimension Studies on the Development of Social Skills in Children with Cerebral Palsy).

  School teachers also provided very interesting accounts. For example, one teacher told a SARAH staff member who was conducting a routine visit to the child's school: "Erika was a very quiet, introverted girl. I called her Keli, her classmates did too, and she never corrected us. When I got the official student roster I saw that there was in fact no one named Keli there was, rather, an "Érika". But she'd never said anything ..."

  "...Erika started the 5th Dimension program and, after about two weeks, she started to speak up, started showing us the problems she was having, the things that she was interested in, started interacting more with her classmates, became empowered in her learning. Now she asks questions, is more responsible with her work and her growth has been excellent…"
  "...Erika stopped being a spectator and became a participant, began socializing. All this started happening rather quickly…" *Statements by Erika's teacher (3rd grade, 10 years old)*

TAB. X. Fifth Dimension Studies on the Development of Social Skills in Children with Cerebral Palsy

Category	Categories and topics addressed	Advantage from fifth Dimension?
Shared learning	Reciprocity Shares interests Trades information Solves problems together with other children	Yes
Social interaction	Communication and expression Takes initiative in the interaction with intergenerational peers	

	Engages in cooperative group activities Develops models of interpersonal relationships: assistance, attention and trust Expanded communication with family members	Yes

- Academic skills: It is well known that many children with brain injury have difficulties learning to read and write (Lebeer & Rijke, 2003; Peeters & van Balkom, 2008). Query—will readers realize you are talking about cp not tbi kids when using the phrase, brain injury here? Also, I have moved this sentence to front of section. However, despite the fact that developing a child's reading and writing skills is not one of the project's fundamental goals, literacy is essential to the child's ability to share experiences in the program and these skills naturally come into play when searching for solutions to problems with the Wizard through e-mail exchanges, or even while performing basic computer tasks. Throughout the sessions, both undergraduates and children shared various tasks that involved reading and writing, and they adjusted the level of assistance that ultimately contributed to better knowledge about grammar.

  Most of the virtual messages exchanged throughout the semester were sent to the Wizard (89.29%), stimulated by the task card challenges. The messages contained either suggestions of activities that could be used for the benefit of the whole group, or proposals for changes in the labyrinth, such as adding a game or a room. At the same time, it was based on these observations sent by the children, the Wizard was able to see the interests and concerns of the individuals and the group, thereby associating reading and writing with an activity that is meaningful to the child. Table Y summarizes the development of reading, writing and computer literacy skills after starting the program (Tab Y. Fifth Dimension Studies on the Development of Academic Learning Process of Children with Cerebral Palsy).

TAB Y. Fifth Dimension Studies on Reading and Writing Development in Children with Cerebral Palsy

Skill	Topics	Positive Influence of Participation in 5th Dimension"?
Computer Literacy	Recognizes and uses computer commands as shortcuts in different programs (save, copy, paste, attach ...) as well as the functions of peripheral tools (mouse, keyboard, speakers...). Views technology and its jargon as a commonplace, modern possibility. Familiarity with e-mail and access to online website.	Yes

Reading fluency	Incorporates rhythm and intonation. Understands and interprets texts, enabling identification of central themes and textual genres. Capacity for inference (non-explicit information) and faithful retelling of the original.	Yes
Writing system	Enriched writing. Punctuation, placement of accents, and division into syllable segments. Broadened understanding of agreement between grapheme and phoneme. Developed effective strategies for more concise writing.	Yes

- Discussion with parents: After observing their child's increased independence, improved interactions and self-images, a number of parents said that they were seeing how much their child was really progressing. They talked about changes, about how much their child is evolving. In this category, the parents cite factors related to their child's independence and self-confidence. One mother said: *"My daughter was stagnated but has grown so much now. She's more independent and was even able to travel by herself during her recent vacation. She is self-confident enough to make new friends."* Another mother stressed: "*My son has changed a lot – and so have I. Before, he was really dependent on me, and now I let him go some places by himself. Now I have more confidence in what he is able to do."* One mother talks about an important situation involving self-image*: "[My son] was playing basketball with some normal kids. His team was losing so he called one of his teammates over. He said to him, 'Take my place, you can play better than I can.' His teacher praised him for resolving the situation without feeling diminished. I owe this change in attitude to the program."*

  Parents also acknowledge the importance of the undergraduates, especially with regards to the intergenerational aspect: "*The fact that there are college kids around helped my son become more centered and focused…they're closer in age to the children".*

  Finally, the parents' accounts underscore the importance of sharing experiences with other families: "*When we hear another mother talking about what she is going through, we see that it's not just our kid who has problems; it's all of them. So you stop treating your kid like he's different, because you see that he's like many other children."*

- Undergraduate Questionnaire: The results showed that length of time in the project and the quality of the interactions are important factors in how they establish connections between their exchanges with children at the Fifth Dimension and theories of child development. The undergraduates' main observations are grouped into three categories: 1.) sharing common interests with the children; 2.) various dimensions of interaction within the setting; and 3.) how they learn things they did not expect to, the theoretical-practical associations that they were able to make, and information from other the students' transcribed accounts.

1. Throughout the process of experiencing and sharing common interests with the children, the undergraduates begin to grasp the project's educational goals: "*Since the undergraduates are much younger, we have a lot more in common with the children, in terms of what's going on in the world, pop culture, games, ways of thinking."*

2. They perceive the various dimensions of interaction within the setting: "*One of the things that makes Fifth Dimension very important is its setting – the hospital, the treatment - where a child oftentimes does not have a voice. Here, children can say what they like and don't like; they can be themselves without having to squeeze into a pre-established mold – they can learn about who they are as individuals. They take this new knowledge to school, to their families, to their interactions with friends. So children also feel happier, because they feel freer."*

3. They understand the child's involvement in motivational, challenging activities; and, in this context, learn to establish associations between theories of development and social interaction and learn things they do not expect to: *"I'd never met anyone with cerebral palsy before, so we get here thinking 'I wonder what we're going to come up against...' Then we started the program and we meet these amazing kids! We give these marvelous children a little of ourselves and they give us so much more back to us. So I think that the project has been really good for both us students and the children, because we grow right alongside them and are able to watch them grow too. I have learned on a personal level…changes that I saw happening to me, things I will take with me into the future"*

Discussion

In this article we have summarized our attempts to adapt the system of educational activity called the Fifth Dimension, first designed for use with North American children who were experiencing school difficulties to the setting a rehabilitation hospital in Brazil. Overall, our quantitative and qualitative results, collected by trained rehabilitation staff at SARAH indicated significant positive changes in the development of children with cerebral palsy after they began participating in the Brazilian version of the activity. These gains were confirmed by the children's parents and teachers, as well as the undergraduate students who worked and played with the children as a central part of the activity. Consequently, we can conclude that the Fifth Dimension approach to re-mediating the intellectual and social development of children is applicable across a wide range of populations.

In addition to this general conclusion, we wish to raise some questions about how to interpret these results and their potential significance as part of a regime of rehabilitation for children with various forms of early brain damage. This inquiry is spurred by the following skeptical question: what is it about the way the Fifth Dimension activities are organized that appears to produce such generalized positive results in many domains of development after so few hours of rehabilitation therapy, the great bulk of which involved interaction between the children and undergraduates who themselves had little prior training? (We should note that an analogous question arises concerning positive results obtained in North American and European implementations). After all, the research we summarized at the beginning of this article emphasized the great difficulties of obtaining positive transfer using more traditional remedial techniques or even in attempts to obtain transfer among seemingly obvious problem isomorphs in research with perfectly healthy college students. What makes the Fifth Dimension strategy different?

Our approach to formulating an answer to this question is to revisit Alexander Luria's distinction between the primary and secondary consequences of localized brain injuries (e.g., Luria, 1983). In Luria's application of this distinction, a relevant example might be that a person's inability to speak, read, and write is a *secondary* result of a phonemic disorder traceable back to a particular lesion. But Luria also recognized secondary disorders associated with social interaction. Moreover, when we move from the level of individual cognitive analysis in test situations to those of everyday functioning, it is clear that secondary disorders (shyness, dependence upon one's parent, etc.) may amplify difficulties more closely aligned with the primary deficit (in the sense of an identifiable lesion, for example).

Children with neurodevelopmental problems often present comorbid deficits. For example, the CP child tends to overlap attention and visuo-constructive disorders. Furthermore, a focused task may need to rely on the active contribution of various cognitive subprocesses. Thus, with children, the primary and secondary deficits are many times difficult to detect (Korkman, 1999).

In 2001, the International Classification of Functioning, Disability and Health expanded its classification of dysfunction into a three-tiered domain, classified as body, individual and social. This new classification, based on Luria's theories, consolidates the concept of primary deficit - impairment (body) - and separates the secondary into two dimensions – disability (individual) and handicap (social). A description of the neurodevelopment of the child would include clinical characteristics, primary and secondary deficits and, since an individual's functioning and disability occurs within a context, also includes a set of environmental-social configurations. In the 5th Dimension setting, with CP children, we could observe that it is possible to realign the configuration of social interactions, thereby alleviating the impact of secondary deficits.

Our clinical experience, which includes many years of observing these children in school settings, shows that group interactions are often the most impacted by participation in the Fifth Dimension. In the classroom, when a child with cerebral palsy who has not participated in the Fifth Dimension engages in peer interaction with a single, paired peer, his or her primary deficits are frequently not an issue and there is good interactivity. This restricted form of interactions differs from group situations in which interaction is impaired for both the peers and the child with cerebral palsy. The group, as an interactive setting, interferes with the brain injured children's ability to engage actively and to participate. As a result of the hindered interaction in multi-party interactions, peers ask - and expect - less from the brian injured child.

Because it is based on a child/student pair structure of dual interactivity that is an integral part of a larger group dynamic, the 5th Dimension activity seems to contribute to improving the child's ability to successfully engage in group settings. Thus, it bridges the two interactive situations, improving children's capacity for social interaction and their self-esteem at the same time that it provides for variously organized practice in component cognitive activities central to school achievement. The expansion of these interactions, we believe, facilitates the learning process, lessens the child's sense of isolation and renders them more adept at managing the different interactional dynamics involved in social, scholastic and community activity.

The most significant aspect of the Fifth Dimension as it applies to this brain injured population is the broad transfer of gains obtained within the scope of the program. For intervention models to truly impact on the development and recovery of children with brain injury, they must generalize beyond the reach of a rehabilitation program, and foster learning that can be applied to other areas of the children's lives. This is an educational and rehabilitation approach that, rather than merely train and improve skill areas in which the child may be deficient, creates means for developing and exhibiting what they are capable of doing. Shared cooperative activity is a strategy that allows the child to improve self-image, especially in children who do not have a good opinion about their abilities.

It is important to offer children with cerebral palsy the opportunity to overcome their difficulties through successful learning, forged by means of authentic activities; in other words, children will attain significant goals when they are intellectually and emotionally engaged in the task at hand. The personal and educational benefits of collaboration depend on the degree to which the individual is involved in the collective activity, as children may be less inclined to cooperate if the activities and tasks are not meaningful to them. Recovery ultimately takes the form of improved self-image, newly acquired skills, and the ability to engage in one's environment, leading to lives, for both the child and the family, pervaded with meaning activity.

Important issues for future research include the expansion of this work to children with other forms of brain damage such as TBI and exploration of the extent to which successful activities can be carried out beyond the confines of a rehabilitation hospital.
With some (as yet unknown) limits, it should be possible to replicate the positive findings of these studies in what we might term “outpatient settings” where perhaps one trained rehabilitation therapist works with college students and their professors in courses/rehabilitation activities that simultaneously improve the education of the undergraduates while recruiting them into health care of this specialized kind and expand the potentials of the many thousands of children who suffer from various forms of childhood brain damage.

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