Growing Brains in Early Childhood: Using e-Learning to Train Professionals in Auditory-Verbal Therapy

Megan Hastie
Hear and Say WorldWide, Australia
megan@hearandsaycentre.com.au

Dimity Dornan
The Hear and Say Centre Brisbane, Australia
dimity@hearandsaycentre.com.au

Nian-Shing Chen
National Sun Yat-Sen University, Taiwan
nschen@mis.nsysu.edu.tw

Richard Smith
Southern Cross University, Australia
smith.richard211@gmail.com

Guy Elston
The Centre for Cognitive Neuroscience, Australia
guyelston@yahoo.com

Abstract

This paper describes the use of Auditory-Verbal Therapy (AVT) to ‘grow brains’ in early childhood learners via intensive auditory brain stimulation that develops listening and speaking skills. One research focus of a specialty paediatric hearing health and education centre, Hear and Say Brisbane Australia, is directed at the period after surgical implantation of the Cochlear Implant. At that time, there is a critical need for intensive auditory brain stimulation by trained and accredited listening and spoken language specialists using evidence-based practice. Certified Auditory-Verbal Therapists (LSLS Cert AVTs™) teach the implant recipient, the prototypical bionic human, to learn to listen and speak. The Hear and Say WorldWide e-Learning Program that is reported here was developed to overcome the global shortage of AVTs by training specialists. The program uses a Learning Management System made available to Hear and Say through collaboration with the National Sun Yat-Sen University, Taiwan. It features a ‘Blended Learning’ mode of delivery, comprising asynchronous and synchronous tools to offer a suite of AVT courses to train participants from introductory to specialty level. More recently, it has been used in mainstream teacher professional development in Australia and internationally.

Keywords: e-Health, Auditory-Verbal Therapy, Neuroscience, Neuro-Cognitive development, e-training
Introduction

This paper reports on new insights into early brain development emerging from the field of Neuroscience. We draw parallels between the ‘circuitry’ of the human brain and the networks that need to develop around individuals, and in particular around children from birth, to optimize human potential. We report on findings related to auditory brain development in infants in which intensive auditory stimulation has been used to ‘grow brains’. Collaborative research undertaken by the Hear and Say Centre Brisbane Australia and the Centre for Cognitive Neuroscience Australia indicates neural pathways can grow and continue to grow through intensive stimulation like Auditory-Verbal Therapy (AVT). The research documents outcomes for children fitted with the Cochlear Implant, the prototypical human-machine interface or ‘bionic ear’, using AVT. With hearing loss being the most common disability in newborns globally, one to three children in every thousand is born with hearing loss. While this represents a neurological emergency for the newborn and their family, in world terms, it results in educational, emotional and financial poverty in developing countries (Dornan, et al., 2011). Regrettably, this statistic is matched by a chronic shortage world-wide of trained and accredited Auditory-Verbal Therapists to teach these children.

The extra-ordinary technical success of the Cochlear Implant, invented in 1978 by Australian Professor Graeme Clark AC, in stimulating the auditory nerve and neural pathways in the brain to simulate sound, is well documented (Clark 2003). As the first technology to replace a human sense organ, the CI continues to lead the way in medical bionics and our understandings of the human-machine interface. Less well known however, is the fact that the Cochlear Implant alone does not equate to hearing. There exists a significant risk that the ground-breaking, life-changing human-machine that is the Cochlear Implant may fall short of its maker’s hopes and dreams to ensure that hearing is the birthright of every child. There is a high risk of under-performance by the Cochlear Implant recipient if they do not mature their auditory brain through intensive stimulation so they can learn to listen and make sense of the sound enabled by the Cochlear Implant. This is a critical next step if they are to successfully interface with the Cochlear Implant and develop listening and spoken language. The Hear and Say Centre Brisbane, Australia, is engaged in on-going evidence-based research in the field of Auditory-Verbal Therapy through programs that adhere to the Principles of Auditory-Verbal Therapy (AG Bell Academy, 2007). Research conducted at the centre showed that as many as 79% or more children achieved average or above average language skills, and progressed at the same mean rate of development for listening, speech, and language compared with a matched group of hearing peers matched for initial language age and other parameters (Dornan, et al., 2011). The Centre recognized the need to share ‘best practice’ world-wide through its Hear and Say WorldWide e-Learning Program as described in Hastie & Chen, 2011. The program addresses the chronic shortage world-wide for trained and accredited Auditory-Verbal Therapists (AVTs) using innovative e-learning solutions.

While the human-bionic ear, the Cochlear Implant, is the first level of human-machine interface for the child with hearing loss, a second level of human-machine interface must build around the child to optimize outcomes. The e-learning programs used in the Hear and Say WorldWide e-Learning Program to train-the-trainers, who then pass on knowledge to the parents of children diagnosed with hearing loss, may be the second level in the human-cyber
interface. This is because it can provide cyber technologies that enable the wider, essential interface between the Cochlear Implant recipient, their care-givers, hearing professionals and communities world-wide.

The aim is to train more AVTs globally to significantly reduce the impact of paediatric hearing loss. Thus, new bionic technologies such as the bionic ear are one solution amongst others to the many physiological challenges that beset human-kind, but they are only a solution if their full potential is optimized. Training therefore is the true interface between human and machine, between the recipient and the technology. The e-learning solutions developed by Hear and Say WorldWide are designed to build a safety net of capacity around the individual learner, and in particular the professional supporting the child with hearing loss, by building strong, networked local and global communities which can support the world’s professionals.

**Literature Review**

Neuroscience is the new frontier in the understanding of early brain development. It is influencing all areas of education and in particular, the specialty area of paediatric auditory brain development. In this section we report on how recent findings on the development of brain circuitry provide a new vista on the development of human abilities such as cognition and auditory processing. In particular, these new data make an advance on the historical theories of brain development, specifically those of Rakic and Huttenlocher.

Rakic’s data (1986) suggested that synapses, the microscopic connections between neurons, grow during the first few months of development to reach a peak very early in life before dying off to levels seen in the adult. This peak was reported to occur somewhere between 3.5 months and four months of age in Macaque monkeys. Within a very short time following this peak, Rakic found that up to 50% of the synapses were eliminated. Furthermore, he reported that this profile was similar in all areas of the Cerebral cortex, including those involved in sensory processing, association, and executive functions such as cognition. These data suggested that circuitry involved in cognitive processing, that is the circuitry in the prefrontal cortex, developed in the same way as the circuitry in all other cortical areas. Based on these data it was believed that there is a very short period early on in life during which cortical circuits could change and adapt, beyond which the circuitry becomes ossified and immutable.

However, Huttenlocher’s study (1997) showed that synapses in prefrontal cortex continue to grow over a much longer period of time. Significantly, Huttenlocher revealed that the circuits in different cortical areas developed at different rates. Based on these data, Huttenlocher developed the theory that cortical circuitry involved in cognitive processing develops over a protracted period of time as compared to that in other cortical areas. During the ensuing years both research groups published further studies in support of their respective theories.

It is apparent then that contradictory data and diametrically opposed theories on cognitive development exist, making for difficult interpretation of the new information. However, it must be noted that the two main theories were based on data obtained from different species. Rakic obtained data from the macaque monkey whereas Huttenlocher obtained his data from the human brain. In August 2011 Rakic published data, sampled from the human brain, which
revealed a protracted period of circuit development and refinement in the prefrontal cortex and this is associated with cognitive processing. While these data were obtained through specific experimental design, both groups used the same method to reveal individual microscopic synapses.

While this method is useful in revealing the total number of synapses in the cerebral cortex, it reveals little about the degree of connectivity between neurons and circuit development. Ultimately, studying the total number of synapses may not necessarily reveal patterns of circuit growth and refinement as factors such as the neuron death, volumetric change in cortex, increasing vascularity, and increasing myelination during development may mask underlying trends in the development of cortical circuitry.

Recently, the Centre for Cognitive Neuroscience in partnership with Japanese collaborators at the Osaka University and Hear and Say, has applied a new methodology to the study of the development of cognition to allow for more a detailed study of the development of cortical circuitry. Specifically, this consists of a series of studies in which individual neurons in the cerebral cortex of macaque monkeys are injected with a fine glass electrode allowing visualisation of their entire structure, from birth to adulthood. In this way it is possible to chart the growth of individual neurons and compare and contrast their growth profiles with predictions based on the absolute number of synapses.

These experiments, performed by Elston in collaboration with Fujita, Oga and Okamoto (2009, 2010 a, b, 2011 a, b), funded by the Japanese Science and Technology Corporation, have revealed quite unexpected results. They found that by injecting pyramidal cells, the most abundant neuronal type in the cerebral cortex, that it was possible to reveal the cortical circuits involved in different types of processing develop at different rates. Moreover, the data reveal that pyramidal neurons in prefrontal cortex, that are usually associated with cognitive function, continue to grow new dendritic processes and establish new synaptic connections from birth through to adulthood. Furthermore, these experiments have revealed that whereas pyramidal cells in prefrontal cortex may continue to grow larger dendritic trees and develop new synaptic connections well into adulthood (Elston et al., 2009), those in the primary visual area attain their greatest size at birth and thereafter become increasingly smaller (Elston et al., 2010a). This new evidence shows that pyramidal cells in the auditory cortex also continue to grow new dendrites and form new synaptic connections over an extended period of time during development (Elston et al., 2010b).

In summary, the Elston et al. studies have shown that cells in the auditory cortex flourished and grew more branches for many months after the cells in the visual cortex had stopped growing (see also Elston, et al., 2011). This indicates a great potential for extended growth and wiring of the auditory brain areas. The potential for extended growth and wiring has implications not only for early intensive auditory stimulation in the optimal developmental period, but also for continued auditory stimulation as the child develops (Elston et al., 2010, b). Specifically, the continued neuronal growth may allow the brain to respond to the first sounds heard following cochlear implantation in children born with hearing loss.

The challenge then is to provide continuing auditory stimulation for children – for children with hearing loss and for all children. Studies demonstrate emphatically that the parents of
the child with hearing loss are integral to the Auditory-Verbal Therapy approach (Dornan, et al., 2009), as is their family, school and wider community – the child’s team. But the bigger challenge is to sustain and support this team. We examine the notion of community and the way communities communicate and connect, and how digital technologies and e-learning can be used to build sustainable communities.

We define a sustainable community as one in which members engage in moral dialogue on the meaning of community. Dialogue leads to the reaffirmation of new directions that in turn lead to more sustainable communities (Etzioni, 2000). It is clear that ‘dialogue’ is the key. This is reiterated by Krebs and Holley (2004, p 1) who say sustainable communities are built through improving internal and external interactions. This creates improved connectivity through an iterative process that they describe as knowing the network and knitting the network. An analogy can be drawn here between the network building that is required at community level and the growing of neural pathways in the brains of children as described previously. While Neuroscience is helping us to know the networks of the brain and Auditory-Verbal Therapy can be likened to the ‘knitting’ of neural pathways in the brains of children, digital technologies and e-learning are knitting the network around the individual to connect them to local and global communities. In our study we refer to this as the ‘micro-macro’ dynamic, as illustrated in Figure 1:

![Figure 1: The ‘micro-macro’ dynamic used to develop community networks by Hear and Say WorldWide](image)

At micro-level, we have the child with hearing loss and their parents working with an Auditory-Verbal Therapist to provide the intensive stimulation required to grow the child’s auditory brain. For Cochlear Implant recipients the ‘micro-macro’ dynamic analogy can be further extrapolated: these prototypical bionic humans represent the first human-machine interface. The human, at micro level, can connect to the world of sound and the macro world, via the Cochlear Implant. Thus, at micro level a local network of support around the child can build. It includes an inter-disciplinary team of teachers, doctors and medical specialists, social workers and local policy makers. Krebs and Holley describe this as a ‘vibrant community network’, and identify four stages:

1. Scattered Clusters
2. Single Hub-and-Spoke  
3. Multi-Hub Small-World Network  
4. Core/Periphery

Each stage is more adaptive and resilient than the one before and each provides a network map that can be used to guide future developments by revealing what is already known. This can also point to possible next steps for the ‘knitting’ of the network by the ‘weaver’. The Core/Periphery model (or Stage 4) is regarded as the ultimate stage and features network weaving by multiple hubs. It is a stable structure that can link to other well-developed networks in virtual and real locations. The key community members are located at the network core of Stage 4 and typically have developed strong ties between themselves.

At the centre of the ‘micro-macro’ dynamic and any vibrant community network is the micro – the individual and their local networks. However, a second or ‘macro’ level of support must form around the individual at ‘micro’ level if the outcomes achieved at ‘micro’ level are to be optimized. The child with hearing loss and, its parents and therapist need support that goes beyond local networks to include national and international communities and networks. Following Kreb and Holley’s analogy, it is at the ‘macro’ level that the network is finally ‘knitted’ and it. This is here that a second or ‘macro’ level of support needs to form around the individual at ‘micro’ level. This can be expedited and maintained through e-learning and through technology enabled ‘circuitry’ or networks. However, technology alone does automatically enable teaching and learning (Hastie, Chen & Smith, 2010). What is required is a ‘facilitator’, an e-learning manager, who is the conduit between the learner and the learning – the ‘weaver’. Such weaving enables critical dialogue to flow. This links the key community members are at the network core with those at the periphery. In this study the weaving or network creation was technology enhanced and enabled by the Collaborative Cyber Community (3C) Platform and the weaver, the conduit, was the Hear and Say WorldWide e-Learning Manager (Hastie, Chen & Smith, 2011). This combination of digital technologies and e-learning was used to build local, national and global networks for Hear and Say WorldWide (Hastie, Chen & Smith, 2010, Hastie, Chen & Kinshuk, 2009, Hastie, Chen and Kuo, 2007).

To reiterate, the work done at ‘micro’ level with the individual must be optimised at ‘macro’ level. The ‘macro’ ensures that the outcomes achieved at ‘micro’ level are shared more widely, more efficiently and more quickly. Thus the network is known at ‘micro’ level and knitted at ‘macro’ level. We now describe three instances in which a specialty paediatric hearing health and education centre has attempted to apply these principles.

**Research Methodology**

The methodological approach to this work is documented in other papers (Dornan et al., 1999-2011, Elston et al., 2007-2011, Hastie, Chen & Smith, 2009-2011). There are three approaches which we now describe. The first approach is ‘The Hear and Say Way’, developed by Hear and Say Brisbane Australia, to ‘grow brains’ in early childhood learners. It consists of descriptions of the use of Auditory-Verbal Therapy (AVT) at the Hear and Say Centre Brisbane, Australia, to optimize listening, speech and language outcomes for children with hearing loss using ‘bionic’ technology - the Cochlear Implant. The second approach
describes the use of ‘The Hear and Say Way’ to train Auditory-Verbal Therapists world-wide. We document e-learning solutions developed by Hear and Say WorldWide to train hearing health professionals, parents and others and thereby build capacity around the individual learner by building communities. The third approach describes the training of mainstream teachers to use ‘The Hear and Say Way’ to optimise the language development of early childhood learners with normal hearing. We now describe these in more detail.

1. Growing Brains in Early Childhood Learners Using ‘The Hear and Say Way’

In this section we describe an approach called ‘The Hear and Say Way’, developed by Hear and Say Brisbane Australia, to ‘grow brains’ in early childhood learners. The approach involves intensive auditory brain stimulation through Auditory-Verbal Therapy (AVT) to develop listening and speaking skills in young children. Hear and Say has used this approach for the past twenty years with children with hearing loss, while concurrently developing a network of support (Dornan, 2011). The approach consists of the combining of AVT Principles in a way that fosters life-long commitment and advancement of knowledge by child, parents, professionals and communities underpinned by the concept of targeting the child’s brain as the organ of hearing.

When Dornan (2009) founded the Hear and Say Centre in 1992, the field of Neuroscience was beginning to reveal its findings on early brain development and the Auditory-Verbal Therapy approach was achieving significant success in treating children with hearing loss to develop listening and spoken language. The challenge for Dornan and other hearing health professionals around the world was to convince parents, communities and politicians that listening and speaking are the birth-right of every child and that AVT was the best way to give children with hearing loss the chance to start in life with the listening and speaking skills required for cognitive and spoken language development.

This involved evidence-based research consisting of a longitudinal controlled study comparing the progress rate of a group of Hear and Say children with a matched group of children with normal hearing of the same language age. The study was undertaken to investigate the potential of AVT to set trajectories to optimize speech, language and self-esteem for the child (Dornan, 2011).

Because early diagnosis and identification of children with hearing loss is integral to the success of AVT, newborn hearing screening is essential. Universal newborn hearing screening was introduced in Queensland in 2006 and has resulted in a drop in the age of referral for hearing intervention and an influx at the Hear and Say Centre of children requiring treatment. The Hear and Say program involves full Audiological testing, decision-making around treatment and the fitting of hearing devices (including the Cochlear Implant), and an early intervention approach that is evidence-based, ongoing Auditory-Verbal Therapy provided by trained and accredited therapists. The Centre recognizes the need to build a team around the child with hearing loss to optimize outcomes and developed a ‘team’ approach to the treatment of children. This involves Therapists working side-by-side with the child and their parents or caregivers to teach the AVT listening and spoken language strategies. A high level of reliance is placed on parents and caregivers to continue the intensive AVT at home between AVT sessions.
2. Using ‘The Hear and Say Way’ to train Auditory-Verbal Therapists World-wide

In this section we describe the e-Learning Program developed by Hear and Say WorldWide to train and educate Auditory-Verbal Therapists (AVTs) to use The Hear and Say Way. This program was instigated to train more AVTs world-wide and thereby build capacity around individual children with hearing loss, their families and communities. It is based on the premise that more AVTs world-wide will provide children with hearing loss with spoken language development.

In 2010 the Centre received funding from the Ian Potter Foundation, Cochlear Ltd., and Education Queensland to develop two hearing health professional training courses for e-learning: the Intermediate (Level 1) and the Advanced (Level 2). An Education Queensland Senior Experienced Teacher was recruited from Brisbane School of Distance Education to manage the e-learning adaptations. Traditionally Hear and Say has used a Physical Face-to-Face mode of delivery for training AVTs. Course content had previously been developed by the Hear and Say Clinical Team, the subject matter experts. The original content comprised PowerPoint presentations with accompanying teacher notes. These were reformatted for e-learning using an instructional design template (Hastie, Chen & Smith, 2011) to create digital (asynchronous) resources which were uploaded to the Collaborative Cyber Community (3C) Platform (Chen & Wang, 2008; Chen & Ko, 2010), as shown in the screen-capture in Figure 2:
Figure 2: Hear and Say WorldWide e-Learning Intermediate Course resources on 3C

A Blended Learning mode of delivery, based on the Holistic Blended Learning Model was applied to Hear and Say WorldWide Programs as shown in the following Table:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(PA + PS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><img src="image" alt="Course Profile" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(PA + CA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(PA + CS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(PS + CA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(PS + CS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>(CA + CS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>(PA + PS + CA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>(PA + CA + CS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>(PS + CA + CS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(PA + PS + CA + CS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The optimal Blended Learning mode of delivery (PA + PS + CA + CS) was adopted for Level 1 and Level 2 Courses. A Learning Management System (The 3C Platform), was made available to Hear and Say through collaboration with National Sun Yat-sen University, Taiwan. A training program was conducted by the e-Learning Manager to train the Centre’s Clinical Team as Instructors in the synchronous cyber classroom. With the asynchronous resources available to participants 24 hours a day and seven days a week, and Instructors trained in the use of the synchronous tools, the first e-learning Course, the Intermediate (Level 1), was launched in June 2010.
In December 2010 the first Advanced (Level 2) Course was delivered in ‘Blended Learning’ (BC) mode via the 3C platform, as shown in the screen-capture in Figure 3:

Figure 3: Hear and Say WorldWide e-Learning Advanced Course Instructors and Participants working in the 3C synchronous cyber classroom

During 2011, three e-learning courses (Levels 1 & 2) were delivered via 3C. Participants joined with Instructors and fellow participants in weekly 3C synchronous cyber classroom sessions, with participants from Queensland, throughout Australia, and internationally (Papua New Guinea, Africa, the United Kingdom and Serbia).

Participants scored an average pass rate of 90% in their final examinations for these courses. Growing interest in the Hear and Say WorldWide e-Learning Courses resulted in courses being conducted continuously throughout 2011, with an extra Intermediate Course in Term 4 to meet demand from Queensland Health employees.

3. Training Mainstream Teachers to Use ‘The Hear and Say Way’ with Early Childhood Learners with Normal Hearing

In this third section, we describe the adaptation of the Hear and Say WorldWide e-Learning Program for use in mainstream education for children with normal hearing. Following the 4th International Conference on e-Learning at the Hamdan Bin Mohammed eUniversity Congress in Dubai, the Hear and Say WorldWide e-Learning Manager visited the Australian International School (AIS) in Sharjah, UAE, and met with the Principal and Staff. This meeting saw AIS Sharjah form a partnership with Hear and Say Brisbane to develop a Teacher Professional Development Program for AIS Junior School teachers. The Program was designed to overcome English language delay in early childhood learners at AIS. The AIS Sharjah Teacher Professional Development Program, based on ‘The Hear and Say Way’, was developed by Hear and Say WorldWide during 2011. The three month program was planned to commence in October 2011 and comprised four units or themes, namely:
Fourteen Topics were developed within these Units and planned using a series of Physical Face-to-Face (PF2F) and Blended Learning Workshops:

- Topic 1: The Hear and Say Way
- Topic 2: Auditory Brain Stimulation: the Key to Normal Development
- Topic 3: Listening and Hearing
- Topic 4: ‘Learning to Listen’ Sounds
- Topic 5: Optimal Listening in the Classroom
- Topic 6: Language Development
- Topic 7: Speech Development
- Topic 8: Cognitive Development
- Topic 9: Theory of Mind
- Topic 10: Literacy Development
- Topic 11: Books and Songs
- Topic 12: Top Ten Tips for Teachers
- Topic 13: Listening and Speaking at Home
- Topic 14: Integrating Developmental Goals

An instructional design template based on Gagne’s Nine Instructional Events (2004) was applied to each topic (above) to provide a pedagogically sound sequence of teaching and learning. The aim was to maximise the engagement and interactivity of participants during each Workshop whether delivered in Physical Face-to-Face (PF2F) or in Blended Learning mode.

In a further development during 2011, the Hear and Say WorldWide Teacher Professional Development Program, developed for AIS Sharjah, was used in a mainstream teacher professional development program in Australia. This program, The Hear and Say WorldWide - EQ Redlands Pilot Project ‘Brain Boost’, consisted of a partnership between the Hear and Say Centre Brisbane and Education Queensland Australia. This Pilot Project came about through ongoing collaboration between Hear and Say WorldWide and Education Queensland. The Project was conducted over two months from October to November 2011. It was a direct response to significant speech and language delay identified in early childhood learners (aged 3-5 years) in Education Queensland Preparatory classes in the South-East region of Queensland, Australia. The Pilot Project had two main foci:

1. A Teacher Professional Development Program based on ‘The Hear and Say Way’ for eleven participants: four Preparatory Teachers, four Principals, two Principal Education Officers (PEOs) from the Department of Education Training and the Arts, and one Librarian from the Redlands Council Library. The Program was designed to provide training to promote age-appropriate speech and language development in early childhood learners identified with speech and language delay.
2. A Parent-Community Awareness Campaign to promote ‘The Hear and Say Way’ to parents and community to reinforce the strategies used at school. The aim of this Program was to develop a model to build capacity long-term around children identified with language delay and to prevent speech and language delay in cohorts of early childhood learners beyond 2011.

The initial focus of the project, then, was the Teacher Professional Development Program for Preparatory teachers to train them to use ‘The Hear and Say Way’ in daily classroom practice. An e-learning strategy was developed for the Pilot Project to provide participants with access to the Program content on the Collaborative Cyber Community Platform (3C) and to the synchronous cyber classroom (JoinNet HomeMeeting). A second and major focus of the project was the Parent-Community Awareness Campaign to ensure strategies used at school were used by the children’s parents at home. Digital technologies and tools were planned to build a community of learners at ‘macro’ level to support individual students at ‘micro’ level, including the dissemination of information using existing networks such as the Redlands Council Library Literacy program.

It is anticipated that a successful Pilot Project in 2011 may lead to the Hear and Say WorldWide Teacher Professional Development Programs being offered in mainstream schools in Queensland and in other Australian states in 2012. The long-term aim of this initiative is to assist in reducing the speech and language delay in early childhood learners world-wide through teacher, parent and community education to optimise brain and language development for children from birth. This Program may also be offered in Indigenous communities to help ameliorate the effects of hearing loss (Otitis Media) in Aboriginal and Torres Strait Islander communities, and in developing nations in the Asia-Pacific region.

**Findings & Implications**

The major policy implications in this paper is that research from Neuroscience is revolutionizing the understanding of early brain development and cognition. It is apparent that the stimulation of the auditory brain is far more critical to the acquisition of speech and language than previously accepted, and that reduced stimulation either through hearing loss or lack of meaningful auditory stimulation represents a neurological emergency. For the approach described in this paper, an important implication is that early intervention for children with hearing loss is essential. If the aim is to optimise the neural plasticity of the young brain and develop audition and speech as the foundations for language and all further learning, then the work reported here is heuristic.

Second, the stimulation of the auditory area of the brain is best achieved using an evidence-based approach such as Auditory-Verbal Therapy and this has been demonstrated with success in young children with hearing loss. Intensive AVT, ‘The Hear and Say Way’, taught by accredited Auditory-Verbal Therapists at the Hear and Say Centre Brisbane, Australia, has enabled hundreds of children with hearing loss to graduate to mainstream education with age-appropriate speech and language skills.

Third, while ‘The Hear and Say Way’ is both life-changing and life-saving for the children with hearing loss in Hear and Say’s historical samples, the outcomes for mainstream
education are heuristic. Simply stated, intensive auditory stimulation can be shown to have generic power, then all early childhood learners from birth would probably benefit from participation in it. For example, significant speech and language delay have been detected in normal hearing early childhood learners in the United Arab Emirates and Queensland. The Hear and Say WorldWide Teacher Professional Development Programs based on The Hear and Say Way is designed to ameliorate this.

Finally, the use of digital technologies and e-learning is an essential element in the development and support of these programs. In particular, the Hear and Say WorldWide e-Learning Program is successful in training Auditory-Verbal Therapists to meet the growing need for children with hearing loss to access AVT. This applies equally to the training of parents, teachers and communities at ‘micro’ level whether they are supporting a child with hearing loss or normal hearing, and to the building of capacity at ‘macro’ level to grow sustainable global communities and networks. As the world’s population grows, it can be anticipated that the need for AVT will grow. The programs described in this paper contribute to the collective duty of care to ensure that children who can benefit from Hear and Say programs receive them.

Given the global problem that is paediatric hearing loss, the extension of existing research and development at the Hear and Say Centre can make a contribution to ameliorating the impact of paediatric hearing loss world-wide. By combining Hear and Say’s instructional program and delivery skills and resources with the Centre for Neuroscience’s research expertise, a significant contribution can be made to knowledge and applications of early brain development, particularly the auditory brain, and Auditory-Verbal Therapy (AVT). Moreover, research based on the Cochlear Implant, is beginning to unravel the intricacies of the human-machine interface and emerging bionic technologies, such as the bionic eye. Finally, the use of sophisticated e-learning solutions to train-the-trainer, have already created capacity in staff use of networked global communities to bridge cultural and wealth barriers. These promising directions have potential payoff for children with hearing loss and for mainstream education from early childhood onwards.

Conclusions

In this paper we reported on research undertaken by Hear and Say Brisbane and supported by Neuroscience on the potential to grow neural pathways in the auditory brain. This new information has changed our understanding of early brain development and is highlighting the critical need for intensive auditory stimulation from birth. It is informing the work of a specialty paediatric hearing health and education centre, Hear and Say Brisbane Australia, in which intensive auditory stimulation, Auditory-Verbal Therapy, has been used to ‘grow brains’ in young children in the period after surgical implantation of the Cochlear Implant. We reported also on the use of e-learning by Hear and Say WorldWide to train more Auditory-Verbal Therapists to reduce the impact of paediatric hearing loss globally, and the recent adaptation of these programs for use in mainstream education by teachers working with early childhood learners with normal hearing. Through the use of digital technologies and e-learning, life-changing education programs like ‘The Hear and Say Way’ are being shared globally to train more trainers to train more children, parents and communities. With hearing loss being the most common disability in newborns world-wide, and with a growing
demand for intervention in the language development of early childhood learners with normal hearing, the need is immense. However, the solutions are found in the combination of intensive auditory stimulation, Auditory-Verbal Therapy, and e-learning as reported in this paper.

Acknowledgements

This research was supported by the National Science Council, Taiwan under project numbers NSC99-2511-S-110-004-MY3, NSC99-2631-S-011-002 and NSC100-2511-S-110-001-MY3.

References


Hastie, M., Chen, N.S. & Smith, R. (2010). The Role of the e-Learning Manager in Re-engineering Educational Paradigms. Presented at the 2011 Hamdan Bin Mohammed e-University (HBMeU) Congress, Dubai, UAE.


