Early Childhood Educ J (2008) 35:571–577
DOI 10.1007/s10643-007-0223-2

Childcare Workers' Knowledge About the Brain and Developmentally Appropriate Practice

Debby Zambo

Published online: 21 December 2007

Abstract Advances in neuroscience are providing information about the brain and its development. Some researchers propose that childcare workers need to understand this information because it confirms their importance and their use of developmentally appropriate practice (DAP). Given the fact that childcare workers could benefit from this insight, it seems reasonable to ask where they get their information about the brain and what they know about the brain and DAP. The purpose of this exploratory study was to investigate these questions by surveying a group of 59 childcare workers from three different centers. Results indicate these childcare workers prefer to get their information from workshops. They knew most about interactions and things that can harm the developing brain. They knew significantly less about brain development. Implications from these findings point to the importance of offering workshops with sound scientific information.

Keywords Childcare workers · Brain development · Developmentally appropriate practice · Professional development

Introduction

During the 1990s technology paved the way for scientists to gain a better understanding of brain structures and functions, brain development, and what happens to a young child's brain when it is deprived of the affection it needs (Mead 2007). Scientists have provided insight and the general public, including parents and early childhood educators, have become interested in learning about the brain, its development, and the types of stimulation it needs. Interest in the brain has spawned many articles devoted to helping parents and teachers create enriched environments deemed to make children smarter, more motivated, and better behaved. For example, *Newsweek* published "Your Child's Brain" (Begley 1996) which claimed that the environment was so powerful it could completely change a child's psychological, emotional, and cognitive trajectory. Likewise, *Parade* magazine in the Sunday paper published "Age of Discovery" (Noonan and Stout 2003) that claimed to provide the "latest cutting-edge scientific news" on how infants learn and what caregivers and educators can do to ensure a bright and healthy child. As evidenced by these examples it seems reasonable to believe that interest in the brain, its development, and its needs has become popular in the everyday press.

In addition to the many articles targeting parents and early childhood educators, many books have been written on brain development as well. Visit any bookstore and it is likely you will find a title like *125 Brain Games for Baby: Simple Games to Promote Early Brain Development* (Siberg 2001) in the shelf. Information about the developing brain is also readily available on the Internet. There are Blogs and Wikis where parents and teachers can discuss the development of their children along with websites full of information and services promising to make children smarter, more creative, and better able to learn. Parents and teachers want their young children to be ready for formal schooling, however, if the products and services they purchase promote inappropriate practice they can do more harm than good.

Many manufacturers and authors like those cited above promote the idea that the first 3 years of a child's life are

D. Zambo (✉)
College of Teacher Education and Leadership,
Arizona State University, P.O. Box 37100,
Phoenix, AZ 85069-7100, USA
e-mail: debby.zambo@asu.edu

critical to all future learning and success. They base their claims on the idea of "windows of opportunities" and the fact that unused neurons get pruned away (Farran 2001). While there is no doubt that early experiences are important there is often fallacious reasoning behind many ideas proposed and because of this teachers of young children are being expected to provide more direct and formal instruction (Mead 2007). This is unfortunate and unnecessary because research indicates windows of opportunity are open longer than expected and that the pruning of unused neurons is a normal and healthy process (Neville and Bavelier 2002).

Research shows experience guides and shapes brain development and environments with natural circumstances are best. The brains of young children do not learn from fancy toys or information that is too ridged or too abstract. They do learn from everyday face-to-face interaction with adults who talk to them, hold them, and nurture them in a loving and natural way (Rushton and Larkin, 2001). Unfortunately, many individuals and companies are using facts from neuroscience to create unrealistic timelines and expectations about learning. They make big promises that their products can accelerate brain development and wire the brain to learn efficiently, when in reality factors that influence brain development are much more complex (Stamm 2007).

While some cash in on brain research, others are dedicated to helping teachers understand and utilize the potential from neuroscience to better understand the children in their lives. These individuals take a more conservative view of what neuroscience can provide. They do not make broad generalities about critical periods or big promises of enrichment. Instead they discuss brain development in the context of genetics, the environment, and culture. For example, in the book in *From Neurons to Neighborhoods: The Science of Early Development* by the National Research Council Institute of Medicine (2000) the researchers and scientists who authored this volume integrate findings from neuroscience, biology, psychology, and genetics to help parents and early childcare workers understand the effect of surrounding contexts on their children and their developing brains.

Another group that is working diligently to help parents and teachers understand young children, how they learn, and the type of environments they need is the National Association for the Education of Young Children (NAEYC). Their position statement on developmentally appropriate practice (DAP) speaks to both typical and unique developmental patterns and the need for a constructivist approach (Bredekamp and Copple 1997). NAEYC has a website (www.naeyc.org) with useful and practical information derived from sound research. They also offer several publications, one of them titled *Young Children* that translate scientific information into practical strategies for classroom use. Groups like NAEYC and the National Institute of Child Health and Human Development (2000) are trying to link brain research with research on DAP in an honest and useful way.

Given the potential usefulness of this information it seems reasonable to wonder where childcare workers get their information about the brain and what they know about the brain and DAP. However, when a search was conducted no previous studies containing this specific information was found. This is an important oversight. The purpose of this initial exploratory investigation was to fill the present gap. Using an assessment instrument the researcher attempted to: (1) uncover what sources a group childcare workers use to get information about the brains of young children, (2) investigate what a group of childcare workers knew about the brain pertaining to sensitive periods, development, and harm, and (3) investigate what a group of childcare workers knew about a broad range of topics related to the brain and DAP pertaining to interactions, learning, the environment, and the classroom.

Methods

Participants

Participants in this study came from three childcare centers in contact with a non-profit group the researcher was aware of through its Director. Participants included 59 childcare workers from three different centers. There were 28 participants from Center 1(C1), 14 participants from Center 2 (C2), and 17 participants from Center 3 (C3). Each individual who participated worked with children 5-years-old or younger. Centers were all located in a large metropolitan city in the state of Arizona. Accreditation was held by two of the centers. The National Accreditation Commission for Early Care and Education Programs (NAC) accredited C1, the NAEYC accredited C2. C3 was relatively new and working toward NAEYC accreditation.

Complete demographic information of the childcare workers in this study including ethnicity, age, educational level, job status, and years of experience is provided in Table 1.

Materials

The purpose of this exploratory study was to examine where a group of childcare workers get their information about the brain development and what they know about the brain and DAP. To gather these data an assessment was developed. The first page of the assessment asked for demographic information without a name. In addition to demographic information the childcare workers were asked

Table 1 Demographic information and work experience of participants by center

	C1 ($n = 28$)	C2 ($n = 14$)	C3 ($n = 17$)
Ethnicity			
Native American	2	1	0
Asian	1	0	0
African American	5	1	0
Hispanic	6	11	0
White	12	0	17
Missing	2	1	0
Age (years)			
Under 20	3	0	1
20–29	8	7	7
30–39	2	5	3
40–49	6	2	1
Over 50	9	0	5
Educational level			
Working toward GED	1	0	0
High school	3	2	2
Vocational school/some college	16	7	9
Undergraduate degree	4	2	3
Some graduate school	2	0	0
Graduate degree	2	3	3
Job status			
Full-time	25	12	16
Part-time	3	1	0
Missing		1	1
Working with young children (years)			
0–2	5	4	5
3–5	7	6	4
6–10	8	3	2
Over 10	8	1	6

to indicate where they typically get information about the brains of young children. Several options (e.g., magazines, television, Internet, workshop, etc.) were offered and participants were asked to mark all sources that applied.

The rest of the assessment contained 40 items designed to understand participants' knowledge about brain development and the brain and DAP. Each item on the assessment contained a statement with the choices *true*, *false*, or *don't know* below. Participants indicated their choice by marking an X in the box next to it. The *don't know* choice was provided as an option so participants who were unsure of an answer could indicate their uncertainty. It was anticipated that this format would minimize guessing and provide a more realistic measure of the childcare workers' knowledge.

Questions on the assessment focused on two overarching target areas (1) knowledge of brain development and (2) knowledge of the brain and DAP. These target areas were further subdivided. Knowledge of brain development was divided into three categories: sensitive periods, development, and harm. Likewise, knowledge of the brain and DAP were subdivided into four categories: interactions, early learning, the environment, and the classroom.

Table 2 Mean values and standard deviations for the two target areas and their categories by group

	C1 ($n = 28$)		C2 ($n = 14$)		C3 ($n = 17$)	
	Mean	SD	Mean	SD	Mean	SD
Overall assessment	0.74	0.16	0.76	0.18	0.81	0.08
The brain						
Sensitive	0.72	0.30	0.73	0.23	0.81	0.18
Development	0.57	0.25	0.61	0.34	0.50	0.23
Harm*	0.74	0.29	0.85	0.24	0.98	0.06
Entire target area	0.67	0.25	0.72	0.22	0.75	0.10
The brain and DAP						
Interactions	0.86	0.24	0.85	0.23	0.94	0.10
Learning	0.69	0.21	0.76	0.19	0.80	0.14
Environment	0.76	0.19	0.85	0.19	0.85	0.13
Classroom	0.86	0.16	0.71	0.20	0.85	0.19
Entire target area	0.80	0.12	0.79	0.16	0.86	0.09

* $p < 0.01$

To support content validity of the assessment all questions were based on information published in *Neurons to Neighborhoods* (National Research Council Institute of Medicine 2000) especially Chapter 8 "The Developing Brain." This source was utilized because it was written by a committee of 17 experts who were sponsored by groups like the National Institute of Mental Health, Centers for Disease Control and Prevention, and the Office of Special Education. A copy of the assessment is provided in the Appendix.

Results

Information Sources

In regard to where early childcare workers get their information about the brain and its development, results indicate most participants receive their information from workshops (45, 76%) followed by magazines (36, 61%), the Internet (35, 59%), courses (26, 44%), and television (21, 36%). The source least marked was radio (2, 3%). Participants indicated multiple sources with a mean of 3.7 sources per participant.

Participants' Knowledge

Overall reliability of the assessment was high with a coefficient-alpha of 0.86 for the combined 40 items.

Reliability was also high (0.82) for the 18 items related to the brain. Reliability was lower (0.63) for the 22 items that related to the brain and DAP.

The mean score and standard deviation for the whole group ($n = 59$) on the overall assessment was 0.77 (0.15). The mean values and standard deviations for the two target areas of the brain and the brain and DAP were 0.71 (0.21) and 0.81 (0.12), respectively. A paired sample *t*-test [t (58) = 5.875, $p < 0.01$] indicated that the mean values for knowledge about the brain and DAP were significantly different with participants scoring higher on questions relating to DAP.

The group mean values and standard deviations for the three categories within the knowledge target area were: harm 0.84, (0.25), sensitive periods 0.75 (0.26), and brain development 0.56 (0.27). Paired sample *t*-tests indicated that the mean for harm was significantly higher than the mean for sensitive periods [t (58) = 3.115, $p < 0.01$] and that the mean for sensitive periods was significantly higher than the mean for brain development [t (58) = 5.096, $p < 0.01$].

The group mean values and standard deviations for the four categories within the knowledge about the brain and DAP target area were: interaction 0.88 (0.21), classroom 0.82 (0.19), environment 0.81 (0.18), and learning 0.74 (0.19). Paired sample *t*-tests indicated that the mean for interaction was significantly higher than both the mean for environment [t (58) = 2.837, $p < 0.01$] and the mean for learning [t (58) = 4.663, $p < 0.01$]. In addition, both the mean for classroom [t (58) = 2.313, $p < 0.03$] and the mean for environment [t (58) = 2.313, $p < 0.03$] were both significantly higher than the mean for learning.

In addition to the whole group mean values presented above, mean values for whole test, the two target areas, and the seven categories were also computed for each of the three childcare centers. A one-way multivariate analysis of variance was conducted to determine the effect of center (C1, C2, and C3) on the three categories related to the brain (sensitivity, development, and harm). Significant differences were found among the three centers on the three categories, Wilks Lambda = 0.714, F (6, 108) = 3.03, $p < 0.01$. Analyses of variances (ANOVA) on each dependent variable were conducted as follow-up tests. The ANOVA on harm was significant, F (2, 56) = 5.348, $p < 0.01$; the others were not. This information is graphically displayed in Table 2.

Discussion

The purpose of this study was to investigate where a group of childcare workers get their information about the brain and what they knew about the brain and the brain and DAP. The following discussion is broken into these two parts.

Information Sources

The childcare workers who participated in this study use multiple sources of information with a mean of 3.7 sources per participant. The use of multiple sources confirms that information about the brain is seeping into their lives and they, like many others, appear to be interested in learning about the brains of young children. When asked about the sources they used 78% marked workshops. Thinking about the participants' job status, age, and educational level may provide some insight into this choice. Of the 59 childcare workers surveyed all were female, 53 were employed full-time, most were between the ages of 20 and 29, and for most, their highest level of education was vocational school or some college. Given these demographics and the nature of the typical workshop, one can deduce why this choice was so popular. Being young, working women (most with no college experience), it is likely that they chose workshops because they best fit their needs. Workshops typically are short and practical. Workshops geared toward teachers often provide hands-on "make-and-take" ideas that can be immediately used in a classroom. Most workshops last only a few days and are often offered at convenient times like evenings and weekends. Employers often encourage their employees to attend workshops by paying their registration fees or allowing space and time for workshops to be presented at the work site. These characteristics may explain why this source of information was most utilized by these childcare workers.

In contrast, fewer than half (44%) of the participants marked coursework and thinking about the typical nature of coursework may provide insight. Coursework entails more time, dedication, and resources because it is typically connected to universities or community colleges. Courses often run for 15 weeks and demand 3 h of in-class time plus the same, or more, additional time outside. Furthermore, courses can be expensive and a textbook is often needed on top of registration fees.

Other popular sources marked were magazines (36%) followed by the Internet (35%) and turning once again to the demographics of this group may lend some credible insight. All of the childcare workers in this study were female and most were 20–29 years of age. Given this fact it is likely that they are busy with outside interests and families of their own. It is likely that the women in this study use magazines and the Internet because these sources provide up-to-date information in a brief, digestible form. Interest in magazines and the Internet is definitely a positive finding but it could also be detrimental if the sources these childcare workers are reading lead to misinformation or developmentally inappropriate practice. Data from this study indicate that these childcare workers read magazines and Internet sources but further research into specific

sources is warranted before any definitive conclusions can be made.

The least chosen source for information was the radio (3%) and thinking about the demographics and the nature of radio broadcasts may provide insight as to why. Talk radio and public radio are the most likely sources for scientific news but these broadcasts are typically offered at limited times. In contrast, 36% of the childcare workers in this study said that they get their information from television. Public television, channels that focus on health and wellness, and science channels sometimes provide programs about the brain and its development. These participants are more likely to access this information than the radio. A possible reason may be the fact that television programs are often aired in the evening and get translated into videos. However, before any definitive conclusions can be made more research is needed.

Participants' Knowledge

In regard to participants' knowledge about the brain and the brain and DAP these childcare workers knew a fair amount ($M = 0.77$). This is definitely positive and shows these workers really do have some insight. Information about the brain seems to be filtering into their lives. Further investigation into each of the target areas reveals that this group knew significantly more about the brain and DAP than they knew about the brain. This group of childcare workers knew more about the brain in the context of the classroom. They recognize that interactions and environments with predictable and responsive care are important to the developing brain. In contrast, they knew significantly less about the specifics of the brain and its development. Turning to the demographics may provide insight. Only 19 of the 59 participants had a college degree and given this fact, it seems reasonable to speculate that they have more tacit knowledge from their experience in classrooms than scientific knowledge about the brain from research. Using tacit knowledge is not necessarily bad but it can be a hindrance when it comes to teaching and working with young children. Many times what seems simple and obvious on the surface is really very complex and matters much to children. While being a skilled childcare worker demands practical knowledge it also demands knowledge about child development and child psychology that comes from science. Perhaps if these childcare workers become more informed about brain development they would come to understand why their simple face-to-face interactions and words are what the children in their care need. Perhaps it could even help them better understand that some of the expectations being placed on them to raise achievement before windows of opportunity close are unwarranted. While this study does not explain if these childcare workers use what they know about the brain and DAP in their classrooms it does provide some initial insight into just how much they know. However, before definitive conclusions are drawn more investigation is warranted.

Each target area was also examined to see what these childcare workers knew most within them. When it came to the brain they knew more about harmful things and less about sensitive periods and brain development. The fact that these childcare workers knew most about harm is definitely a positive finding because they are often the first to notice abuse and neglect in young children. In contrast, these childcare workers knew less about sensitive periods. They knew the least about when specific brain systems develop and how systems relate and interact.

When it came to knowledge about the brain and DAP this group of childcare workers knew significantly more about the importance of interacting with children and less about the classroom, environment, and learning. As elaborated above it is likely that this knowledge comes from their everyday experience. They learn how classrooms should function from each other, lead teachers, and Directors at their site. Learning was the lowest category in this target area with a significant difference between it and the other three. When it came to understanding the specifics of learning in young children these childcare workers did not fare well.

Implications

Understanding how the childcare workers in this study get their information from workshops could be valuable for their Directors and others interested in their education and professional development. Providing information on upcoming workshops, helping childcare workers access to them by paying their fee, and offering workshops on site could help them gain the information and training they need. Data from this study indicate that these workers scored lowest in the areas of brain development and learning and workshops could focus on these areas.

Given the vast amount of new information about the brain and its development and the many products targeting childcare workers, it may also be beneficial if those concerned with their development empower childcare workers with strategies to discern scientific fact from speculation. These workers use multiple sources for their information and three ranked highly were magazines, the Internet, and television. Given this Directors and others concerned with their professional development may want to consider providing childcare workers with access to magazines like *Young Children* and websites like the NAEYC's.

Finally, many of these childcare workers were attuned to the fact that neglect, abuse, and stress can harm a child's developing brain. This finding was positive because they are in touch with children every day. Therefore, helping childcare workers recognize the signs of neglect and abuse is important, as is helping them recognize the signs of maternal and family stress. It is important that childcare workers be knowledgeable and be aware of public agencies that offer assistance to families in crises. Childcare workers are the first line of defense for the children in their care.

Appendix: Traget areas and individual items under each target area

Sensitive periods
There are sensitive periods of brain development when a child's brain is vulnerable to the absence of certain experiences.
The brain's sensory systems need certain types of experience to develop.
The brain's language system does not have a sensitive period of development.
The brain's emotional system has a sensitive period of development.
Critical brain structures needed for learning are easy to change, especially in elementary school.
Brain development
Major sensory systems of the brain get wired after the age of three.
Regions in the brain that serve reading are established late in childhood.
Memory regions of the brain depend on healthy social-emotional development.
The ability to pay attention develops during the preschool years.
Maternal stress or depression can change how a baby's brain develops.
Fifty percent of the brain's growth is complete by age three.
Biological systems for emotional health wire up after a child turns three.
Harm
Neglect has little effect on the structure of a young child's brain.
Abuse can change the structure of a young child's brain.
Chronic stress at high levels rarely changes the structure of a young child's brain.
Children under chronic stress rarely experience developmental delays in their cognitive abilities.
Children under chronic stress experience delays in their social skills.
It is easy to rewire a brain that has been abused.
Interactions
In order to "wire-up" in a normal, healthy way, a child's brain needs predictable, responsive care.
A caring adult who hugs a child often is helping that child's brain "wire" in a normal healthy way.
An adult who frequently talks to a child is helping that child's brain "wire" in a normal healthy way.
Emotional communication between a child and a consistent caregiver is critical to wiring the brain.
The kinds of care young children receive have little effect on their later ability to regulate their emotions.
Bonding is the most important factor in wiring the brain for intellectual development.
Learning
The brain is wired early for vision so learning begins with vision.
It takes expensive toys to wire up a thinking brain.
There are purposeful ways to work with young children to encourage the development of sustained attention.
A child in a state of anxious vigilance is ready to learn.
Early music training provides practice for the brain in pattern detection and tone.
Environment
In a young child's environment it helps to frequently change the objects.
In a young child's environment it helps to frequently change the people.
A secure environment has little influence on wiring up a brain in a normal, healthy fashion.
The brain of a child who lives in a chaotic, unpredictable environment rarely becomes over reactive to stress.
The brain of a child who lives in an unpredictable environment is unlikely to develop attention problems.
Brain structures that process language sounds are wired rapidly in response to what a young child hears.
Classroom
It should be a priority for preschool teachers to teach children to add and subtract.
The main reason for classroom routines is to help children learn how to regulate their behavior.
The main reason for classroom routines is to keep the teacher organized.
The main reason for classroom rituals is to help children feel safe and secure.

References

Begley, S. (1996, February 19). Your child's brain. *Newsweek*. (Special Edition)

Bredekamp, S., & Copple, C. (1997). *Developmentally appropriate practice in early childhood education programs*. Washington, DC: National Association for the Education of Young Children.

Farran, D. C. (2001). Critical periods and early intervention. In D. B. Bailey Jr., J. T. Bruer, F. Symons, & J. Lichtman (Eds.), *Critical thinking about critical periods* (pp. 233–266). Baltimore, NH: Paul Brooks Publishing.

Mead, S. (2007). Million dollar babies: Why infants can't be hardwired for success. Retrieved June 1, 2007, from http://www.educationsector.org

National Institute of Child Health, Human Development. (2000). *From neurons to neighborhoods: The science of early development*. Washington, DC: National Academy Press.

National Research Council Institute of Medicine (2000). *From neurons to neighborhoods: The science of early childhood development*. Washington, DC: National Academy Press.

Neville, H., & Bavelier, D. (2002). Human brain plasticity: Evidence from sensory deprivation and altered language experience. *Progress in Brain Research, 138*, 177–188.

Noonan, P. J., & Stout F. (2003, Jan 17–19). The age of discovery. *Parade*, 6–7.

Rushton, S., & Larkin, E. (2001). Shaping the environment: Connecting developmentally appropriate practices to brain research. *Early Childhood Education Journal, 29*(1), 25–33.

Siberg, J. (2001). *125 Brain games for baby: Simple games to promote early brain development*. New York: MJF Books.

Stamm, J. (2007). *Bright from the start: The simple science-backed way to nurture your child's developing mind, from birth to age 3*. New York: Gotham Books.