COGNITIVE DEVELOPMENT CONSIDERATIONS IN PRESCHOOL FIRE SAFETY EDUCATION

STRATEGIC ANALYSIS OF FIRE PREVENTION PROGRAMS

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ABSTRACT

According to the National Center for Health Statistics (NCHS), data from the National Vital Statistics System show that the 1991 death rate from fire and burns for children age one to four was 4.1 per 100,000 population. This compared to a rate of .92 per 100,000 population for children aged 5 to 19. One of the problems associated with reaching this high-risk group, given their age and related thinking skills, is making the limited opportunities to teach preschoolers fire safety as meaningful to them as possible.

The purpose of this research project was to establish some basic criteria for the evaluation of fire safety lessons for preschoolers, in consideration of their unique cognitive abilities.

A descriptive research procedure was conducted to determine the current theories of educational psychology, as they relate to the cognitive development of preschoolers. This research project studied the cognitive abilities of preschool children, including teaching strategies, and made application of the results to teaching fire safety and evaluating current programs. Research questions to be answered included the following:

1. What are some of the basic principles of learning?

2. What cognitive processes occur in children?

3. How are those processes different in children than adults?

4. What are some characteristics of fire safety lesson plans developed in consideration of the unique cognitive abilities of preschoolers?

5. How do current Muscatine Fire Department fire safety lessons for preschoolers fit those characterizations?

The physiology of brain development was researched, along with teaching strategies directed at that particular age group of children. On the basis of that information, an association was made between general teaching concepts and specific fire safety messages. Current fire safety programs of the Muscatine Fire Department were evaluated against those conclusions, and modifications were made to programs where indicated by the research.

Recommendations were made to change certain portions of the preschool programs that are currently in use where it appeared that language, terminology, or the method used were not consistent with the cognitive abilities of the children.

The findings of the project included a distinct need to consider the cognitive abilities of the audience. On the basis of the research, it was apparent that changes in the programs were necessary in order for the messages to be as meaningful as possible for this high-risk group, with whom our opportunities to teach are limited.

INTRODUCTION

Problem Statement

According to the National Center for Health Statistics (NCHS), data from the National Vital Statistics System show that the 1991 death rate from fire burns for children age one to four was 4.1 per 100,000 population. This compared to a rate of .92 per 100,000 population for children aged 5 to 19. One of the problems associated with reaching this high-risk group, given their age and related thinking skills, is making the limited opportunities to teach preschoolers fire safety as meaningful to them as possible.

Purpose Statement

The purpose of this research project was to establish some basic criteria for the evaluation of fire safety lessons for preschoolers, in consideration of their unique cognitive abilities.

A descriptive research procedure was conducted to determine the current theories of educational psychology, as they relate to the cognitive development of preschoolers. The physiology of brain development was researched, along with teaching strategies directed at that particular age group of children. On the basis of that information, an association was made between general teaching concepts and specific fire safety messages. Current fire safety programs of the Muscatine Fire Department were evaluated against those conclusions, and modifications were made to programs where dictated by the results.

Research questions to be answered included the following:

1. What are some of the basic principles of learning?

2. What cognitive processes occur in children?

3. How are those processes different in children than adults?

4. What are some characteristics of fire safety lesson plans developed in consideration of the unique cognitive abilities of preschoolers?

5. How do current Muscatine Fire Department fire safety lessons for preschoolers fit those characterizations?

BACKGROUND AND SIGNIFICANCE

In 1991 (NCHS) 620 children under the age of five died as a result of fire and burn injuries. At a rate of 4.1 deaths per 100,000 population, this represents a rate over four times that for children aged 5 to 19, which was .92 per 100,000 population. Children in that age group are considered to be a high-risk group because of the high incidence of fire related to them, and the disparate effects of fire on them. Preschoolers are typically ill-prepared to respond in a meaningful way to a life-threatening situation. They are as likely to hide from fire as to flee, and they are largely dependent upon adults to make their environment fire-safe, as well as to rescue them when those efforts fail.

They are a difficult group to reach with fire safety messages, for a number of reasons. One problem is accessing them in the first place. Many children do not attend an organized preschool prior to entering kindergarten. Another problem is their age, as it relates to their ability to understand and remember the fire safety messages that were presented to them.

Many firefighters have taken on the role of educator, in an attempt to reduce the incidence of fire, with particular emphasis on the at-risk groups. While the intent is good, there should be some consideration given to the abilities of very young children to grasp the messages the firefighters are trying to send. The mechanics of the learning process is a very complex subject, but one that should not be ignored in the program development process. Mayer (1987) stated the following:

> The child is not a miniature adult who lacks only great quantities of knowledge. Instead, the child at any stage possesses modes of representing and processing information that are quite different from adult thinking. Thus instructional experiences will be useful only if they are matched to the child's level of cognitive development (pp. 42-43).

The relevance of this project to the Muscatine Fire Department lies in the extensive fire prevention programs conducted in the school system on an on-going basis. A formal written curriculum for preschoolers is currently in the development process. In addition, firefighters present programs to children, beginning in the preschools, throughout the elementary grades. The written curriculum, intended to be presented by the preschool teachers during the school year, will be supplemented with the presentations made by firefighters.

Likewise, the effectiveness of preschool public education, whether accident prevention generally, or fire protection specifically, is directly related to the National Fire Academy course, *Strategic Analysis of Fire Prevention Programs*. Given the few opportunities fire safety educators have to reach this

high-risk group, it is imperative that the messages have a meaningful impact on the children.

LITERATURE REVIEW

The Literature Review began with research on basic brain structure and function. Thinking, learning, understanding, and processing of information are all functions of the brain. Healy (1987) describes a process of brain cell formation, beginning as early as three weeks after conception, multiplying faster than any other body cells, until approximately six months after birth.

Dr. Paul MacLean, of the National Institute of Mental Health, describes it as a triune brain, or three distinct structures tied together (Healy, 1987, p. 15). At the base of the brain, rooted below the level of consciousness, is a layer responsible for instinctive behaviors such as feeding, socialization, and territorial behaviors. This area is known as the *r-complex*.

The *limbic system*, which lies on top of the r-complex, is the seat of emotion. Like the r-complex, it functions without input from the rational, intellectual areas of the brain. This area, according to Healy (1987), "... confers tendencies to nurture the young, to flee when frightened, and to play" (p. 16), providing a hidden agenda for our behavior, which may play into our ability, or lack thereof, to control feelings.

The top layer, the *cortex*, lies like a blanket over the lower areas. The cortex is responsible for, among other activities, vision, hearing, and spatial understanding (Healy, 1987). As Healy describes it. "At birth it is like an untracked plain, but it soon begins to increase its topography of folds and fissures, its surface area, and its thinking power.... The first two years are a period of dynamic growth for the cortex" (p. 18). Healy's narrative of subsequent brain development includes the description of a process of nerve cell growth which is enriched by repeated use. The last part of the cortex to develop fully is the portion responsible for reasoning, memory, and judgment. It is a very complex process, not entirely understood, but, "The more work the brain does, the more it becomes capable of doing" (p. 19), progressing geometrically.

In order to fully understand the development of the information processing function of the brain, a basic understanding of the brain cell function is necessary. The information transmitters of the brain are called *neurons*. Appendix A shows diagrams of mature and immature neurons. Messages travel from neuron to neuron from the *dendrites*, through the cell body and the *axon*, to the *axonic* fibers. The area where the axonic fibers of one neuron and the dendrites of the next approach is called the *synapse*. Messages travel from

neuron to neuron through this space, known as the *synaptic cleft* (McConnell, 1989).

The difference between an immature and mature neuron, in part, is the development of the dendrites and the axon. As the brain is stimulated through what is heard, felt, tasted, etc., the neurons fire the messages from one to another, building new physical connections. The brain cells which develop synapses grow and develop, and those that don't, die. Stimulated connections are strengthened by repeated use (Healy, 1987).

In addition, there is a natural maturing process, called *myelination*, where the message-sending component of the neuron develops, which speeds messages through the system. Prior to that maturation, messages are sent, but erratically and inefficiently. As described by Healy (1987):

> The order of myelination formation is set by nature; overall, it starts at the top of the spine and moves up to higher, more complex, brain structures.... Common sense tells us that it is useless to try and get a newborn to walk alone, but at about one year, when those connections have myelinated, it may be difficult to prevent. Myelin formation appears to occur in cycles that precede the child's mastery of increasingly complex learning (p. 26).

In the context of brain development, then, we may try to force instruction on the children, but trying to speed the process through unfinished neural pathways, in manners inconsistent with their developmental abilities, may be counterproductive. Healy (1987) states, "There is good evidence that environments which provide appropriate and loving stimulation facilitate brain development" (p. 22). Healy warns that there is an appropriate amount of stimulation, and that overstimulation can cause emotional pressures which inhibit the ability of the neurons, the information transmitters of the brain, to send or receive the desired signals. Healy states:

> So, although we can certainly stimulate development of cell networks when they are ready, many aspects of this growth cannot be rushed... It is possible to force skills by intensive instruction, but this may cause the child to use immature, inappropriate neural networks and distort the natural growth process... Moreover, the pressure which surrounds such learning situations may leave permanent emotional debris. There is an order in which learning is programmed to take place; while it can be encouraged, it need not be forced (pp. 26-28).

This understanding of the structures and complexities of the brain is necessary for understanding how teaching relates to learning. "Defining children's work is easier if we try to understand how thinking and learning changes at different ages" (Healy, 1987, p. 46).

Jean Piaget, a noted Swiss psychologist, is well known for his work in the area of cognitive development, finding his way into all of the literature resources on educational psychology. Healy (1987) observed that, "Although Piaget himself never wanted to tie his ideas to brain science, the connection appears to be inescapable" (p. 46).

At this point, the focus of the Literature Review changed from the physiology of brain development to the field of cognitive development. According to McConnell (1989), "Cognitive development refers to development in children of such mental activities as perception, memory, imagery, language, concept formation, problem solving, reasoning, and decision making" (p. 399).

The subject of cognitive development in children is a relatively small part of a very broad subject. The purpose of this part of the Literature Review was to examine available documents related to learning, teaching, child development, and child psychology in an attempt to narrow the focus of the research to a manageable, relevant topic. Even after limiting the scope of the research, it became clear that the spectrum of available information and opinions of leading researchers is very wide. In addition, as new theories are shared, researched, and published, there is no lack of hindsight by those in the field in reevaluating once-embraced theories of the past.

The Literature Review showed that developmental psychology includes a rather large number of related issues, and is a very complex integration of opinions, problems and analyses. There are few, if any, absolutes in terms of how children learn to process the vast array of sensory inputs they are exposed to minute by minute. While there are many theories and applications related to cognitive development, and how we process information, the Literature Review indicated that it was the theories of Jean Piaget that would have the greatest applications to this project.

Piaget (1972/1973, pp. 54-61), defined basic principles of cognitive development from infancy through adulthood. His theories are held in high regard today, although many alternative theories abound. Piaget defined four distinct stages of development, including the sensorimotor stage (birth to approximately two years), preoperational stage (approximately two to seven years), concrete operations (approximately seven to eleven years), and formal operations (approximately eleven years and older). According to Piaget (Woolfolk, 1987), the ages are approximate, depending upon the influence of several other factors, including biological maturation, social and physical

environmental experiences, and an information processing mechanism he calls *equilibration.*

Equilibration involves *assimilation*, making new information fit with what we already know, and *accommodation*, which means that we change our thinking to fit the new information. In other words, we are constantly trying to make sense of the information we receive, either by comparing it to what we already know (assimilation), or changing our thinking to match the new information (accommodation) (Woolfolk, 1987, pp. 53, 54).

Given Piaget's age guidelines, the preschoolers whom we wish to address fall into Piaget's preoperational stage. As the name implies, the prior stage, the sensorimotor stage, is characterized by development of motor skills. Sensorimotor intelligence is not very effective for planning ahead or keeping track of information. The preoperational stage expands on sensorimotor abilities, when the child begins to develop and carry out *operations*, or actions that are mentally, rather than physically, accomplished. Since the child at this stage is only beginning to master operations, it is called preoperational (Woolfolk, 1987).

It is also a period of language development. Words become more than ways to communicate for preoperational children. They are symbols by which children structure their world. The key to this, however, is that in so doing they attach meanings to words that suit themselves, but not necessarily the same as an adult would. They are also developing a more accurate sense of time, although their concept of time may still be somewhat different than that of an adult (Glover and Bruning, 1987).

An example of how those two concepts, language and time, demonstrate preoperational thinking was provided by Glover and Bruning (1987):

> In telling a story, a child of one of the authors began, "Once upon a time, far, far, away--in Kansas City--and long, long, ago--last Tuesday..." She understood the past but her ideas of "long ago" were rather different from her father's (p. 121).

Piaget also described preoperational children as egocentric. Egocentrism in this case is not selfishness or pride. Rather it is simply that they often assume that everyone else shares their feelings, reactions, and perspectives (Woolfolk, 1987, p. 59). They tend to view themselves at the center of their universe. Because of this, they may not view things objectively, or reason as an adult would. As an example, the prospect of a parent needing to go to do the dishes instead of playing may frustrate a preoperational child, since they cannot see why you should bother with the dishes (Glover and Bruning, 1987, p. 120).

The entire scope of Piaget's studies is massive, and difficult to fully comprehend. The need to develop a basic understanding is summarized by Mayer (1987) who states

> The child is not a miniature adult who lacks only great quantities of knowledge. Instead, the child at any stage possesses modes of representing and processing information that are quite different from adult thinking. Thus instructional experiences will be useful only if they are matched to the child's level of cognitive development.... This theme can also be summarized by saying that the intellectual growth of a child depends both on the characteristics of the child at the time of instruction and on the characteristics of the instruction (pp. 42, 43).

Mayer (1987) also states that, "Especially in preschool and elementary school, experience with appropriate concrete objects is crucial" (p. 43). That message carried the Literature Review into the next arena, regarding the practical application of what has been revealed to this point. As Glover and Bruning (1987) put it, "No psychology, regardless of how interesting, is useful unless it can be related to actual situations and problems" (p. 40). Guidelines for teaching children, in consideration of their cognitive development and information processing abilities, were provided in at least two of the resources reviewed.

Woolfolk (1987) makes recommendations, specifically for teaching preoperational children. Some of those included the following:

1. Use concrete props and visual aids whenever possible. Don't explain with words alone.

2. Make instructions relatively short, using actions as well as words.

3. Don't expect the students to be able consistently to see the world from someone else's point of view.

4. Be sensitive to the possibility that students may have different meanings for the same word or different words for the same meaning (p. 60).

Glover and Bruning (1987) provide "Applications for Teaching: Piaget's Theory," which covers the issue from a cognitive development standpoint. Some of those included:

1. Remember that students construct their knowledge. [This point is based on Piaget's emphasis that children are trying to make sense of their environment, taking in information, and] ...trying to construct their own new understandings.

2. Recognize the developmental basis for learning. [That basis is prior knowledge.] Faulty or poorly-organized prior knowledge may make genuine understanding of new material impossible.

3. Aim for moderate levels of novelty. Students learn best if presented with new material slightly beyond their present understanding.

4. Value the students' point of view. The student who does not understand may not simply lack knowledge but may have an entirely different way of looking at things (pp. 128, 129).

Glover and Bruning (1987) also provide applications for teaching based upon information-processing views of learning, summarized as follows:

1. Students are active processors of information.... What is learned will depend not only on the actual content but also on what the student already knows and on how the student processes the information received.

2. Learning is most likely to occur when information is made meaningful to students. [This refers to prior interest, knowledge, or experience, or a particular concern of the student.]

3. Reduce the memory requirements of the task to a minimum. [This point refers to providing information which can be processed through accommodation and assimilation, without introducing too much disequilibrium.]

4. Allow students the opportunity to manipulate objects directly (pp. 131, 132).

Summary

The Literature Review was critical to the success of the project. It was upon the findings of experts in the field of educational psychology that the report was based. Information processing is a function of the brain, and cognitive development research done by others established the foundation for understanding the basics of information processing in a young child's mind.

In addition, the work of others, specifically in the area of cognitive development, established the basis for the evaluation of current fire safety programs. The recommendations of authors, with respect to the practical applications of the various findings, regarding teaching preschoolers, were used to develop the guidelines for evaluation.

PROCEDURES

The Literature Review constituted a major part of this project. It was necessary to separate, from an extensive amount of information on the issues related to child development, the information that dealt with a particular age group of children. At the same time, it required that the information available be narrowed down to that which is applicable to a particular group of educators, firefighters, whose opportunities to interact with any particular group of children are limited, and short-lived. Therefore, the time spent with them must be as productive as possible, in consideration of the children's cognitive and information-processing abilities, in addition to a relatively short attention span.

The Literature Review began with a study of brain structure and function. A cursory study of the anatomy of the brain was conducted. Following that, the research expanded into the area of cognitive development, focusing on the developmental characteristics of preschoolers. A review of some practical teaching applications led to the development of evaluation criteria related to fire safety lessons.

In consideration of the information gathered at that point, the next step taken was the evaluation of the current fire safety programs being delivered by the Muscatine Fire Department. A list of evaluation questions was created to lay the groundwork for the analysis. Those were

(a) What words are used that might not be considered household words for preschoolers (i.e., fire service jargon)?

(b) What words are used that might have more than one clear meaning to a preschooler?

(c) Are the messages likely to build on prior knowledge or past experiences of the average preschooler?

(d) What conceptual pictures are the children expected to form in their minds, and how might those concepts be formulated in a child's mind, which are inconsistent with the presenter's intent?

(e) Are the messages being presented from the point of view of a preschooler, or from the point of view of a firefighter?

(f) Are there any hands-on portions, where applicable, to reinforce learning?

(g) Are props available to illustrate the lesson?

(h) Is the message action-oriented, or in the form of a lecture?

The Muscatine Fire Department delivers fire safety messages to preschoolers in two formats. The first is a curriculum distributed by the Iowa State Fire Marshal's Office entitled *Kid Safe Program*, a product of the efforts of members of the Oklahoma City Fire Department's Early Child Development Task Force (1992). The *Kid Safe* curriculum includes nine lessons on a variety of fire and burn safety topics. The curriculum is designed to be delivered by preschool teachers.

A second approach is used where a company of firefighters schedules a time to visit the preschool and delivers a program which covers a number of fire safety topics. That program addresses the issues of handling hot items, matches and lighters, stop-drop-roll, crawling low in smoke, fear of firefighters, and cooling burns.

Evaluations of both programs were conducted by reviewing the curriculum and by attending a scheduled presentation of the preschool program to a group of children. The content of those evaluations is provided in the Discussion section of this report. Following the evaluations, a draft copy of the Literature Review for this report and a copy of the evaluation of the supplementary preschool program was provided to the firefighters for their review. It was anticipated that, given some insight into the learning abilities of children and the teaching strategies presented in the various literature resources, some of the potential problems would be eliminated, and the lessons would be presented in consideration of the children's ability to process the information.

As a result of the new information, changes in the format and delivery of the programs were made, to include more hands-on practice, and consideration given to the language and terminology used in the delivery. Other considerations, as listed in the Recommendations section of this report, have been or will be implemented.

The research questions to be answered include the following:

1. What are some of the basic principles of learning?

2. What cognitive processes occur in children?

3. How are those processes different in children than adults?

4. What are some characteristics of fire safety lesson plans developed in consideration of the unique cognitive abilities of preschoolers?

5. How do current Muscatine Fire Department fire safety lessons for preschoolers fit those characterizations?

Project Limitations

The limitations faced in this project included an inability to objectively measure the long-term learning of the students. Pretests and posttests provided in the curriculum portion of the program may indicate whether the lesson was effective in imparting information on those topics covered in the tests. However, while the information gathered in the Literature Review shows that using language and terminology consistent with their cognitive abilities is necessary, long-term, definitive, and controlled studies which are beyond the scope and time frame of this project would need to be conducted.

Another limitation was in the availability of current texts. The source of the texts on educational psychology was the local library. Traditionally, the texts are updated periodically, as they are used in college coursework. However, it is not the practice of public libraries to continually update this type of text, unless the information substantially changes. While the texts are somewhat dated, the information on Piaget's work, biological brain function, and their applications to this study would not appear to be affected by newer editions of those texts.

Definitions of Terms

Accommodation: Internal information processing system, where our thinking changes to match new information.

Assimilation: Internal information processing system, where new information is made to fit what we already know.

Axon: Information output fibers of the neuron.

Cortex: The top layer of the brain, responsible for, among other activities, reasoning, hearing, memory, and judgment.

Dendrites: Information input fibers of the neuron.

Equilibration: Internal information processing strategy, using assimilation and accommodation to make sense of new information received.

Limbic system: Middle portion of the brain, and the seat of emotion and behavior.

Myelination: Natural maturing process of the neuron, increasing the efficiency of the message-sending component.

Neurons: Information transmitters of the brain (Appendix A).

R-complex: The base of the brain, responsible for instinctive behaviors such as feeding, socialization, and territorial behaviors.

Synaptic cleft: The area between the axonic fibers of one neuron and the dendrites of the next. Messages travel from neuron to neuron through this space.

RESULTS

The results of the project included the development of criteria which was used to make an evaluation of existing fire prevention programs of the Muscatine Fire Department. Basic anatomy and physiology of brain structure and function were studied, in addition to learning strategies based upon the cognitive abilities of children. That research was the basis for development of the criteria on which the evaluations were made. The full context of the evaluations is contained in the Discussion section of this report.

Conclusions

There is a clear need to consider the cognitive abilities of the audience when teaching fire safety, primarily in the case of young children. The language, terminology, concepts, methods, and delivery all play a part in determining the effectiveness of the message, including the long-term impact of the lesson. The research showed a need to change some portions of the preschool programs which are part of the Muscatine Fire Department's public education efforts.

In addition, the same consideration needs to be given to new programs, to include on-going evaluations, and training for those people responsible for delivery of the programs. Followup research will be necessary to address related concerns regarding older children at the elementary level who have their own unique needs and abilities.

The answers to the research questions are as follows:

1. What are some of the basic principles of learning?

According to Healy (1987), the human brain forms from about the third week after conception until about six months after birth. It forms in three distinct parts, including the r-complex, the limbic system, and the cortex (p. 13). The brain continues to develop after birth, through adolescence. The r-complex is responsible for instinctive behaviors such as feeding, socialization, and territorial behaviors. This area develops and matures first. That is followed by the maturation of the limbic system, which is the emotional seat of the brain. The last part of the brain to develop is the cortex. The last part of the cortex to develop fully is the portion responsible for reasoning, memory, and judgment (p. 30).

After birth, the brain goes through a maturation process where stimulation of the brain increases its ability to process information. As the brain is stimulated by thought processes, the child becomes capable of performing more complex mental and physical tasks. "The more work the brain does, the more it becomes capable of doing" (Healy, 1987, p. 19), progressing geometrically.

However, the brain can be overstimulated, and it then uses inappropriate or undeveloped areas to process information. Healy (1987) warns that there is an appropriate amount of stimulation, and that overstimulation can cause emotional pressures which inhibit the ability of the neurons, the information transmitters of the brain, to send or receive the desired signals (pp. 25, 26). Healy states

> So, although we can certainly stimulate development of cell networks when they are ready, many aspects of this growth cannot be rushed.... It is possible to force skills by intensive instruction, but this may cause the child to use immature, inappropriate neural networks and distort the natural growth process.... Moreover, the pressure which surrounds such learning situations may leave permanent emotional debris. There is an order in which learning is programmed to take place; while it can be encouraged, it need not be forced (pp. 26-28).

Learning takes place when stimulation of the brain cells occurs in appropriate amounts and at appropriate times during the process of brain development.

2. What cognitive processes occur in children?

While there are many theories and applications related to cognitive development, and how we process information, the literature review indicated that it was the theories of Jean Piaget that would have the greatest applications to this project. Piaget (1972/1973) defined basic principles of cognitive development from infancy through adulthood. His theories are held in high regard today, although many alternative theories abound.

Piaget (1972/1973) defined four distinct stages of development, including the sensorimotor stage (birth to approximately two years), preoperational stage (approximately two to seven years), concrete operations (approximately seven to eleven years), and formal operations (approximately eleven years and older). According to Piaget, the ages are approximate, depending upon the influence of several other factors, including biological maturation, social and physical environmental experiences, and an information processing mechanism he calls equilibration (Woolfolk, 1987).

Equilibration involves assimilation, which involves making new information fit with what we already know, and accommodation, which means that we change our thinking to fit the new information. In other words, we are constantly trying to make sense of the information we receive, either by comparing it to what we already know (assimilation), or changing our thinking to match the new information (accommodation) (Woolfolk, 1987, pp. 53, 54). This process continues as a person moves through the stages of development, each of which are marked by particular developmental characteristics.

3. How are those processes different in children than adults?

From a biological standpoint, information processing in young children begins in areas of the brain not well suited for complex thinking skills. As the child grows and matures, so do the areas of the brain that ultimately will become the information processing centers which are responsible for rational, abstract thought, in the cortex (Healy, 1987).

There are two primary differences between adults and children regarding their cognitive abilities. The first is environmental. Adults simply have more experiences on which to equilibrate new information. While adults are presented with new information on an ongoing basis, any particular new piece of information is a proportionately smaller part of an adult's knowledge base. Secondly, by virtue of years of physical development, with mature neural pathways established, the portions of the brain responsible for rational and abstract thinking have taken over those processes (Healy, 1987).

4. What are some characteristics of fire safety lesson plans developed in consideration of the unique cognitive abilities of preschoolers?

The Literature Review revealed a number of general teaching strategies, which were applied specifically to create a list of fire safety lesson plan evaluation questions. Those included the following:

(a) What words are used that might not be considered household words for preschoolers (i.e., fire service jargon)?

(b) What words are used that might have more than one clear meaning to a preschooler?

(c) Are the messages likely to build on prior knowledge or past experiences of the average preschooler?

(d) What conceptual pictures are the children expected to form in their minds, and how might those concepts be formulated in a child's mind, which are inconsistent with the presenter's intent?

(e) Are the messages being presented from the point of view of a preschooler, or from the point of view of a firefighter?

(f) Are there any hands-on portions, where applicable, to reinforce learning?

(g) Are props available to illustrate the lesson?

(h) Is the message action-oriented, or in the form of a lecture?

Those questions define the parameters of teaching preschool children fire safety. They address issues of language, terminology, past experiences of the students, perspective, hands-on learning, and visual impact.

5. How do current Muscatine Fire Department fire safety lessons for preschoolers fit those characterizations?

The results of the project showed that a number of areas of concern needed to be addressed, both in the written curriculum provided to the preschool teachers and in the firefighters' presentations. Evaluations of the programs led to revisions in language and terminology, with some additions to enhance visual impact and hands-on involvement by the students. Changes in the format and delivery of the programs were made, to include more hands-on practice, and consideration given to the language and terminology used in the

delivery. Other considerations, as listed in the Recommendations section of this report have been or will be implemented.

DISCUSSION

The results of the study showed that there are distinct differences between adults and children in terms of the ways in which they learn to communicate. Experts in the fields of educational psychology, biology, and human growth and development have conducted extensive research in the broad spectrum of subjects which are covered under the blanket topic of learning.

The published results of some of that research established the background for this project, which included an analysis of current fire safety programs of the Muscatine Fire Department. The basis for performing that analysis was that, as a result of the biological and developmental differences between adults and children, strategies for teaching children must coincide with their unique cognitive abilities.

Evaluation

When measured against the criteria listed in the Procedures section, an evaluation of the *Kid Safe Program* (Oklahoma City Fire Department Child Care Development Task Force [OCFD], 1992) revealed the following concerns:

Lesson 1 - Hot and Cold Objects. In this lesson, a number of hot and cold objects are identified by drawings. One of the points in the teaching outline states

> Show the picture of the object and point to the wavy lines. Stress that wavy lines mean that something is hot. If the lines show steam or smoke, explain that steam is a sign that something is hot. Ask the student what the wavy line means (OCFD, 1992, p. L1-6).

Wavy is a word that, if unknown to the students, can probably be explained in the lesson. However, it may be beyond the ability of the preschooler to correlate wavy lines on a piece of paper to heat emanating off of an actual object. Adults rely on past experience with seeing waves of heat off of particular objects, but they are not always visible, and the concept may be beyond the reasoning abilities of these children.

In addition, the concept of *steam* may prove to be confusing. The experience of children with steam-like matter includes auto exhaust, clouds, chimney smoke, etc. The danger here may be that, while incorrectly associating all steam-like discharges as hot, and not to be touched may not be a great

problem, the message may inadvertently come across as, "All things that are hot have steam or wavy lines coming from them." One aspect of this misconception is dealt with later in the lesson where it says, "Steam doesn't always come from a hot pot or pan, so you can't always see that it will burn you. Only grown-ups should handle pots and pans" (OCFD, 1992, p. L1-8). However, this message may be, in the mind of a preschooler, somewhat counter to what had earlier been presented. In the end, while the child tries to assimilate or accommodate the message, there is no firm conclusion to be drawn when differentiating between steam and heat.

Lesson 1 also includes the terms, "electric iron," "portable heater," "coffee cup," and "cooking pan" (OCFD, 1992). Clearly, labeling the items themselves is necessary, but the words *electric, portable, coffee,* and *cooking* may be burdensome to a preschooler trying to assimilate the terms to items they are already familiar with.

Another example is part of the lesson regarding coffee cups, where it says

> When steam comes from the cup, the drink inside the cup is hot. A little child can get burned if the cup spills over. You should tell a grown up to please cool down the liquid before you pick up the cup (OCFD, 1992, p. L1-7).

If presented like that, the teacher is assuming that the child considers him/herself a little child, and that the child understands the concept of "cool the liquid." Making the information meaningful to the student may involve removing the third-person connotation, and changing or defining *liquid*.

The strengths of the material include the drawings that show hot things and cold things. The Muscatine firefighters went out and purchased, from a second-hand store, a representative sample of items such as irons, curling irons, and hair dryers for use in classrooms while teaching this lesson.

Lesson 2 - Matches and Lighters. The lesson includes showing the children examples of different kinds of matches and lighters. The appropriate uses of matches and lighters are illustrated in pictures shown to the children. The concerns that appeared included an activity where the children are asked, "Who has seen grown-ups strike a match? Stand up and 'pretend' [sic] show us how they do it" (OCFD, 1992, p. L2-6). The activity may give mixed messages to the children. Some of the lessons include pretending to perform correct actions in the event of a fire, or in case of a burn injury. In this case, they are asked to perform a prohibited action: lighting a match. Separating appropriate actions from bad actions, after practicing both, may be difficult for the child to accomplish, mentally, at some point in the future.

One other concern, in the area of terminology, is a question given to the children, "What bad accidents could happen?" (OCFD, 1992, p. L2-8). While *accident* is a relatively simple word, it is one that can have a broad connotation, even for adults. Accident is related to intent, and in the area of fire safety, a child may intend to light the match, but not to set the closet on fire. The child may intend to burn the leaves, but not the garage. The point is that even where a good understanding of the word accident exists, the concept of where intent ends and an accident begins may be conceptually difficult for a child. A better way may be to avoid the potential for misunderstanding by replacing the phrase *bad accident* with the word *problems*.

Lesson 4 - Stop, Drop, and Roll. The concept of burning clothes is presented with slight modifications of terminology, including, "...clothes catch on fire" (OCFD, 1992, p. L4-2), and "...clothes catch fire" (p. L4-14). Children at this age also catch cold, catch balls, and catch up to parents who walk faster, so the concept of clothes catching something may be confusing. The demonstration of the stop, drop, and roll response is accomplished while using a red felt flame to attach to a student's clothing. That visual aid would seem to clear up any potential conceptual problems, but it should be a integral part of any references to clothes catching fire or catching on fire.

Lesson 5 - Good Fires and Bad Fires. Points are stressed in the beginning of this lesson, from previous lessons, regarding playing with matches and burning clothes. The context of the lesson shows good fires as those that are used for heating and cooking, or candles. Bad fires include those that are out of control, destroying property. In addition, the lesson shows that bad fires occur from, as examples, standing too close to a heater or playing with matches (OCFD, 1992).

The concern here is that the extremes of good and bad are portrayed, without presenting the inherent bad of good fires. In other words, it may appear that, as with the accident issue earlier, the intent defines whether fires are good or bad, rather than identifying all fires as very dangerous. In the absence of that, a child may believe that while playing with matches is wrong, a lit candle is a good fire, and good things are, simply, good. The erroneous concept, that bad things hurt us and good things don't, may be inadvertently supported without additional information provided to help the children sort this paradox out in their minds.

The written program is intended to be delivered by preschool teachers. As a supplement to that program, firefighters schedule times to present a fire safety program to the children. It consists of a multi-message program covering the topics of *hot and cold, matches and lighters, stop-drop-roll, crawl in smoke, don't be afraid of firefighters, and cool a burn.*

In addition to the evaluation of the *Kid Safe Program*, the presentation of the firefighter's supplemental program was evaluated, measured against the same criteria.

An evaluation of the program was conducted as it was being delivered to a group of a dozen preschoolers. The delivery of the program was well received by the children. The program in Muscatine is supplemented by the use of a robotic fire truck. A firefighter, hidden in a nearby mock-up of a firehouse, is able to communicate through the fire truck while hearing their responses, including the ability to control lights, the siren, and a cassette player, which plays prerecorded fire safety songs.

Concern about the program and its delivery is limited to language and terminology issues. A list of words used in the presentation, without supporting definitions or clarification, included the following: *electricity, microwave, tattle-tale, hero, accidents, special gear, bunker pants, bunker coat, good air, air pack, clothes on fire,* and *smoke detectors*. Two phrases used were, "There's a lot of heat and a lot of smoke, and that's why we wear our air pack," and "Everything I have is called bunkers."

A great deal of new information was introduced to the children. As many as six new concepts were presented. In that regard, the use of a dozen new, undefined word or phrases may have served to complicate and undermine the intended messages.

The bulk of the program was very well done, and well received by the audience. The stop-drop-roll segment included practice by a couple of child volunteers, and the firefighters showed actual matches and lighters to be sure the children knew what was being referred to.

Interpretation

An interpretation of the results of the study has applications across the board in fire service education. Firefighters may not necessarily view themselves in the role of a formal educator, with the associated considerations given to delivery and context of message. It is fairly well understood that a group of preschoolers is a different audience than a group of adults, and a change in communication style is appropriate. However, the need to understand the cognitive abilities of the students is critical for program success. That is particularly true for the age group which was the focus of this study, preschoolers.

Fire service educators should not take the opportunities to teach fire safety to children of any age for granted. Fire safety is one very small part of a child's education, and for that reason, the lessons they receive must be as effective as possible, if there is to be any lasting impact. The study showed that it involves more than just using simpler words. The lessons need to be planned with a view toward the concepts the children are expected to form, the meanings they may attach to our words, how their perspectives may differ from ours, and how to add visual impact to the message, among other considerations.

In addition, beyond the lesson planning, the same considerations need to be given when delivering the information to the children. In the case of the Muscatine Fire Department, the messages are not delivered off of a script. They are presented from memory after practicing the prepared lesson. That type of delivery lends itself to ad-libbing, opening the door for inappropriate terminology or concepts. An understanding by the presenters of the elements of learning and cognitive development would serve to prevent that type of problem.

Implications

The immediate implications of the project were to evaluate the current preschool programs in use at the Muscatine Fire Department. Some potential problems were identified, and corrective action was taken. All future preschool programs will be evaluated on the basis of the conclusions drawn as a result of this project.

The longer term implications involve expansion of research into age groups not covered in this report. The resources cited in the literature review developed the issues further, through subsequent age groups. Followup research will be conducted to arrive at teaching strategies and evaluation tools for older children. The Muscatine Fire Department currently conducts the same types of public education for children in Kindergarten through Grade 5. The goal of maximized fire safety education effectiveness applies to these children as well.

A broader perspective may be applied to all public education. The tendency to use fire service jargon applies in all situations. Even when dealing with educated, rational adults, the use of unfamiliar terminology or concepts will likely leave people confused.

Fire safety does not need to be complicated to be effective. In fact, just the opposite is true. The need to make the messages understandable in order to have a positive impact transcends age groupings. Attention to detail, in terms of message and delivery, is certainly more critical where young children are involved, but that principle must not be lost on any of our audiences.

RECOMMENDATIONS

The recommendations made as a result of this project include the following:

1. Implement a preschool fire safety program, if none exists. Preschool children represent a high-risk group in terms of their involvement with fires. They are more difficult to access, but they suffer disproportionately from the ravages of fire.

2. Consider the cognitive abilities of preschoolers when developing lesson plans and presentations. The issues of language, terminology, past experiences of the students, perspective, hands-on learning, and visual impact, among others, need to be considered.

3. Train fire service educators in the area of cognitive development, related to the age of the audience. Age-appropriate lesson plans are no better than their delivery. Firefighters and others responsible for the presentations need to recognize their roles in making the messages meaningful for the students. A basic understanding of how their words and actions are interpreted by the students will do much to assure that the message is not lost in the interpretation by the children. The same principle applies to the presentation of information to adults. As new personnel are added to the team, it is important that they receive the same training.

4. Evaluate current preschool fire safety lessons against the same criteria by which new material will be developed. Evaluation of existing programs should be an on-going activity. Slight modifications of material as time goes by opens the door for inappropriate message delivery to occur.

5. Conduct additional research into the needs and abilities of the next age group of children, through elementary school. This group has its own cognitive development characterizations which need to be considered.

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