Teaching Our Children to Communicate:
The Importance of Symbolic Language

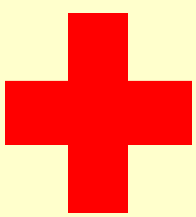
By Judith Levy Cohen, M.Ed.

I happened to turn on the television the other night and discovered a special Nature program in which David Attenborough examined the ways that birds communicate with one another. Color, call, flight pattern, dance and feather displays were only a few of the myriad ways in which various species communicated with members of their own species. I was struck by the clarity of that communication. Birds don't misunderstand each other. It seems as though they are lucky enough to have an instinctive understanding of these complex mechanisms. Hawks never seem to attract starlings as potential mates; the many species of finches that reside in the same territory never confuse the group to which they belong...color tells them all they need to know. Since sparrows often live in big flocks within small territories, there is a need for orderliness within the group. All members of the flock easily detect the pecking order by the size of the black chest bib of feathers: the bigger the bib, the higher the rank of the member. Every sparrow seems to understand this symbol system. As a result, communication is effective and skirmishes within the flock are kept to a minimum. How wonderful it would be if human communication were that simple.

The symbol systems used to communicate important information within the human world are neither simple nor easy to understand. I came to this realization when, after years of teaching at all levels from elementary to graduate school, I kept hearing the same question from parents, colleagues, and students. The question is usually worded something like this, "Why is it that young children are innately good problem solvers, that they can solve complex problems, and yet after a couple of years in school, they seem to be worse off than when they came to school?" In other words, what are we doing to our baby birds that seem to make them less well able to communicate within the flock?

I remember a story that a dear friend and colleague told me regarding the behavior of her 4 four-year old son. She had recently arrived in New York, prior to which he had spent his infancy and young childhood on a small Caribbean island.For most of his young life, he listened to and watched his father, a well-known physicist, work with complex equations.

Walking around the city of New York with his mother, she noted that he kept looking up and appeared to have a rather quizzical look on his face. Finally, when he could contain himself no longer, he asked, "Mommy, why do so many buildings have these large 'plus' signs on them?" Since he had had very little experience with church iconography, the cross, to him, was the large symbol for addition.



Each of us brings our unique experiences to the interpretation of a new symbol system. However, idiosyncratic interpretation limits communication.

We know that they have not lost their innate capacities for thinking and reasoning. In fact, as they are growing and developing, they should be better able to use their growing capabilities to thrive and communicate even more effectively...but they don't. So, why don't they?

I suspect the answer lies hidden within the nature of the symbol systems we use and the ways in which we teach them to our young students. Our symbol systems, be they numeric or alphabetic, are very abstract. From a purely pragmatic point of view, the more abstract and complex the symbol system is, the more power it has to communicate complex information. However, for a young child whose thinking is still quite literal and concrete, being asked to work with an abstract symbol system poses many dangers and difficulties. After all, in order to use the system effectively, first you must understand what it means and how it works. I have seen many pre-school children easily handle the task of dividing the snack so that it is "fair." Using a one-to-one correspondence, they allot one cookie to each child and then see if there are enough to go around more than once. I have even observed a hungry pre-schooler mention that if the remaining cookies were cut in half, then everyone could have some more. Now can you imagine that same class of four year-olds solving the problem using the symbol system of numerals? Herein lies the problem. When we move to the symbol system to solve the problem, the nature of the problem for that child has shifted. The strange written symbols are supposed to mean something, and if we "monkey around" with them, we are supposed to know how many cookies each child will get.

The difficulty may be that as we shift from the world of real cookies to the symbol that represents both the actual cookies and the number of cookies, we are requiring a translation shift within the child's thinking. However, we have not trained the student in simultaneous translation. Even as adults, we tend to have different methodologies for handling that same problem. Some of us have the numeral system and its procedures so well embedded within us that we immediately begin to solve the problem algorithmically. Others of us need to make a visual mental image of the cookies and people and solve the problem using visual active working memory, assigning the cookies to the people in our heads. But what would happen if we could not translate the words into an algorithmic format because those symbols were meaningless to us? What would happen if we were too young to have the active working memory skills to handle the task mentally?

To test my theory, I decided to present a problem to both second and seventh graders. The second graders were told that they were free to use any math tools they needed to solve the problem. The seventh graders, busy learning algebra, were not given any instructions as to how to solve the problem. The problem is similar to many found in basic algebra textbooks.

"A farmer goes into his barn late one night. He has chickens and cows in the barn. He counts 15 heads and 44 legs. How many chickens and how many cows are in the barn."

It was fascinating to note that all of the second graders solved the problem. However, not one child used a mathematical algorithm involving numerals to solve the problem.

All of the seventh graders used algebra to solve the problem, but only three students out of a class of 21 actually solved it. Let's examine what happened to discover why the younger children were able to solve the problem but the older children could not. Most of the little ones drew 15 circles on their papers. These pictorial images represented their own symbols for the animal heads. Most of the children then put two little lines under each circle to represent two legs. After counting the legs they discovered they had used up 30 legs. But the farmer counted 44 legs. They had 14 more legs to assign to the animals. Next, most of the children drew two more legs on seven of the heads. The animals with four legs were the cows, and the animals left with only two legs must be the chickens. So, they concluded that there were seven cows and eight chickens. Only one child in the group added a third leg to fourteen heads and concluded that there were 14 chickens and 1 cow. When he presented his answer and his work to his classmates, he quickly realized his mistake. "Oops, chickens don't have three legs," he laughed.

By contrast, the seventh graders began by using an algebraic algorithm. Their papers looked something like this:

"Let X = the number of chickens
Let Y = the number of cows"

After that, they got stuck. They could not translate the information into symbols in order to formulate a set of equations by which to solve the problem. Not even one child realized that by using two variables, he or she would have to construct a set of simultaneous equations to solve the problem. Taught to rely on a symbolic format behind which there is little understanding, children become unable to move forward to manipulate that system to generate a solution.

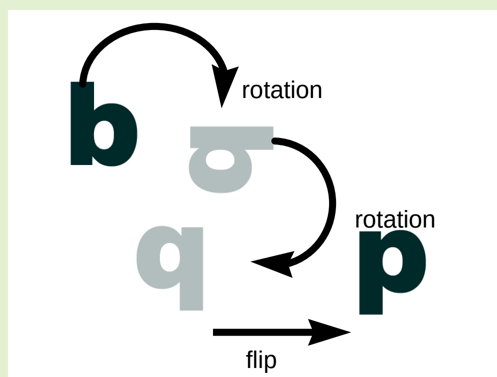
You might ask yourself, why do we even bother to teach these complex symbol

There are rules and conventions that govern symbol systems. In order to make meaning, one must understand those rules.

Young children believe that symbol systems behave in the same way that things in the real world behave. This is not true.

For example, take a frog...when we turn it upside down, is it still a frog? Any two-year old will tell you...giggling, yes that is still the frog.

Now take the letter "b". Change its orientation by a rotation and it becomes a "q". Flip the "q". Is it still a "b?" No, it is now a "p."



In the real world, the orientation of an object does not alter meaning. In the symbolic world, orientation often alters meaning dramatically. Is it surprising that children are confused?

systems if, in the end, we cannot use them effectively? The answer is quite straightforward. It is simple enough to draw the representation when only 15 animals are involved. However, what happens when we are talking about a farm which has many hundreds of animals with thousands of legs. Is it efficient to draw circles and little leg marks? Is that the best way to solve the problem? Clearly, the answer is no. In this case, the algebraic symbol system involving two variables and a set of simultaneous equations is far superior. It is efficient no matter whether we have fifteen or five thousand animals. But for it to be efficient and effective, a child must understand the problem conceptually so he can decode the language cues and translate them into the symbols he can manipulate for solution. If the child understands the concepts and if the language has been decoded, the process of encoding into symbolic language for algorithmic manipulation becomes fluid and easy.

You might think, from the examples above, that mathematics is the only symbolic language to which we expose very young children. Nothing could be further from the truth. At the same time our little learners are making a stab at understanding the mathematical symbol system and the conventions that govern it, they are simultaneously attempting to learn the alphabetic symbol system and the unique, and often unconventional, rules that govern it.

Most children come to school with an oral language system that is remarkably well established. They speak and can express themselves and they listen and can understand what is being said to them. By contrast, it is interesting to notice how often they struggle to make meaning from written words and sentences that they would understand by ear. It seems clear that the struggle emerges when they must decode the written symbol and extract meaning from it.

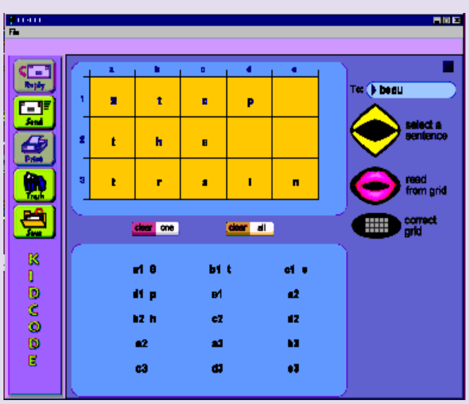
It doesn't end there. Legends, keys, graphs, maps are all symbolic representations. For many children, these pictorial symbols are somewhat easier to understand. But even in these cases, the translation from symbol to meaning must be clear, and the conventions that govern the symbol system must be understood.

In a world that is increasingly reliant on technology, a world in which icons become the entry symbols to the information highway, isn't it time for us to rethink how we teach our youngsters to cope efficiently and effectively with the symbol systems they will be asked to use? To do so, we must teach our children directly about symbol systems. We must help them to understand that each system has rules or conventions, which govern its use. We must give them multiple experiences and exposures acting as encoders and decoders. Even more importantly, we must help them to understand that the ultimate purpose of encoding and decoding within any symbolic system is to facilitate communication among people. Clearly, as children understand symbol systems, and mathematics is a good example of just such a symbol system, they become more confident in their abilities to think about and to become creative problem solvers in their world. As they learn to manipulate the symbol system, they become much more adept in using mathematical algorithms. I believe that this occurs because the symbol system has been demystified and the children are better able to separate the conceptual issues from those involved with procedures.

In my recent work with Kidcode, an e-mail software program specifically designed to help children learn about the mysteries of symbolic representations, I was

In the KidCode electronic mail software the Rebus activity helps young children explore symbol use for the purposes of communication.

Children substitute images, phonetic spellings, or other types of symbols for words in a message. They send the message to thir peers and correct misunderstandings by selecting alternative symbols. KidCode helps children to understand that symbols convey meaning but that a common interpretationis necesary for succesful communication. The Rebus activity encourages children to consider the perspective of a message recipient when selecting a symbol.



The KidCode grid activity at left helps children use symbols to represent location in space.

See the KidCode website http://www.kidcode.com

delighted to discover that many children who had explored and played with the software quickly discovered their own methods for resolving communications difficulties by altering and refining their choices of symbolic representations.

Aside from the very serious purpose of teaching children to encode and to decode information into and from complex informational units, there are several other values which children can learn from having direct experiences in symbolic representation. The first lesson is that symbolic representations enable us to transmit and communicate large chunks of information efficiently and easily. Second, as we understand the rules and conventions that govern these symbol systems, we are also learning about the underlying principles, which organize and systematize our communications. Moreover, once the conventions are understood, we become capable of thinking about larger issues, of handling many more variables, and of exploring many more options. In fact, symbolic representations enable us to become more flexible problem-solvers. All of these lessons are valuable for anyone to learn.

But to me, the most important value that emerges when we teach children to use symbol systems is that they are powerless if we do not mutually agree on their meaning. Let's take the letters C,S,T,E,N. If we arrange the letters to make "cents," we are talking about the parts per hundred or about pennies. However, if we arrange the letters to spell, "scents," we are talking about aromas or odors. If we spoke those words in isolation, we would have no basis on which to decide meaning. The symbolic representation of the letter choices and the order in which those letters appear give us the cues we need to imbue meaning. In the process of learning to use symbol systems effectively, children are bound to make mistakes. Mistakes are illuminating. When we communi-

There will be a spill (she thought to herself) if the child is not more careful.

In order for symbols to be really useful, we must agree on their meaning. When a symbol has multiple meanings, they can be very confusing.

Think about how we translate parenthetical expressions in English. The words enclosed by the parentheses are considered secondary or exclusional. We don't really need them in order to grasp the main idea of the communication.

By contrast, a set of parentheses in mathematics is vital. The information contained within the parentheses is primary; so primary, in fact, that it must be done first. A child must learn to distinguish when a symbol indicates primary or secondary information. He must know when he should include or may exclude the contained unit of meaning.

3*5+4-3*6 = 1
3*5+(4-3)*6 = 21
3*(5+4-3)*6 = 108

cate and those around us do not understand, we redouble our efforts so that we are understood. We learn from our mistakes so that we communicate more clearly in future. Perhaps if we taught our young children how to use the powerful tools of symbolic representation to communicate effectively, we too would have fewer skirmishes within our flock.