Some Logic Helps

One way to make the logical elements in Harry Stottlemier's Discovery more interesting to children is to get them to enjoy working with sentences beforehand. I have found that puzzles which illustrate logical principles can be used to build initial interest in working with sentences that carries over into the chapters in Harry. Puzzles can also be used as a reward. After a particularly good class, instead of homework the fifth grade students I work with are given a puzzle - something to think about for next time. There are some themes in Harry which can be supplemented with logical riddles; and I will mention one and describe how to do this below. But before I get into a description of the mechanics of using logic puzzles with Harry, some comments about the psychological benefits of puzzles might be useful.

Besides teaching logic to fifth graders, I have taught applied logic to college students for the past four years. A useful technique with these students, many of whom are freshmen and who seem to be in awe of anything written in a book, is to start out with a particularly fallacious letter to the editor or newpaper column. I have spent as much as the first three hours of a college level course going through a letter on sex education in the schools by an irate parent. We analyze the letter line by line, word by word, evaluating each significant unit. We do a social deconstruction of the text. Students gradually begin to participate, to vie with each other in finding examples of bad reasoning.

My next move is to give college students columns by nationally known authors such as Nicholas von Hoffman and George Will. I do not however tell the students who the authors are or identify them as Pulitzer Prize winners until later. I find that my classes proceed to take apart these columns with enthusiasm. When they are later informed of what they have been reading, they seem to posses a new confidence in their ability to detect faulty reasoning. They gain a sense of power over the written word which carries over into the work we do on more substantial pieces later in the course.[1]

But now, back to the fifth graders. It is important that they be given riddles for which they can find the solution. Success gives them a sense that they can master this new subject of reversing sentences and translating sentences into standard form. Add to their success the element of play in the riddles and your chances of getting them to think about sentences improves. And, finally, an occassional riddle that they cannot solve, but that their parents and other teachers find impossible also, gives them the unique satisfaction of finding adults without an answer. When you are so often without answers yourself, it is comforting to have some company. But, enough of this; here are some riddles and some suggested uses.

1. There is a one room cabin. In each of the four walls there is a window which faces south. Outside the window is a bear. What color is the bear?

My students initial reaction to (1) is to guess: brown? black? white? This is not such a bad move on their part from a teaching standpoint if you reply with a question like: how could it be a white bear? Eventually one of the students will ask about the house. There is then some curiosity about how all the windows of the house could face south. I found it necessary to assure them that there could be such a house, but only in one place. Also, they were given the additional information that there could also be one house with windows that faced north. At this point the cabin was pin pointed at the north pole and it was quickly determined that the bear had to be white.

I used the riddle in my first class. Student reaction was one of participation, talking to each other, working on a solution with friends. The obvious logical principle embedded in the riddle is complex question. In order to solve it one must not go right to the stated question about the color of the bear, but instead ask the unstated question about the location of the house. Of course, one does not use the words 'presupposition' and 'complex question' at this point with fifth graders. But they do acquire the corresponding concept that sometimes one has to supply the missing question, before the missing answer.

2. You are trapped in a room and want to get out. There are two doors. Behind one door is a ferocious polar bear, behind the other is a safe way to leave. There are two people in the room with you who know what is behind the doors. All the information you have is that they do know what is behind the doors and that one always tells the truth and the other always lies. How many questions will it take for you to find your way out?[2]

This is one to send the students home with to think about. The instructions I give are to try to solve it with two or three questions, but I also tell them that the solution can be found with just one question. This latter piece of information resulted in their consulting their parents and other teachers about the riddle. And since the adults had no more luck than the children did, some of the children acheived that unique form of gratification I mentioned above - seeing adults without answers.

Most of my students turned in written answers which solved the puzzle in three questions. For example, "I would ask each person if he was a tractor. Then I would ask the one who said no which way to go out." A few students gave two question answers. "Ask one of the persons if $2 + 2 = 5$. If he says no, ask him which way to go. If he says yes, ask him where the polar bear is and go out that way since he is the liar.

In reply to the former type of answer, I ask the student what she would know if the first person said he was a tractor. Once the student sees that she knows who the liar is, I ask if she needs to ask the other person anything to determine if they are the truth teller. The students seemed to quickly see that they could just ask the second person the way out and solve the puzzle in two questions. It took a bit of discussion but they soon also realize that they could also just ask the liar which way out and go the opposite way.

I do not see any need to list here all the different ways the riddle can be answered, but I compile an exhaustive list with the students. For instance, once we know who the liar is we can either ask where the polar bear is or which way is the safe exit as our second question. The point I try to get across with this example is that there is not a one-to-one relationship between a question and correct answers. There can be more than one equally good answer to the same question. By the way, the one question answer to the riddle is at the end of this article.

3. You are on one side of the river with a goat, a wolf, and some cabbages. You want to cross the river but your boat is so small that it can only carry you and one other item at

the same time. Wolves eat goats and goats eat cabbages. Figure out a way to cross the river and not lose your goat or your cabbages. It takes seven trips.

This puzzle is purely for fun, something to do after a particularly good class. It could be used to work on the concept of possibility. Students could be asked to list all the possible combinations of two items out of the three on the shore with them and then asked which can be safely left behind. So they will discover that the goat will make the first trip. In any case, the riddle is not one which fifth graders have too much difficulty doing.

I did get several fanciful answers. One boy stopped in the middle of the river because he had to go to the bathroom. This, I hope, is not a Freudian comment on what he thinks of my class. Another student transported the goat first, went back for the wolf and clubbed him to death with an oar, then transported the cabbages. Riddle solved in only three trips.

4a. I have two coins in my pocket worth a total of thirty cents. One of them is not a quarter. What are the coins? (A nickel and a quarter - one of the coins is not a quarter.)

4b. There is an item sold in hardware stores. Five costs ten cents. Fifty costs twenty cents. Five hundred and eight costs thirty cents. What is the item? (House numbers.)

I do 4a in class with students, then give 4b for homework telling them that it is similar in its funny use of language (ambiguity). They have no problem getting 4a. In fact, the example was booed and their attitude seemed to be that they were too sophisticated to be fooled so easily. About a fifth of my students solved 4b (five out of twenty-two). I do know that the gentleman who runs a local hardware store was not successful. We solved this one in class after I asked several students their address and told them what two hundred seven cost, etc. . .

Besides illustrating the fallacy of ambiguity, these examples can have a practical application. We listed the names of several local airline companies on the board. Then, the class was asked to consider the advertisement of one company that claimed that no one flies you to Florida for less than they do. Students were told that the rate was $99 and asked what the cheapest fare on another airline could be. One hopes that they learned a little bit about commercials from the answer. I plan to go back to this example in the future as a lead in to a discussion of lying.

5a. You own a wooden raft made of 30 separate planks. Each year six of the boards rot and have to be replaced. After five years when all the original boards are gone from the raft, is it the same boat? If not, when does it become a new boat?

5b. Give the same information as 5a plus the fact that the old boards are stored in a shed and at the end of five years are reassembled. Which boat is the same boat now?

The purpose of these two riddles is to get children thinking about identity conditions through time. Most students accept the raft in 5a as the same raft. When asked for reasons they cite: same name, same owner, same use, and gradual replacement of the planks. A few students say it is a new raft when all the original boards have been replaced. The move to make with these children is to back them up a year: ask them if the five year old boat is the same one as the four year old raft since only six boards are changed. Then ask how many boats there are according to their view -six?

I use 5b to combat the view that identity through time is a matter of having the same name. Also, 5b suggests that identity might depend on the issue of what other candidates are available for the role of same thing. In 5a there is no closer competitor for the designation 'same boat', in 5b there is a closer competitor. One can imagine a 5c in which both rafts are in the water and one competitor sinks.

These two examples were helpful to my students in beginning to discuss the characters in Harry. What things about Harry make him the same person besides his name? One can also use the raft examples as an analogy in doing the exercise on personal identity. When the question is raised about whether you are the same person you were as a baby parallels can be drawn between the gradual replacement of planks and physical changes to a person's body. Also, 5b can be used in conjunction with the role of having a twin in questions of personal identity. If you had a twin would you be one person or two? When you are asleep and your twin is not, are you awake?

So, in summary, it seems that puzzles can be used in several profitable ways. Students can accept logic as enjoyable, they gain a sense of their own reasoning powers, they begin to work in communities, and they can see the point of some of the discussions in Harry a bit better if they use puzzles as analogies for the more overtly philosophical topics.

Answer to puzzle 2:

Which door will the other guy tell me is the way out? Then you go the opposite way. Conversely, which door will the other guy tell me is the door to the polar bear? Then exit that way.

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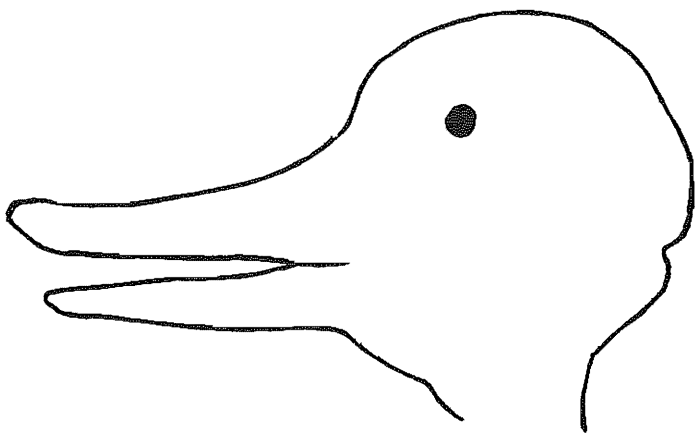

DUCK-RABBIT

Footnotes

[1]Another way of building self confidence in students who watch a lot of television is to show them a fallacious piece of television journalism or a message film. Two favorites of college freshmen are Nixon's Checkers speech and the film Absence of Malice.

[2]This and many other similar riddles can be found in: Raymond M. Smullyan, What is the Name of This Book? New Jersey: Prentice-Hall, 1978