

Four Riddles with Four Brothers

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We present four logic riddles by Raymond Smullyan, taken from his book ‘To Mock a Mockingbird’. In these riddles there are four identical brothers: Arthur, Bernard, Charles, and David. They are quadruplets and they are indistinguishable in appearance.

Arthur is an *accurate truth-teller*, namely he gets everything right and tells the truth (he will give you correct answers). Bernard is an *inaccurate truth-teller*, namely he is totally deluded in all his beliefs but always states honestly what he does believe (he will give you wrong answers). Charles is an *accurate liar*, namely all his beliefs are correct, but he lies about every one of them (he will give you wrong answers). David is an *inaccurate liar*, namely he is totally deluded in all his beliefs and he always lies about what he believes (he will give you correct answers).

For example, suppose that you ask to one of the brothers “Are you Arthur?”. Then Arthur knows the correct answer (yes), is truthful, and answers yes. Bernard knows the wrong answer (yes), is truthful, and answers yes. Charles knows the correct answer (no), lies, and answers yes. David knows the wrong answer (yes), lies, and answers no.

1. Suppose you meet one of the four brothers. You wish to find out his first name, and you are allowed to ask only yes/no questions. What are two suitable questions?
2. You once met one of the four brothers and asked him a yes/no question. Asking it was pointless, because you could have known in advance what the answer would be. Can you supply such a question?
3. Suppose you ask each of the four brothers: “Do you believe that two plus two equals four?” What will each brother answer?
4. You have the photograph of one of the brothers. If you ask each of them whether it is his photograph, three of them will answer no and one will answer yes. If you ask each one whether he believes it is his photograph, then again three will answer no and one will answer yes. Whose photograph is it?

Solutions

1. You first ask whether two plus two equals four, and then you ask “Are you Arthur or Bertrand?”. If the first answer is yes, then you know that the brother answers all questions correctly and hence he is either Arthur or David. If the second answer is yes, then he is Arthur; if the second answer is no, then he is David. If the first answer is no, then you know that the brother answers all questions wrongly and hence he is either Bernard or Charles. If the second answer is yes, then he is Charles; if the second answer is no, then he is Bertrand.
2. The question could have been: “Are you Arthur or David?” Indeed, each brother answers yes to this question. Arthur answers yes because yes is the correct answer, he believes that the answer is yes, and tells the truth. Bernard answers yes because no is the correct answer, he believes that the answer is yes, and tells the truth. Charles answers yes because no is the correct answer, he believes that the answer is no, and he lies. David answers yes because yes is the correct answer, he believes that the answer is no, and he lies.
3. The correct answer to the question asked is yes for Arthur and Charles because they have a clear mind: the former gives the correct answer, while the latter lies and gives the wrong answer. Bernard doesn’t think that two plus two equals four, and so the correct answer to the question is no, but he gives only incorrect answers, so he answers yes. David doesn’t think that two plus two equals four, and so the correct answer to the question is no: being an inaccurate liar he gives the correct answer, so he answers no.

In summary, the truth-tellers answer yes and the liars answer no.
4. The photograph is of Charles. If the photograph were of Arthur, then only David would answer no to the first question. If the photograph were of Bernard, then only Arthur would answer no to the second question. If the photograph were of David, then only Arthur would answer no to the first question.