**CRITICAL THINKING**

**by Simon Moss**

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| **Introduction** |

To complete a thesis—and indeed to thrive at work—you need to demonstrate excellent critical thinking skills. Almost everyone agrees that critical thinking is vital. Yet, nobody quite agrees what critical thinking is or how critical thinking can be developed.

Despite this variability, most scholars agree that people who think critically can identify, and potentially correct, the flaws and fallacies in the arguments that other people propose. Therefore, this document illustrates many examples of these flaws and may improve your capacity to think critically.

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| **Can you identify these common logical fallacies?** |

This section presents several pairs of statements. Your task is to decide which statement is unconvincing and which statement is more compelling.

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| The bandwagon fallacy and appeal to authority | |
| Statement 1 | Statement 2 |
| Many researchers believe that watermelons, honeydew, and cantaloupe enhance intelligence, indicating that melons are beneficial. | Many researchers believe that watermelons, honeydew, and cantaloupe enhance intelligence, implying the campaign to promote the benefits of melons may have been effective |

In this instance, Statement 1 is an example of the bandwagon effect and is thus flawed. This statement does not indicate that researchers have collected evidence that melons enhance intelligence. These researchers merely believe that melons enhance intelligence. Many people, including researchers, often express beliefs that are incorrect. Hence, this belief that melons enhance intelligence could be incorrect as well. In practice

* If researchers suggest that some statement is correct, do not assume the statement is correct
* instead, assess whether these researchers have collected evidence that supports this statement.
* the bandwagon effect refers to the tendency of students to trust a statement that many people believe. Appeal to authority refers to the tendency of students to trust a statement that an expert believes.

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| The equivocation fallacy | |
| Statement 1 | Statement 2 |
| George W Bush was not an ethical person. He often played golf, indicating his work ethic was limited. | George W Bush was not an ethical person. He often cheated while playing golf. |

In this instance, Statement 2 is probably sound. In contrast, Statement 1 demonstrates the equivocation fallacy. That is, the meaning of *ethical* in the first sentence is different to the meaning of *ethic* in the second sentence. Consequently, the observation that his work ethic is limited does not indicate his ethical behavior is limited. When people demonstrate the equivocation fallacy, they incorrectly imply that all instances of some word correspond to the same meaning. In practice

* identify words that are repeated in an argument
* does the author imply these words always imply the same meaning
* if so, determine whether these words actually imply the same meaning
* practice this set of instructions by re-assessing Statement 1 in the previous table.

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| Circular arguments | |
| Statement 1 | Statement 2 |
| Without gravity, an object that is denser than water would not sink | An object that is less dense than water will float because these objects do not sink |

In this instance, Statement 2 is a circular argument. That is, the first portion of the argument is merely a belief—the belief that an object that is less dense than water will float. The second sentence does not substantiate this belief but merely assumes this belief is correct. That is, the proposal that such an *object will not sink* is merely another way to write that that *an object that is less dense than water will float*. In practice

* when evaluating an argument, identify the sentence or portion that is touted as evidence or proof of some belief
* then determine whether this evidence is compelling or merely assumes this belief is true

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| Slippery slope fallacy | |
| Statement 1 | Statement 2 |
| If you prohibit an overweight child from eating a biscuit today, the child might become upset and actually eat more biscuits when you are not watching. | If you permit an overweight child to eat one biscuit today, you might let this child eat two biscuits tomorrow, three biscuits the next day, until they are eating a multitude of biscuits. |

In this instance, whether Statement 1 is correct or not is not certain, but the logic is not necessarily flawed. In contrast, Statement 2 represents the slippery slope fallacy. In essence, the reader assumes that one small act or problem will inevitably evolve into more extreme acts or problems. But this argument is incorrect: In this example, the person might stop at one biscuit. In practice

* be attuned to arguments that resemble the form “If you accept one slightly unfavorable act, more severe problems will unfold in the future”
* in response to these arguments, consider how individuals or organizations might be able to prevent the more severe problems even if they accept the slightly unfavorable act.

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| False dichotomy | |
| Statement 1 | Statement 2 |
| Most people in Australia seldom attend religious services and thus tend to be atheists. | Most people in Australia attend religious services |

Statement 2 might not be accurate but is not illogical. But Statement 1 is illogical: The statement indicates that people either attend religious services or are atheists. That is, the statement assumes that everyone belongs to one of two categories. But perhaps other categories are possible, such as people who do not attend church but still believe in god. Hence, this statement reflects what is called a false dichotomy.

Another variant of false dichotomies are statements that incorrectly assume that two categories are mutually exclusive, such as “Most people in Australia attend religious services and thus are not atheists”. Arguably, these two categories—attending religious services and atheism—are not mutually exclusive. People could attend religious services and also be atheists. They might attend church only because they feel obliged. In practice,

* whenever evaluating arguments, identify the main categories, such as people who attend services and atheists
* consider whether some people do not belong to either category or belong to both categories; if so, does this realization contradict the argument?

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| Composition, division, or aggregation biases | |
| Statement 1 | Statement 2 |
| This organization has developed a recruitment approach that attracts and selects only people who are very innovative. Therefore, the employees in this organization tend to be very innovative. | Most of the employees in this organization are very innovative. Therefore, the organization is very innovative |

Statement 2 is incorrect. A feature that is true to part of some object may not be true to the whole object. All employees of an organization might be innovative: But the organization might not be innovative. For example, if the organization is not managed well, these innovative employees might attempt to sabotage each other.

An amusing example revolves around how the features of human cells do not generalize to the features of humans. Cells are invisible. But humans are not invisible. Or consider this example

* When people eat excessively, they accumulate more fat over their body.
* Fat in the brain diminishes intelligence.
* Therefore, if people eat excessively, their intelligence diminishes

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| Eat excessively | Fat accumulates | Fat on brain impairs IQ |

Is this logic correct? No. When people eat excessively, fat might accumulate on parts of their body. But fat might not accumulate on all parts of the body. So fat might not accumulate in the brain.

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| **Can you identify these common research fallacies?** |

Some logical fallacies are especially common in research. Indeed, many research designs have been designed to prevent these fallacies.

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| Problems with causality: Opposite direction of causality | |
| Statement 1 | Statement 2 |
| In this study, nations that spend more on sport tend to excel at the Olympic Games. That is, funding sporting organizations is positively associated with the number of medals | In this study, nations that spend more on sport tend to excel at the Olympic Games. Therefore distributing more funds to sporting organizations should increase success at the Olympic games |

In this instance, Statement 2 is flawed. The first sentence does not necessarily indicate that spending money on sport enhances performance at the Olympic Games. Instead, the opposite direction of causality is possible: strong performances at the Olympic Games might encourage more spending in sport. For example, if nations excel at the Olympics, citizens might participate more often in sport, and so the government might then need to devote more funds to sport. So, in practice

* whenever two variables are correlated with each other, recognize that you cannot be certain which variable is the cause and which variable is the effect
* a design called the randomized control trial or experiment prevents this problem

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| Problems with causality: Spurious variables | |
| Statement 1 | Statement 2 |
| In this study, nations that spend more on sport tend to excel at the Olympic Games. Therefore either distributing funds to sporting organizations will enhance performance at the Olympic Games, or performance at the Olympic Games will encourage more funding to sporting organizations | In this study, nations that spend more on sport tend to excel at the Olympic Games. Researchers should thus conduct a randomized control trial, or experiment, to ascertain whether increasing funding to sporting organizations does indeed attract more Olympic gold medals. |

In this instance, Statement 2 is reasonable. However, Statement 1 is flawed. Another explanation of this observed relationship between spending in sport and Olympic success is possible, called a spurious variable. Specifically

* some other variable could affect both spending in sport and Olympic success—such as GDP
* for example, when GDP is high, both spending in sport and Olympic success is likely to be high
* so, a subset of nations will report high spending in sport and Olympic success
* because of these nations, spending in sport will seem to be related to Olympic success.

In the following table, the high levels of spending in sport appear to coincide with the high levels of Olympic gold medals—as the top four rows in particular show. These two variables would seem to be related to each other, even if spending in sport and Olympic success did not actually affect one another. The relationship is thus spurious.

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| GDP | Spending in sport | Olympic gold medals |
| $ 893.5 billion | $ 5.1 billion | 34 |
| $ 473.8 billion | $ 9.1 billion | 54 |
| $ 453.5 billion | $ 7.1 billion | 36 |
| $ 145.5 billion | $ 1.2 billion | 29 |
| $ 3.5 billion | $ 0.4 billion | 3 |
| $ 9.4 billion | $ 0.1 billion | 2 |
| $ 2.1 billion | $ 0.3 billion | 3 |
| $ 4.5 billion | $ 0.2 billion | 3 |
| $ 3.5 billion | $ 0.1 billion | 2 |

Observed relationships between variables can always be ascribed to either the opposite direction of causality or to spurious variables, except in one circumstance: when the researcher has utilized a design called an experiment or randomized control trial. So, what is an experiment randomized control trial?

* In this design, the researcher randomly allocates individuals, animals, specimens, and so forth to one of two or more conditions.
* For example, the researcher could randomly choose which nations receive funding for sport and which nations do not receive funding for sport—something that would not, of course, be possible in practice.

Now suppose that, after this allocation of money, funding in sport is positively associated with Olympic success. Can this relationship now be ascribed to the opposite direction of causality? That is, can this finding be ascribed to the notion that Olympic success promotes funding in sport rather than vice versa. The answer is no: The researcher, and not Olympic success, determined funding in sport. So this figure below could not be correct.

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| Spending in sport |  | Success at the Games |

Can this relationship be ascribed to spurious variables. Again the answer is no, because the researcher, and not GDP or another variable, determined funding in sport. The figure below could not be correct. In short, when an experiment or randomized control trial is utilized, researchers can be certain which variables are the cause and which variables are the effects or outcomes.

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|  | GDP or another spurious variable |  |
| Spending in sport |  | Success at the Games |

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| The generalization fallacy | |
| Statement 1 | Statement 2 |
| In a sample of University students, the number of Facebook friends of each student was positively associated with their happiness. Therefore, people with more Facebook friends are more likely to experience a positive mood | In a sample of University students, the number of Facebook friends of each student was positively associated with their happiness. Nevertheless, this finding does not indicate that deliberately accruing more Facebook friends will improve mood. |

Statement 2 is correct. In contrast, Statement 1 is potentially misleading. The study demonstrated that number of Facebook friends is associated with happiness in University students. However, this finding might not generalize or apply to other people. That is, number of Facebook friends may not be associated with happiness in all segments of the population.

Nevertheless, in practice, some researchers overestimate this problem called the generalization bias or overgeneralization. They believe that any study that is conducted on University students does not generalize to the broader population.

But, this position is somewhat excessive. To illustrate, suppose researchers found that University students who floss their teeth are less likely to exhibit tooth decay. Researchers can probably generalize this finding to the broader population. That is, the benefits of flossing should not differ significantly between University students and other segments of the population. If flossing is beneficial to University students, flossing is likely to be beneficial to the broader population.

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| Non-significant results—and appeals to ignorance | |
| Statement 1 | Statement 2 |
| Smith (2010) examined whether carrot consumption was related to IQ. Smith did not accrue enough evidence to demonstrate that carrot consumption is related to IQ: That is, the association between carrot consumption and IQ was not significant. Therefore, carrot consumption does not improve IQ. | Smith (2010) examined whether carrot consumption was related to IQ. Smith did not accrue enough evidence to demonstrate that carrot consumption is related to IQ: That is, the association between carrot consumption and IQ was not significant. Therefore, whether carrot consumption improves IQ is uncertain at this time. |

In this instance, Statement 1 is actually incorrect. To illustrate, if Smith had shown that carrot consumption did improve IQ markedly, we could be quite confident that carrots are beneficial. But, instead Smith reports that carrot consumption does not seem to be related to IQ, we cannot be as certain that carrots are not beneficial. The findings could be ascribed to many other reasons. Perhaps Smith did not assess IQ accurately enough. Perhaps Smith did not assess enough people. In practice

* Remember that non-significant results are not as convincing as significant results.
* Non-significant results can often be ascribed to a flawed study.

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| **A culture of critical thinking** |

In some nations and in some cultures, students are expected to accept the opinions of authorities, such as supervisors and lecturers. In Australia, however, students are encouraged to question the opinions of authorities. For example, research students in Australia should

* consider whether the beliefs and suggestions of the supervisor have been justified convincingly—either with evidence or logic
* if they feel these beliefs or suggestions may be incorrect, they could politely express a different perspective. For example, if a supervisor suggests “spending in sport promotes Olympic success”, the student could say “Or could Olympic success promote spending in sports?”

In other words, in Australia, you are not expected to merely accept all the beliefs or suggestions of supervisors. You are welcome to question your supervisors, but politely rather than belligerently of course.