

# The Monash Critical Thinking Study

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## 1. The Monash Critical Thinking Study

### **Aims:**

- To investigate the factors that effect improvements in critical thinking
- To discover what methods of teaching critical thinking lead to some improvement

### **Specific methods and techniques:**

1. Argument mapping
2. Actively Open-Minded Thinking
3. Peer-instruction

## 1. The Monash Critical Thinking Study

### **Methodology**

- Single semester critical thinking course: PHL1030: *Thinking: Analysing arguments*.
- Students are pre-tested and post-tested using two different measures:
  - California Critical Thinking Skills Test (CCTST)
  - Critical Thinking section of the Graduate Skills Assessment (GSA)
- The course runs in both semesters and the teaching methodology varied each time.
- A control group of students in other first year philosophy subjects are also pre- and post-tested.
- Lectures stay the same, instruction is varied in the tutorials.

## 1. The Monash Critical Thinking Study

### **Overview of the course**

- Twelve weeks of instruction.
- One hour lecture per week.
- Two hour tutorial per week.
- 4-6 homework assignments.
- Tutorials and homework practice consists of:
  1. Exercises using LSAT logical reasoning questions
  2. Analysis and evaluation, mainly through class discussion, of example arguments. Various sources: philosophy, science, law, politics. Since 2004, used examples from Singer's *The President of Good and Evil*.

## 1. The Monash Critical Thinking Study

### **Course structure**

1. Argument analysis (identifying conclusions and premises, argument structure) 30%
2. Argument evaluation (truth, relevance, strength) 20%
3. Criticism (criticising arguments, repairing arguments) 20%
4. Fallacies 30%

## 1. The Monash Critical Thinking Study

### **Teaching methodologies:**

- 2003 S2 Pilot study
- 2004 S1 Argument mapping with automated feedback
- 2004 S2 Standard course (no special method)
- 2005 S1 Reasonable
- 2005 S2 AOMT
- 2006 S1 Peer instruction

## 2. Argument Mapping with Automated Feedback

Acquiring expertise in critical thinking, as in other areas, requires large amounts of *deliberate practice*.

Deliberate practice must be:

1. Motivated
2. Guided
3. Scaffolded
4. Graduated
5. Feedback provided

The use of computer software helps to achieve this, without expensive one-on-one tutoring.

**Question:** Can feedback be automated?

## 2. Argument Mapping with Automated Feedback

[ArgumentMaps\Demo\AM\DemoExercises1.html](#)

## 2. Argument Mapping with Automated Feedback

1. Students spent approximately 30-40 minutes each week on these exercises.
2. Made available on the WebCT website for the course
3. Students could complete exercises at home if they did not finish them in class.

## 2. Argument Mapping with Automated Feedback

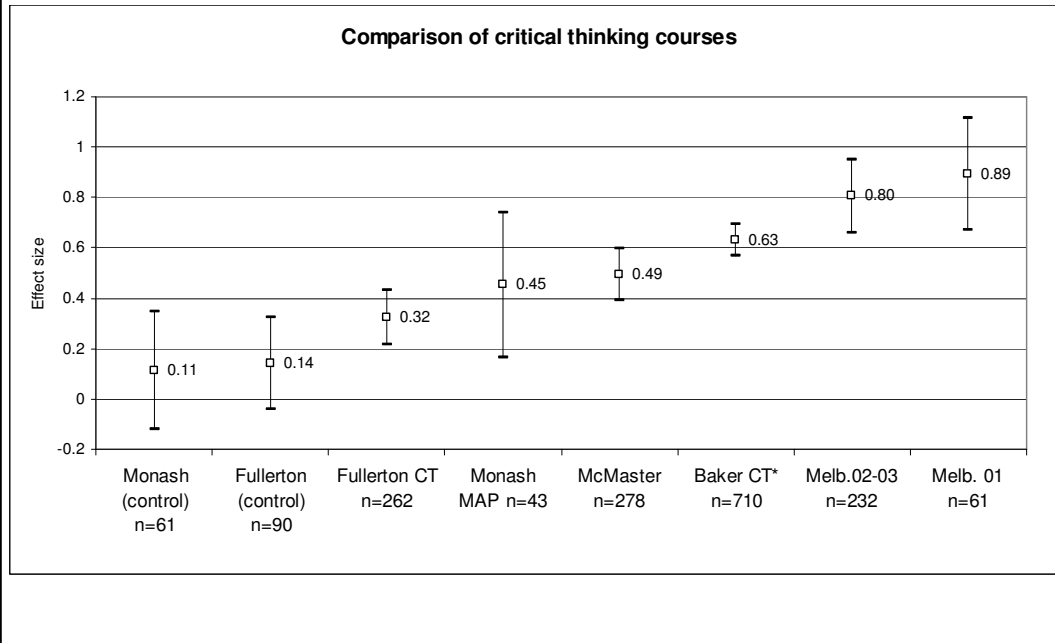
### **Results**

Students showed statistically significant improvement in critical thinking scores.

Average improvement: 14%.

Effect size: **0.45** standard deviations. ( $n = 43$ )

## 2. Argument Mapping with Automated Feedback



## 2. Argument Mapping with Automated Feedback

### Possible future R&D

1. Better integration with other course materials
2. Making the feedback more informative
3. Throwing away the scaffolding – allowing for free form exercises with model solutions
4. Argument evaluation
5. Hypothetical arguments – inferences that discharge assumptions

### 3. Actively Open-Minded Thinking (AOMT)

AOMT is “the willingness to search actively for evidence against one’s favoured beliefs, plans or goals and to weigh such evidence fairly when it is available” (Baron 2002)

There is a great deal of evidence that AOMT is not widespread in the general population.

In particular, evidence for widespread confirmation bias or “myside” bias.

People tend to overestimate arguments for claims they already accept and underestimate arguments against claims they accept.

AOMT is the disposition and ability to avoid myside bias.

### 3. An illustration of myside bias

**Which of these arguments are valid?**

1. All things with four legs are dangerous. Poodles are not dangerous. Therefore, poodles do not have four legs.
2. All mammals walk. Whales are mammals. Therefore, whales walk.
3. All African countries are hot. Canada is not an African country. Therefore, Canada is not hot.
4. All things that are alive drink water. Televisions do not drink water. Therefore, televisions are not alive.
5. All nuts can be eaten. Rocks cannot be eaten. Therefore, rocks are not nuts.
6. All things made of wood can be used as fuel. Petrol is not made of wood. Therefore, Petrol cannot be used as fuel.

### 3. An illustration of myside bias

#### Which of these arguments are valid?

- |   |  |
|---|--|
| ➤ All things with four legs are dangerous. Poodles are not dangerous. Therefore, poodles do not have four legs. | ➤ All things that are alive drink water. Televisions do not drink water. Therefore, televisions are not alive.       |
| ➤ All mammals walk. Whales are mammals. Therefore, whales walk.   | ➤ All nuts can be eaten. Rocks cannot be eaten. Therefore, rocks are not nuts.                                       |
| ✗ All African countries are hot. Canada is not an African country. Therefore, Canada is not hot.                | ✗ All things made of wood can be used as fuel. Petrol is not made of wood. Therefore, Petrol cannot be used as fuel. |

The arguments in the first column are all either valid arguments with false conclusions or invalid arguments with true conclusions.

The arguments in the second column are all either valid arguments with true conclusions, or invalid arguments with false conclusions.

People are more likely to make a mistake on the arguments in the first column than on the arguments in the second column.

### 3. Actively Open-Minded Thinking (AOMT)

#### What factors affect individual differences in AOMT?

1. Some evidence that cognitive ability (general intelligence) is positively correlated with AOMT.
2. Also evidence that certain attitudes to thinking, or thinking dispositions are also positively correlated with AOMT.

### 3. Actively Open-Minded Thinking (AOMT)

#### Thinking Dispositions Questionnaire

1. There is nothing wrong with being undecided about many issues.
2. Difficulties can usually be overcome by thinking about a problem, rather than waiting for good fortune.
3. Changing your mind is a sign of weakness.
4. Intuition is the best guide to making many decisions.

Studies have shown that people who agree with statements like 1-2 and disagree with statements like 3-4 perform much better on a wide variety of reasoning tasks and are less prone to myside and other biases.

(Stanovich and West, 1997, 1998)

### 3. Actively Open-Minded Thinking (AOMT)

Perhaps people do not reason well because they are not disposed to.

#### Two questions:

1. Does specific instruction aimed at improving AOMT abilities and attitudes lead to an improvement in critical thinking?
2. Are AOMT attitudes associated with performance and gains on critical thinking tests?

### 3. Actively Open-Minded Thinking (AOMT)

#### **AOMT teaching strategies**

1. Students were taught about some of the empirical evidence for myside bias and the evidence that AOMT reduces bias and improves thinking.
2. Exercises that focus on the ability of students to find alternative explanations or counter-evidence for a given claim.
3. Students taught that good arguments must take into account all the relevant evidence and counter-arguments or possible objections to the reasoning or premises.
4. Exercises in which students must criticise arguments in support of their own position on the topic under discussion and suggest evidence or arguments against their position.
5. Exercises in which students are instructed not just to pick the answer, but to actively look for evidence against their choice, by carefully considering the alternatives.

### 3. Actively Open-Minded Thinking (AOMT)

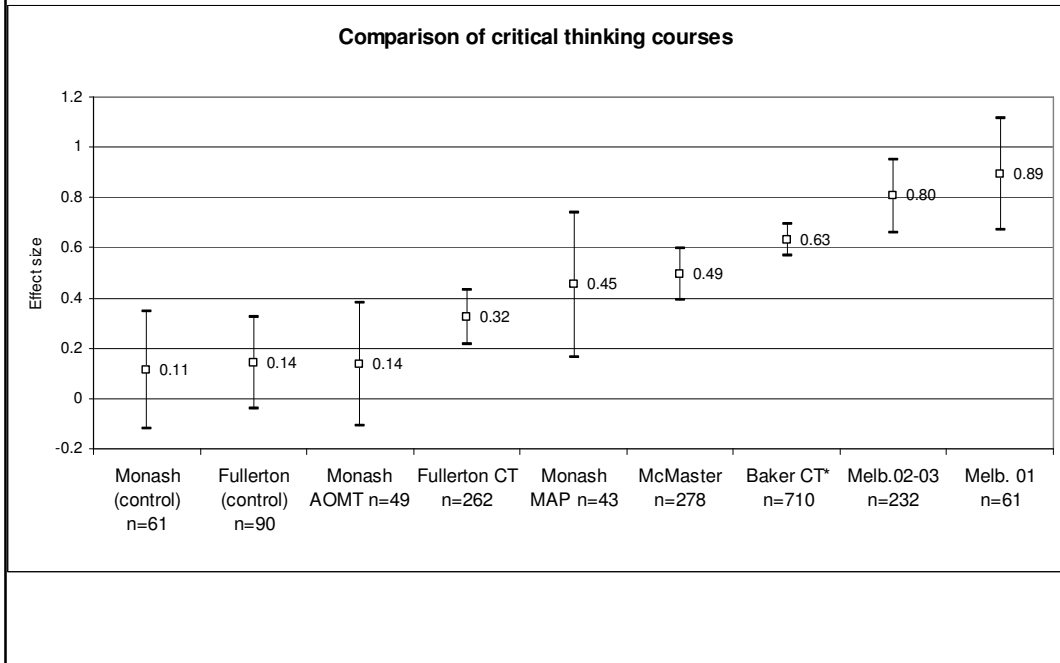
#### **Results**

1. Students showed no statistically significant improvement in critical thinking scores.

Average improvement: 7%.

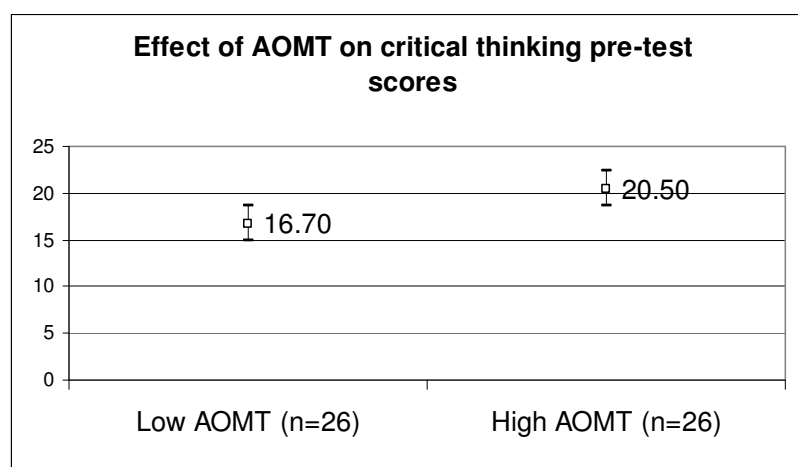
Effect size: **0.14** standard deviations. ( $n = 49$ )

### 3. Actively Open-Minded Thinking (AOMT)



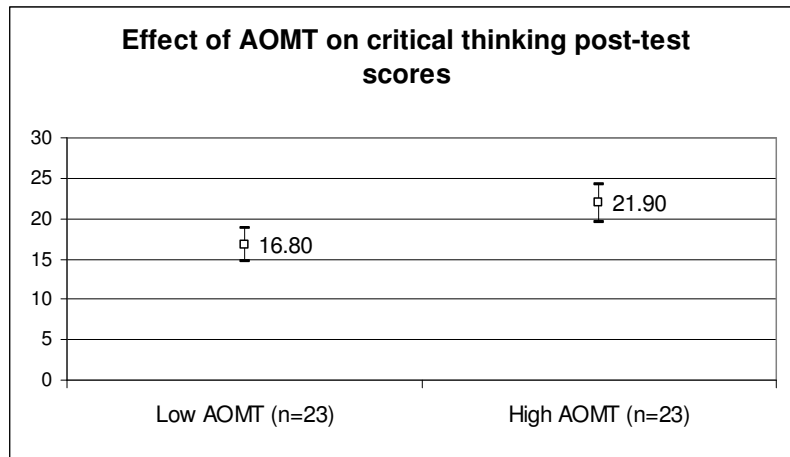
### 3. Actively Open-Minded Thinking (AOMT)

2. There was a significant correlation between open-minded attitudes and critical thinking test scores. (Pre-test:  $r = 0.32$ ,  $n = 52$ )



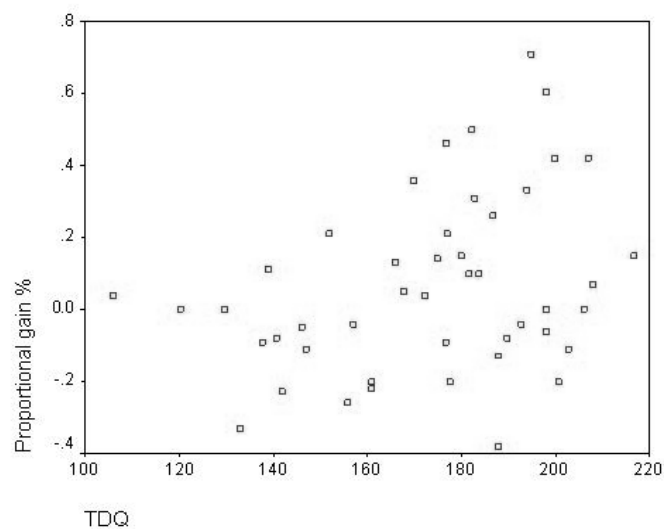
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2. There was a significant correlation between open-minded attitudes and critical thinking test scores.  
(Post-test:  $r = 0.5$ ,  $n = 46$ )



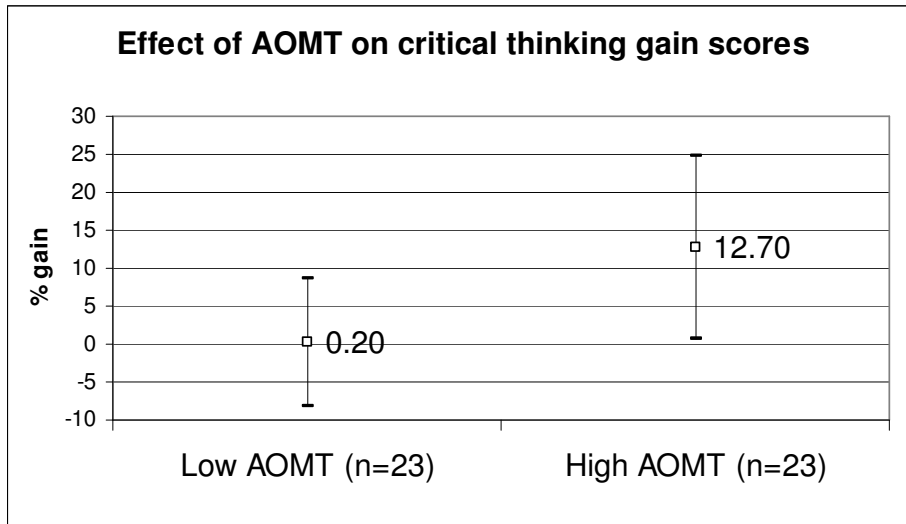
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3. There was a significant correlation between open-minded attitudes and *improvement* in critical thinking.  
( $r = 0.33$ ,  $n = 46$ ).



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### All results

