

# **Chess and Meta-cognition, a pilot study.**

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# What is the definition of Meta-cognition?

- Meta-cognition has been used to refer to two distinct, yet inter-related, concepts:
  - 1) Knowledge about cognition.
  - 2) Regulation of cognition.

“Meta-cognition refers loosely to one's knowledge and control of his/her cognitive system” (Brown, 1987).

# 1) Meta-cognitive Knowledge

- We can categorize meta-cognitive knowledge according to a person's awareness of his/her:
  - 1) Declarative knowledge: it refers to “knowing what”.
  - 2) Procedural knowledge: it refers to “knowing how”.
  - 3) Conditional knowledge: it refers to “knowing when and why”. (Brown, 1987).

## 2) Meta-cognitive regulation

- “It is the ability to use meta-cognition knowledge **STRATEGICALLY** to achieve cognitive goals, especially in cases that someone needs to overcome cognitive obstacle”. (Panaoura & Philippou, 2007).
- Put simply, it is the capability of wielding effectively and consciously his/her own knowledge.

# Why is Meta-cognition so important for a student?

- A student, even in primary school, is requested to develop complex “competencies” (Le Boterf, 2008), in domains where the mere application of a simple procedural algorithm is not always sufficient (such as Mathematics).
- So he/she needs to be aware of his/her knowledge and he/she needs to know how to manage his/her knowledge.
  - Do I know how good/bad I am in this task?
  - Do I know whether this strategy can be used in another context?

# Why is Meta-cognition so important for a student?

- “Successful learners are able to swiftly transfer the knowledge and strategies acquired in one situation to new situations, modifying and extending these strategy on the way” (Panaoura & Philippou, 2007).
- Meta-cognition is one of most important predictor of students' success in school (Albanese et al., 2003).
- Meta-cognition and mathematical skills (such as problem solving) are highly correlated (Kazemi et al., 2010).

## And what about the relationship between Chess and Meta-cognition?

- Knowledge and regulation of cognition are needed when we play chess. We are “forced” to think strategically, and we are “forced” to know what to do, how and when to do it, and why we should do it.
- But can chess train meta-cognition in order to improve a pupil's meta-cognitive ability in other domains?
- The famous *problem of transfer* (Gobet & Campitelli, 2006).

## Kazemi et al. (2012) study

- Method: 180 subjects (5<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> grades) were randomly assigned to an experimental (6 months of chess training) and to a control (regular school activity) groups. They were assessed on meta-cognition (Panaoura et al. 2003) and on mathematics (TIMSS).
- Results: the chessplayers outperformed the non-chessplayers both in maths ( $d=0,69$ ) and in meta-cognition ( $d=0,83$ ).
- Main flaw of the study: there was no pretest.

## Some examples of Meta-cognition items

“My performance depends on my will and my effort”.

“When I finish my work I wonder whether I have learned new important things”.

“I use different ways to learn something according to the subject”.

The pupils answer on a Likert scale: 1 Never, 2 Seldom, 3 Sometimes, 4 Often, 5 Always.

## Our study (Sala, Trinchero)

Theoretical background: intelligence is a repertoire of universal cognitive functions, able to operate on every content (Feuerstein et al., 2006). Pupils, towards chess, usually have an intrinsic motivation. So, chess is potentially a *medium* through which some intellectual abilities are boosted and transferred.

Two key points: 1) some cognitive abilities are **CONTEXT-INDEPENDENT**; 2) some cognitive abilities are **TRAINABLE**.

## Our study (Sala, Trincherro)

It is still a controversial issue,  
but we need to believe.

(Influential metaphysics;  
Lakatos, 2001)

## Our study (Sala, Trincherro)

- Method: 78 subjects (3<sup>th</sup> and 4<sup>th</sup> graders) were randomly assigned to an experimental (10-12 hours of chess training) and to a control (regular school activity) groups. They were assessed on meta-cognition (Panaoura et al. 2003), on mathematics (OECD-PISA) and on chess abilities.
- Results: No difference between the two groups (in terms of mathematics and meta-cognition).

## Possible interpretations of the data

The children of the experimental group improved in neither mathematics nor meta-cognition. It is possible that:

- 1) The chess intervention was too limited (only 12 hours).
- 2) The mathematical items were too difficult (OECD-PISA).
- 3) Chess does not foster mathematical or meta-cognitive skills.

## Possible interpretations of the data

But the literature (Nicotera & Stuit, 2014) suggests that chess does improve mathematical abilities, so it is reasonable to suppose that our study was a faux pas, but in the right direction.

Moreover, the outcomes of Trinchero, Dominici & Sala (2014) seem to uphold the idea that chess training can build habits of mind.

We should clarify the link between chess, meta-cognition and mathematics.

# The new oncoming studies: CASTLE and Chess & Checkers

## Methods:

### 1) A new three groups design (C&C):

- Chess (Experimental Group 1)
- Checkers (Experimental Group 2)
- Control ( Do-nothing group)

### 2) More hours:

- 25 hours of in-presence lesson.
- Or 15 hours of in-presence lesson along with 10 hours of web training (Victor Chess House).

# The new oncoming studies: CASTLE and Chess and Checkers

## 3) New tests for the assessment of mathematics and meta-cognition:

- TIMSS items (more accessible for primary school children) and OECD-PISA items (mathematics).
- Panoura & Philippou (2007) test (meta-cognition).

4) A bigger sample: about 600 primary school pupils (mainly 3th graders).

## The new oncoming studies: CASTLE and Chess and Checkers

Problem: if the previous studies clearly suggest that chess increases children's mathematical abilities, then why does this improvement occur?

Maybe the direction of causality is

CHESS → META-COGNITION → MATHS

If chess is a “meta-cognitive” game it is reasonable to assume that it can increase the awareness of children about their knowledge and regulation of their cognitive skills.

Possibly, chess promotes a *forma mentis*.