TEACHING PRACTICES IN SCIENCE: A SURVEY OF PRIMARY TEACHERS IN THE FRENCH SPEAKING COMMUNITY OF BELGIUM

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General Context: French speaking Community of Belgium (BE-Fr)

- Secondary Education
  - Performance in science
    - PISA 2000 to 2012: performance of 15 year-old students largely below the OECD average
    - TIMSS 95: the same was true for grade 7 and grade 8
    - FISS 1971: quite low performance
  - Science implemented curricula
    - PISA 2006 - Student Questionnaire: very few experimental activities and less academic pressure than for Maths and Reading
- Primary Education
  - Performance in science
    - No assessment available so far
  - Science implemented curricula
    - National study in 98: teachers reported a low self-efficacy/self-confidence and a small time allocated to science

STUDY CONTEXT

- Assumption that the low performances already occur in primary education. In fact, TIMSS study highlights a very high rank correlation between population I (grade 3/4) and population II (grade 7/8):
  - TIMSS 95 :0.84 – 97: 0.92 – 11: 0.94

→Focus on primary education of BE-Fr.

- State of the science teaching practices (self-reported)
- State of the self-confidence of teachers

State of the art

- Teaching and learning activities have an effect on the development of scientific competencies and interest (Furtak, Seidel, Iverson & Briggs, 2012)
- Four main factors for educational effectiveness (Creemers and Kyriakides, 2008):
  - Teacher's qualifications and professional development
  - Teaching practices and classroom climate
  - Learning time
  - Learning opportunities

State of the art

- Effective teaching practices in science:
  1. **General** instructional qualities: classroom management, supportive climate and cognitive activation (Klieme, Pauli and Reusser, 2009)
  2. **Science-specific** instructional activities related to inquiry-based instruction (Furtak *et al*, 2012):
     - Cognitive and social activities of the student: conceptual, procedural, epistemic and social activities
     - Guidance by the teacher: balance of leading between teacher and student

- Negative self-efficacy and self-confidence have some negative effects on pedagogical practices (Enochs and Riggs, 1990).

General 'investigation field'

- What are the teaching practices of our primary teachers in science?
- What is the reported learning time for science?
- How confident and effective do they feel in their own science teaching?
- What is the place attributed to science in their professional development ?
- To what extent does their school support science?

Methodology

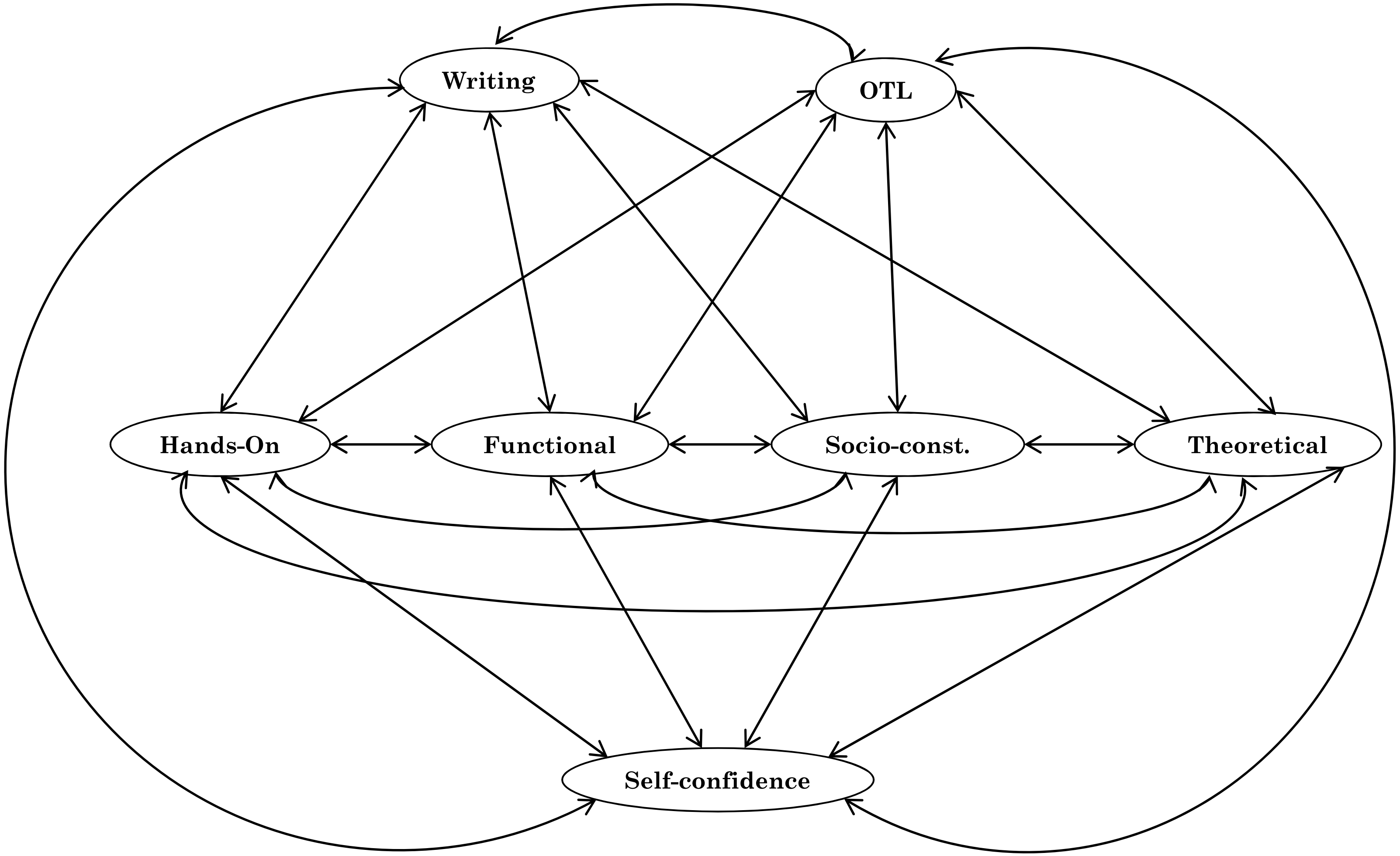
- Teacher questionnaire development
  - Five mains sections:
    - Teacher professional development
    - Self-confidence and self-efficacy
    - Teacher practices and classroom climate
    - Learning time and content coverage
    - School learning environment for science
  - Items:
    - From TIMSS 2011 Teacher Questionnaire
    - Adapted from the PISA 2006 Student Questionnaire
    - New items

    → 143 items (Likert scales)
- Data Collection
  - Teachers at grade 3 and grade 4
  - Online version and paper version
  - 400 schools contacted, 325 teachers' responses
- Analyses
  - Exploratory factoriel analyses
  - Confirmatory factoriel analyses with MPlus

RESEARCH HYPOTHESES

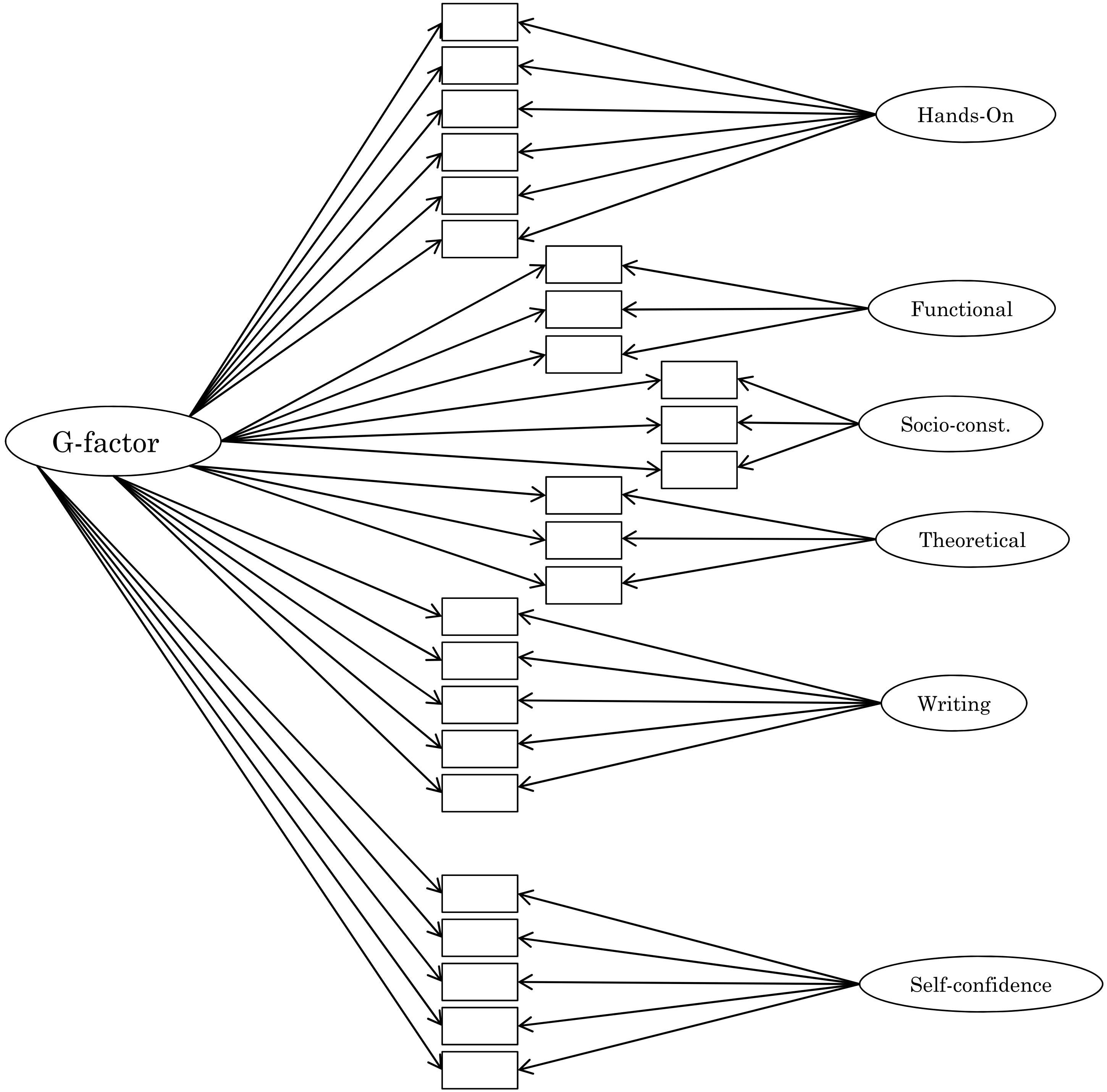
- The self-confidence of teachers influences their teaching practices. The more confident the teacher, the more he/she will implement practices that are acknowledged as efficient in science teaching. The least confident teachers will choose to use more traditional approaches in science teaching.
- Teachers lacking of self-confidence in science teaching devote less time to science education and will offer less opportunities to learn to students.

Tested model



Response styles and biases

- Response styles are commonly defined as "consistent and stable tendencies in response behavior that are not explainable in terms of question content or what a given question aims to measure" (Yang, Harkness, Chin & Villar, 2010).
- The main response style biases are acquiescence (disacquiescence), extremity (or mid-point scoring) and social desirability. Response styles may vary according to several characteristics of the respondents, such as gender, age, education.
- The response style bias can be addressed by multidimensional scaling.


G-factor
Hands-On
Functional
Socio-const.
Theoretical
Writing
Self-confidence

Latent variables

Teaching practices

1. Hands-On facet:

	λ General Factor	λ Specific Factor
The students design or plan experiments or investigations.	.20	.74
The students conduct experiments or investigations.	.17	.87
The students are asked to do an investigation to test out their own ideas.	.50	.48
The students are asked to develop an experimental plan before conducting operations.	.46	.46
The students are asked to conduct experiments by trial and error.	.59	.47
The students are asked to draw conclusions from an experiment they have conducted.	.51	.60

Latent variables

Teaching practices

2. Functional facet:

	λ General Factor	λ Specific Factor
The students observe natural phenomena (such as the weather or a plant growing) and describe what they see.	.24	.67
The students relate what they are learning in science to their daily lives.	.30	.56
The students do field work outside the class.	.24	.46

Latent variables

Teaching practices

3. Socio-constructivist facet:

	λ General Factor	λ Specific Factor
Students are given opportunities to explain their ideas.	.24	.67
A whole class (or a group) discussion takes place in which I participate.	.30	.56
I encourage my students to question and critique scientific arguments made by other students.	.24	.46

Latent variables

Teaching practices

4. Theoretical facet:

	λ General Factor	λ Specific Factor
The students interpret data that are provided (for example in their textbook).	.49	.60
The students fill in a diagram that is provided.	.40	.60
The students are asked to draw conclusions from a reported experiment (for example in their textbook).	.29	.68

Latent variables

Teaching practices

5. Production of scientific working writings :

	λ General Factor	λ Specific Factor
Schemes of experiment	.24	.81
Observational drawings	.32	.79
Notes in a experiment workbook	.37	.36
Reported measures	.37	.54
Exhibition panels or posters	.54	.34

→ Tool for cognitive activation

LATENT VARIABLES

TEACHER SELF-CONFIDENCE (REVERSED SCALE)

	λ General Factor	λ Specific Factor
I fear my students' questions, mostly when I cannot answer them directly.	-.07	.68
I am destabilized while teaching by the students who seem to have some scientific knowledge that I have not.	-.06	.65
I think it's hard to explain the relevance of a scientific activity to students.	.19	.75
I don't know how to manage the class during scientific experiments.	.27	.72
I don't understand scientific concepts enough to teach science.	.22	.69

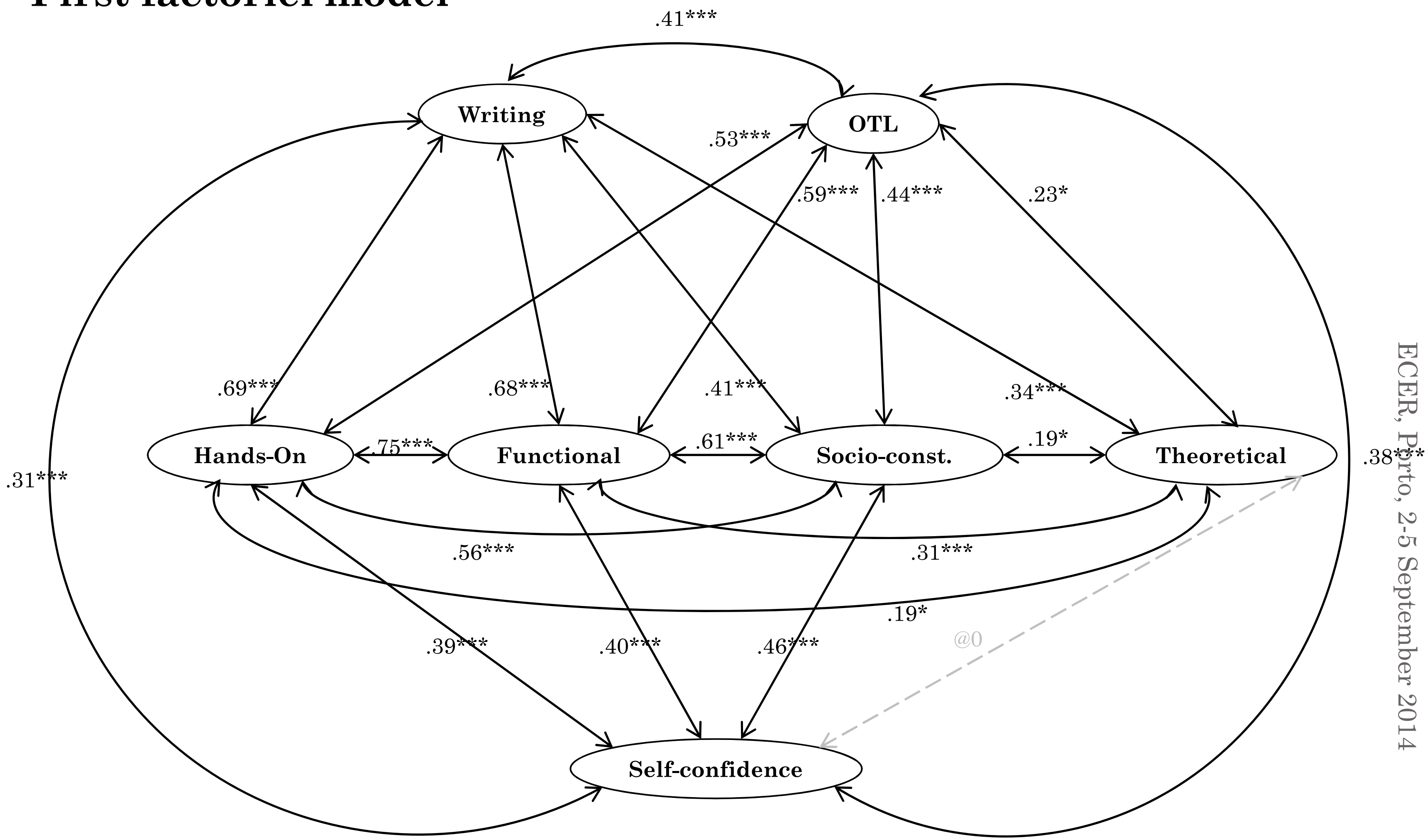
LATENT VARIABLES

OPPORTUNITY-TO-LEARN (OTL)

Narrow sense:

- Content coverage: the extent of coverage of the core content curriculum
  - 25 manifest variables added into a summary indicator
- Content exposure: the amount of time allocated for science
  - 1 manifest variable

First factoriel model



All factors are kept orthogonal with the general factor.

Model fit:
CFI: **0.95**
TLI: **0.97**
RMSEA: **0.05**

OBSERVATIONS

- This first model is consistent with the theory.
- The teaching facets of an inquiry-based instruction are highly correlated:
  - Hands-on: procedural facet
  - Functional: 'epistemic' facet
  - Socio-constructivist: social facet
- The teaching facets of an inquiry-based instruction are positively linked to the teacher's self-confidence, especially the social facet.
- But no significant latent correlation between a theoretical teaching of science and the self-confidence.
- Production of working writings are related to the effective teaching practices but more surprisingly, also with a theoretical approach of science (even less, but significant).
- Higher latent correlations between OTL and constructivist practices than with a theoretical approach.
- Teacher's self-confidence in science and OTL are significantly linked.

Discussion

- This first model supports the relationship between the teachers' self-confidence and the constructivist teaching practices in science.
- In the context of BE-Fr:

Distortion {
- Policy directives:
  - Science teaching and learning: 'inquiry-based instruction'
  - Time allocated for science: no clear directives
- Teachers:
  - Low self-confidence

→ Investigation of the causes of low confidence

→ COACTIV model of teacher's professional competence (Baumert & Kunter, 2013): professional knowledge - professional values, beliefs and goals - motivational orientations – professional self-regulation

LIMITATIONS AND FURTHER RESEARCHES

- This is a work in progress
  - Cross-validation has to be implemented to test the stability of this first model
  - The general factor will be further explored
  - Additional dimensions will be included (self-confidence investigation)

THANK YOU !

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