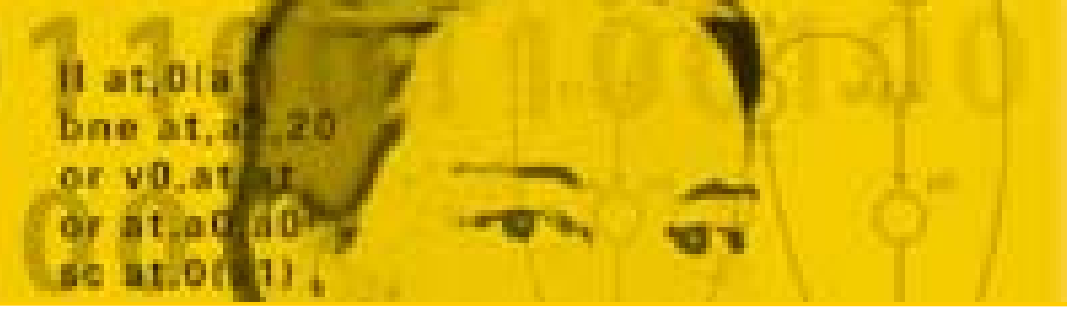

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Improving Student Modeling: The Relationship between Learning Styles and Cognitive Traits

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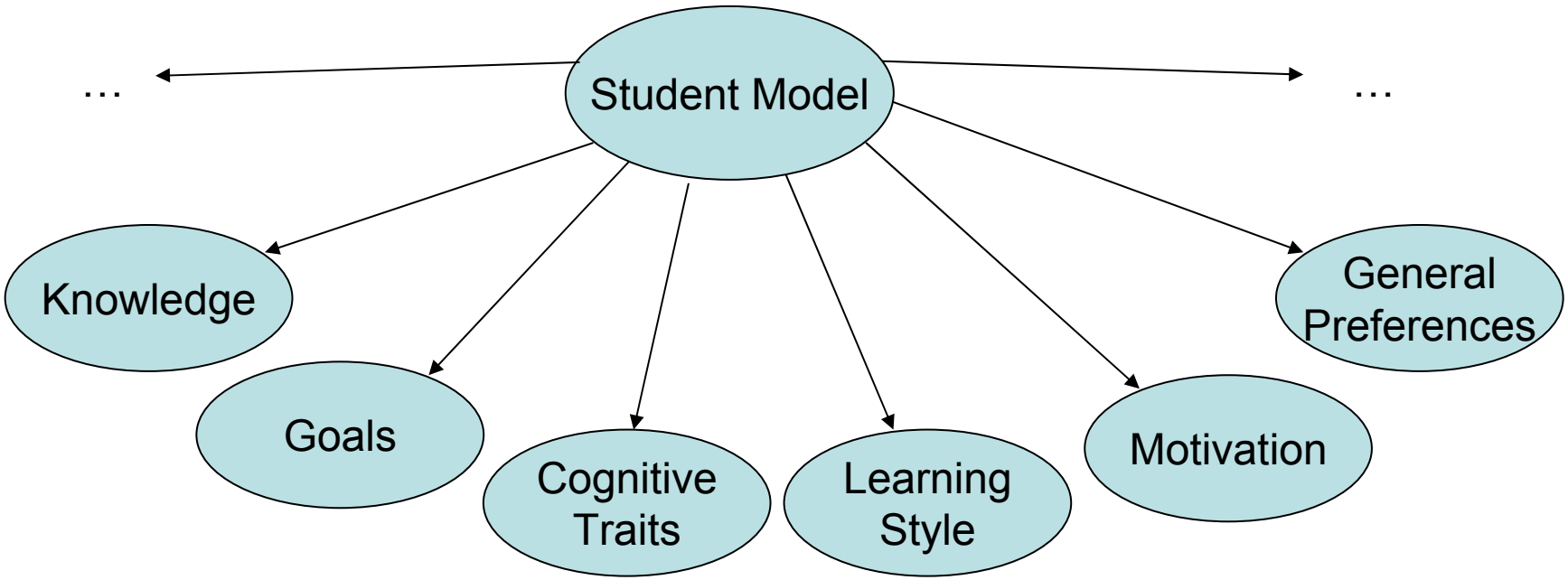
Motivation and Aims

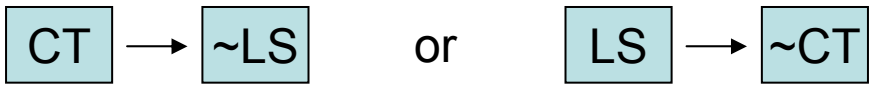


- How to get this information?
  - Ask the students
  - Initial questionnaires or test
  - Track the behavior of the students

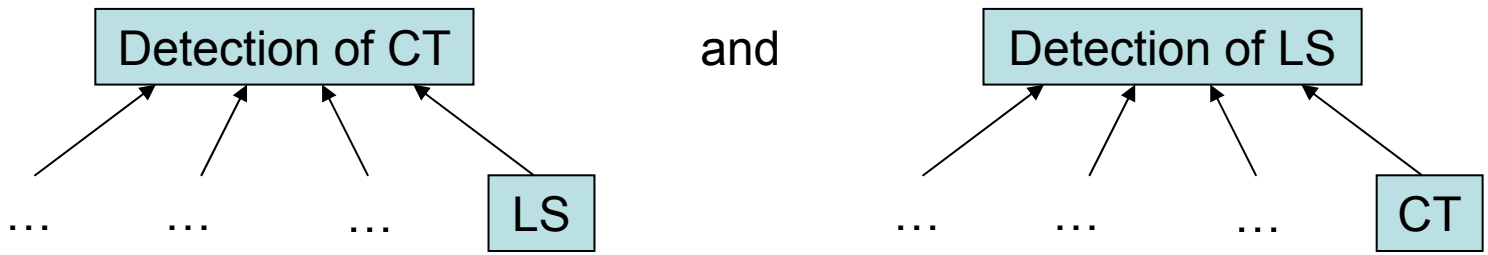
Motivation and Aims

Why relate cognitive traits (CT) and learning styles (LS)?

- Case 1: Only one kind of information (CT and LS) is included
  → Get some hints about the other one



- Case 2: Both kinds of information are included
  → The information about the one can be included in the identification process of the other and vice versa
  → The student model becomes more reliable



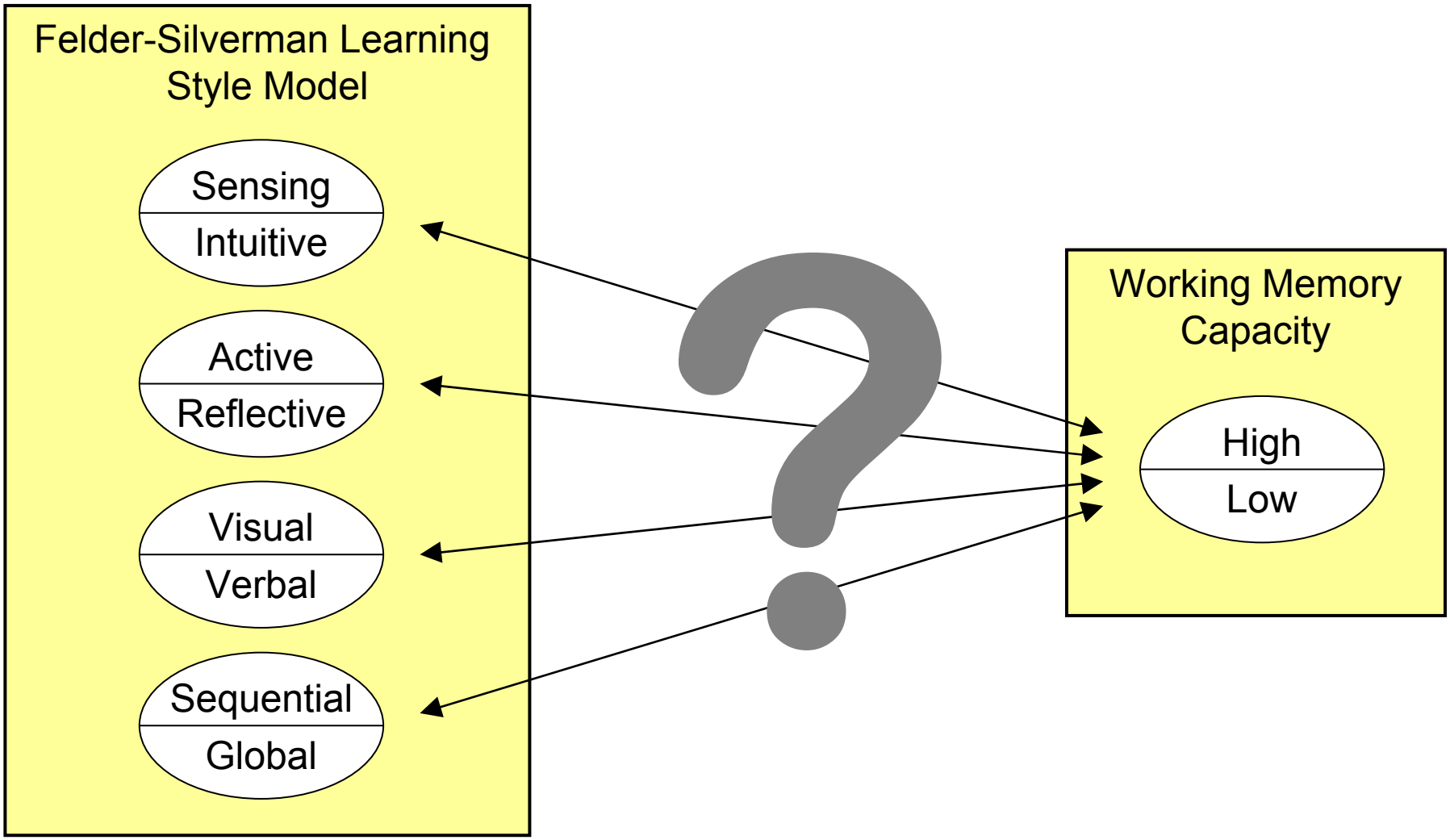
Felder-Silverman Learning Style Model

- Richard M. Felder and Linda K. Silverman, 1988
- Each learner has a preference on each of the dimensions
- Dimensions:
  - Active – Reflective
    learning by doing – learning by thinking things through
    group work – work alone
  - Sensing – Intuitive
    concrete material – abstract material
    more practical – more innovative and creative
    better in single answer-tests – better in open-end tests
    patient / not patient with details
  - Visual – Verbal
    learning from pictures – learning from words
  - Sequential – Global
    learn in linear steps – learn in large leaps
    good in using partial knowledge – need „big picture“
    serial – holistic

Cognitive Trait Model (CTM)

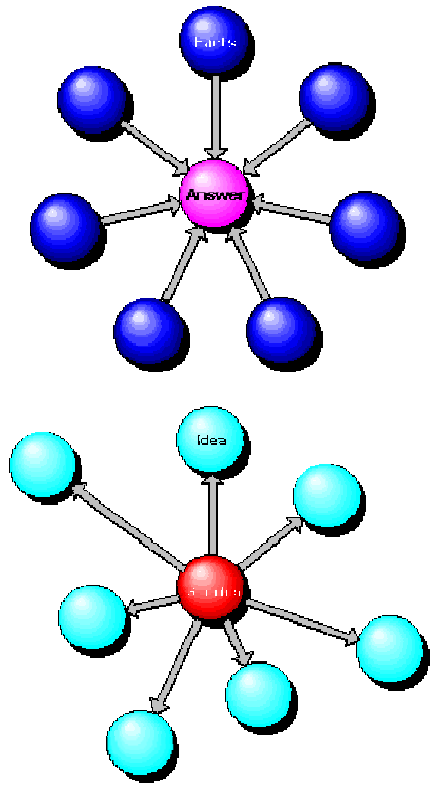
- Lin, Kinshuk and Patel, 2003
- Includes cognitive traits such as
  - Working Memory Capacity
  - Inductive Reasoning Ability
  - Information Processing Speed
  - …
- Cognitive traits are more or less persistent
  → CTM can still be valid after a long period of time
  → CTM is domain independent and can be used in different learning environments, thus supporting life long learning

Relationship between FSLSM and WMC



Sensing-Intuitive Dimension and WMC

- Sensing and intuitive learners have similar characteristics to convergent and divergent learners
  - Hudson, 1966 (thinking style)
    - Convergent:
      - Good in seeing information leading to a restricted answer or solution
      - Score better in single answer tests
    - Divergent:
      - More creative
      - Good in finding a greater variety of answers to a problem
      - Score better in open end tests



[http://www.learningandteaching.info]

Sensing-Intuitive Dimension and WMC

- Convergent/Divergent and High/Low WMC
  - Study by Bahar and Hansell, 2000
    - About 400 students
    - Tests on convergency/divergency and WMC
    - Results:

      convergent ↔ low WMC

      divergent ↔ high WMC

→ Sensing ↔ convergent ↔ low WMC

→ Intuitive ↔ divergent ↔ high WMC

Sensing-Intuitive Dimension and WMC

- Concreteness / Abstractness
  - Field-dependency (FD) and field-independency (FI) proposed by Witkin et al., 1977
    - Field dependent learners learn best when given a larger context, or "field," in which to embed new learning
    - Field independent learners can learn material that is separated from its context.
  - Several experiments about FD/FI and preferences for concrete/abstract learning material
    - Ford and Chen, 2000
    - Davis, 1991

    → FD ↔ concrete material (= sensing)

    → FI ↔ abstract material (= intuitive)

Sensing-Intuitive Dimension and WMC

- Several experiments about FD/FI and high/low WMC
  - Al-Naeme, 1991
  - Bahar and Hansell, 2000
  - El-Banna, 1987

  → FD ↔ low WMC

  → FI ↔ high WMC

→ Sensing ↔ field dependent ↔ low WMC

→ Intuitive ↔ field independent ↔ high WMC

Active-Reflective Dimension and WMC

- Kolb's learning style theory (1984)
  - Convergers
    - More practical
    - Finding one solution to a problem
    - More attracted to technical problems than to social or interpersonal issues
    - Active experimentation
  - Divergers
    - Perform well in idea-generation
    - Reflective observations

  → similar to Hudson's definition

  - Relation to active and reflective dimension
    - Convergers tend to be more active – by doing something
    - Divergers tend to be more reflective – by watching

→ Active ↔ convergers ↔ low WMC

→ Reflective ↔ divergers ↔ high WMC

Active-Reflective Dimension and WMC

- Relation to field-dependency and field-independency
  - According to Witkin et al., 1977
    FD learners are more socially oriented and prefer interaction as well as communication

→ Active ↔ field-dependent ↔ low WMC

→ Reflective ↔ field-independent ↔ high WMC

Verbal-Visual Dimension and WMC

- Study by Beacham, Szumko, and Alty, 2003 about dyslexia
  - Dyslexia refers to a specific learning difficulty regarding written language
  - Effect of different presentation modes in e-learning courses for dyslexic students
  - 30 students
  - Performed Index of Learning Styles
    - 97 % have a visual learning style
    - 3 % have a verbal learning style (mild-verbal)
- Studies about dyslexia and working memory capacity
  - Study by Simmons and Singleton, 2000
    - Dyslexic students had done very poor in inferential questions
    - Working Memory deficiency was identified as a cognitive cause
  - Study by Beacham, Szumko, and Alty, 2003
    - weakness in working memory, sound processing, co-ordination and motor skill, and visual processing

→ Visual ← dyslexic ↔ low WMC

→ Verbal/Visual ↔ high WMC

Sequential–Global Dimension and WMC

- Study by Huai, 2000
  - Relationship between working memory capacity and long-term memory capacity to serial and holistic learning style
  - Serial learning style is strongly related to a sequential one

    Holistic learning style is strongly related to a global one
  - About 140 students
  - Results:

    serial ↔ high WMC

    holistic ↔ low WMC

→ Sequential ↔ serial ↔ high WMC

→ Global ↔ holistic ↔ low WMC

Sequential–Global Dimension and WMC

- Relation to field-dependency and field-independency
  - FI learners can learn material that is separated from its context and perceives information analytically
    → sequential
  - FD learners learn best when given a larger context, in which to embed new learning and perceives information globally
    → global

→ Sequential ↔ field-independent ↔ high WMC

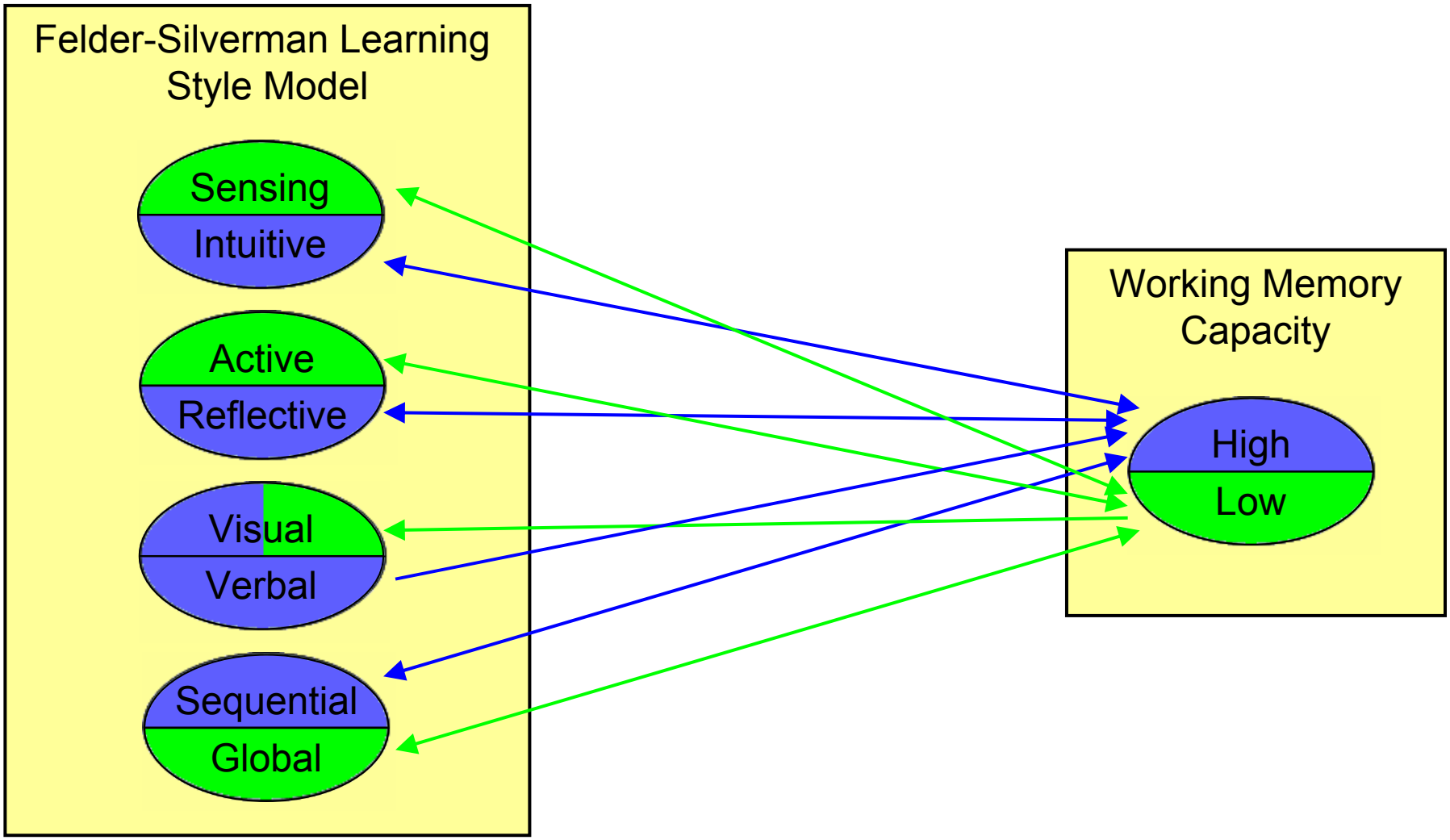
→ Global ↔ field-dependent ↔ low WMC

- Study by Beacham, Szumko and Alty, 2003 (dyslexia)
  - Higher preference (14 % higher) of global learning style among dyslexic learners (low WMC)

→ Sequential ↔ high WMC

→ Global ↔ low WMC

Relationship between FSLSM and WMC



Conclusion & Future Work

- Relationship between Felder-Silverman Learning Style Model and Working Memory Capacity
- Result
  - Low WMC ↔ Sensing, Active, Visual, Global
  - High WMC ↔ Intuitive, Reflective, Visual/Verbal, Sequential
- Future work
  - Study aiming at comparing data about LS and CT
    → Verifying the results
    → Investigating how strong the influences are
  - Use the relationship in a web-based educational system to make the student model more reliable
  - Further investigations concerning other cognitive traits (e.g. inductive reasoning ability, associative learning skills, ...)