Achievement Motivation and Learning: A Gamma-Band EEG Study

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Self Theories about Intelligence

“There are qualitatively different motivational frameworks, driven by people’s beliefs and goals, that affect basic attentional and cognitive processes.”

Self Theories about Intelligence

**Entity Theorists**
- **Intelligence is fixed**
  - Trait largely determined by nature

**Incremental Theorists**
- **Intelligence is malleable**
  - Quality that can be increased through nurture

Desire similar outcome
- *achieving* good scores, doing “well”

Different *goals* motivating pursuit of this outcome
- **Performance goals**
  - seeking to validate ability as good relative to others
- **Learning goals**
  - seeking to develop ability

*(Dweck, Self-theories: Their role in motivation, personality and development, 1999)*
Self Theories about Intelligence

Entity Theorists

- **Intelligence is fixed**
  - Trait largely determined by nature
- **Performance goals**
  - seeking to validate ability as good relative to others
- **Helpless-Oriented**
  - Low effort

Incremental Theorists

- **Intelligence is malleable**
  - Quality that can be increased through nurture
- **Learning goals**
  - seeking to develop ability
- **Mastery-Oriented**
  - Effortful processing
Hypotheses

• Goal-relevant information differs for entity and incremental learners; what they “seek”
  – **Entity**: information relevant to proving ability
  – **Incremental**: information relevant to learning

• Following negative feedback, how does this influence learning from mistakes?
  – **Entity**: Rumination or disengagement (helpless)
  – **Incremental**: Enhanced effort toward error correction (mastery)
Test-Retest Feedback Paradigm

- dissociate response to ability-relevant vs. learning-relevant information

**Ability-Relevant Feedback**

“What is the capital of Australia”

“Sydney”

1 2 3 4 5 6 7
Low Med High

• immediate surprise retest on wrong items

**Learning-Relevant Feedback**

Canberra

2.5 s 1 s 2.5 s 1 s

1 s

or

Δ
Accuracy at First test and Retest

![Accuracy at First test and Retest](image)
Accuracy at First test and Retest

Why did incrementals perform better than entities at retest?

\[ p < 0.05 \]
Previous ERP Research

Ability-Relevant Feedback

Entity orient more than Incremental to negative feedback (but not positive)

Learning-Relevant Feedback

Incremental more sustained conceptual processing than entity
A Different Direction:

• Differences in anticipatory processing before onset of stimuli?
  – Top-down attentional control

• Consequences on learning
  – Induced-EEG
  – Gamma Band Activity [GBA]
Why Induced-EEG?

- **ERP**
  - time and phase locked
  - Stimulus-evoked processes

- **Induced-EEG**
  - Time but not phase locked
  - Internally driven endogenous processes
  - Multiple frequency bands:
    - Theta (4-8 Hz)
    - Alpha (10-12 Hz)
    - gamma (25-55 Hz)
Why Gamma?

- Top-down attentional control
  - GBA correlated with memory of predictable versus non-predictable items (Summerfield and Mangels, in press)
  - GBA correlated with reaction time; motor preparation/expectancy (Andino et al, 2004)
  - greater GBA for ‘attend’ vs. ‘unattend’ condition (Tallon-Baudry et al, 2004)
Differences in induced GBA

• How TOI influences top-down attentional control to goal-congruent stimuli?
• Pre-ability period: Confidence
  – Low > High
  – Entity > Incremental
• Pre-learning period: Retest Accuracy
  – Later Correct > Later Incorrect
  – Incremental > Entity
Pre-Stimulus: Ability-Relevant

“What is the capital of Australia”

“Sydney”

Ability-Relevant Feedback

Canberra

Learning-Relevant Feedback

-200-0 ms
Low > High at Right Temporal

- Less certain about performance
- Interest in upcoming information
- Sustained vigilance

\( p = .05 \)
Pre-Stimulus: Learning-Relevant

“What is the capital of Australia”

“Sydney”

+ * + Canberra

2.5 s 1 s 2.5 s

-200-0 ms

Learning-Relevant Feedback

Ability-Relevant Feedback
Rights and Corrected: Inc > Ent

p < .05
Not Corrected: Ent > Inc

p < .09
Conclusions

• Pre-ability results:
  – Higher GBA \( \rightarrow \) more top-down attentional control and readiness for processing of stimulus

• Pre-learning results:
  – Incremental: more interest in learning-relevant information \( \rightarrow \) GBA facilitates
  – Entity: more GBA for items they don’t correct: rumination on negative feedback
Thanks!

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