# Demystifying the complexity of individual differences under incidental conditions: A conceptual replication and extension

Ryo Maie
Michigan State University
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# Incidental conditions

- Incidental (learning) conditions
  - ***Conditions*** that have potential to result in incidental learning
  - Experimentally, conditions wherein learners are not told of
    1. The fact that they are learning something
    2. The existence of systematic patterns or rules
    3. The existence of posttests
- L2 learning under incidental conditions is everywhere!
  - Incidental learning
  - Intentional learning
  - Implicit learning
  - Explicit learning

# IDs under incidental conditions

- To what extent do individual differences (IDs) play a role in language learning under incidental conditions?

- Existing studies diverge as to
  1. Whether IDs play a role at all under incidental conditions

     Brooks & Kempe (2013); Brooks, Kwoka, & Kempe (2017); Denhovska, Serratrice, & Payne (2016); Grey, Williams, & Rebuschat (2015); Hamrick (2015); Jackson (2016); Morgan-Short, et al. (2014); Tagarelli, Borges-Mota, & Rebuschat (2011); Tagarelli et al. (2016); Robinson (2005)

     Blue = Yes, Red = No
  2. How and when IDs play a role under incidental conditions

# Yes to IDs

- Brooks et al. (2017) – production task
  - Positive: Statistical learning ability for trained items
  - Positive: WM for untrained generalization items

| Knowledge | IDs |
|---|---|
| Implicit | Implicit |
| Explicit | Explicit |

- Denhovska et al. (2016) – production task
  - Positive: WM only when learning was not facilitated by type/token frequency manipulation

| Knowledge | IDs |
|---|---|
| Explicit | Explicit |

- Hamrick (2015) – recognition task
  - Positive: Declarative memory at the immediate posttest
  - Positive: Procedural memory at the delayed posttest

| Knowledge | IDs |
|---|---|
| Explicit | Explicit |
| Implicit | Implicit |

# Yes to IDs

- Jackson (2016) – picture-sentence matching
  - Positive: WM for learning with variation sets
- Tagarelli et al. (2016) – Grammaticality judgments
  - Positive: WM for learning complex sentence type
  - Negative: ILA for learning complex sentence type
- Robinson (2005) – Grammaticality judgments
  - Positive: WM for incidental group
  - Negative: IQ for implicit group

| Knowledge | IDs |
|---|---|
| Explicit | Explicit |

| Knowledge | IDs |
|---|---|
| Implicit | Explicit |
| Implicit | Implicit |

| Knowledge | IDs |
|---|---|
| ? | Explicit |
| Implicit | Explicit |

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  - Negative: ISLA for learning complex sentence type
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  - Negative: IQ for implicit group

?

| Knowledge | IDs |
|---|---|
| Explicit | Explicit |

| Knowledge | IDs |
|---|---|
| Explicit | Explicit |
| Explicit | Implicit |

| Knowledge | IDs |
|---|---|
| Explicit | Explicit |
| Explicit | Explicit |

# Preliminary summary

- It seems that most of the results can be explained by retrodicting learning processes transpired or knowledge developed as a result of incidental exposure
- Furthermore, it seems critical to consider
  1. The nature of aptitudes (e.g., explicit vs. implicit)
  2. The nature of outcome measures (e.g., explicit vs. implicit)
  3. When learning is measured (e.g., immediate vs. delayed)

# DeKeyser (2012)

*"When variables are shown to interact, this points to a common denominator between them, for example, a treatment variable interacts with an ID variable because the treatment variable requires a mental process that is facilitated/hampered by the value of the ID variable"*

*"Sometimes a hypothesis about such a process motivates interaction research; sometimes, of course, the discovery of an interaction will generate such a hypothesis" (p. 190)*

# The study

Q. If we make manipulations to linguistic structures that can relatively lead to explicit or implicit learning, can we predict which ID variables to significantly moderate the learning outcomes under incidental conditions ?

- Simple construction → Noticing → Explicit learning
- Complex construction → Implicit learning
  - "*a rich and complex stimulus domain is a prerequisite for the occurrence of implicit learning*" (p. 220, Reber, 1989)
  - Harder to explicitly encode them in memory

# Participants

- 63 L1 speakers of English
  - $M_{age}$ = 19.47, $SD_{age}$ = 1.78
  - No experience with Japanese nor any case-marking languages
  - Data of 14 participants were excluded
  - 49 participants constituted the final sample

    Experimental group (*n* = 28) and Control (*n* = 21)
  - Only data from Experimental group will be analyzed

# Language

A semi-artificial language, *Japlish*

1. **OSV**
   *That wall-o Mary-ga painted*
   "Mary painted the wall"
2. **OSIV**
   *The picture-o John-ga his friends-ni sent*
   "John sent the picture to his friends"

Simple

-ga: subject
-o: direct object
-ni indirect object

3. **OSSVV**
   *The tuition-o Mary-ga her school-ga raised said*
   "Mary said her school raised the tuition"
4. **OSSIVV**
   *This document-o Mary-ga her colleague-ga their boss-ni faxed realized*
   "Mary realized that her colleague faxed this document to their boss"

Complex

# Methods

## Exposure

- 100 sentences of Japlish x 2 = 200 trials
- 50 items for each WO type
- Presentation was auditory
- Incidental conditions = semantic verification task
- Participants were not told of
  1. The fact that they are learning something
  2. The existence of systematic patterns or rules
  3. The existence of posttests

# Measure

## Untimed Auditory Grammaticality judgments (U-AGJT)

A measure of explicit knowledge :

- 80 sentences in total
- Grammatical items included: OSV, OSIV, OSSVV, and OSSIVV
- Ungrammatical items included: *OVS, *OSVI, *OSVSV, *OSSVIV
- Cronbach's alpha = .92 and .94 for Immediate and Delayed

# Measure

## Word-monitoring task (WMT)

A measure of implicit knowledge:

- 130 sentences of Japlish (96 targets and 34 distractors)
- 16 sentences for each item type (8 grammatical and 8 ungrammatical)
- A comprehension question once in two sentences
- Spearman-Brown prophecy formula, $r$ = 0.95 and 0.81

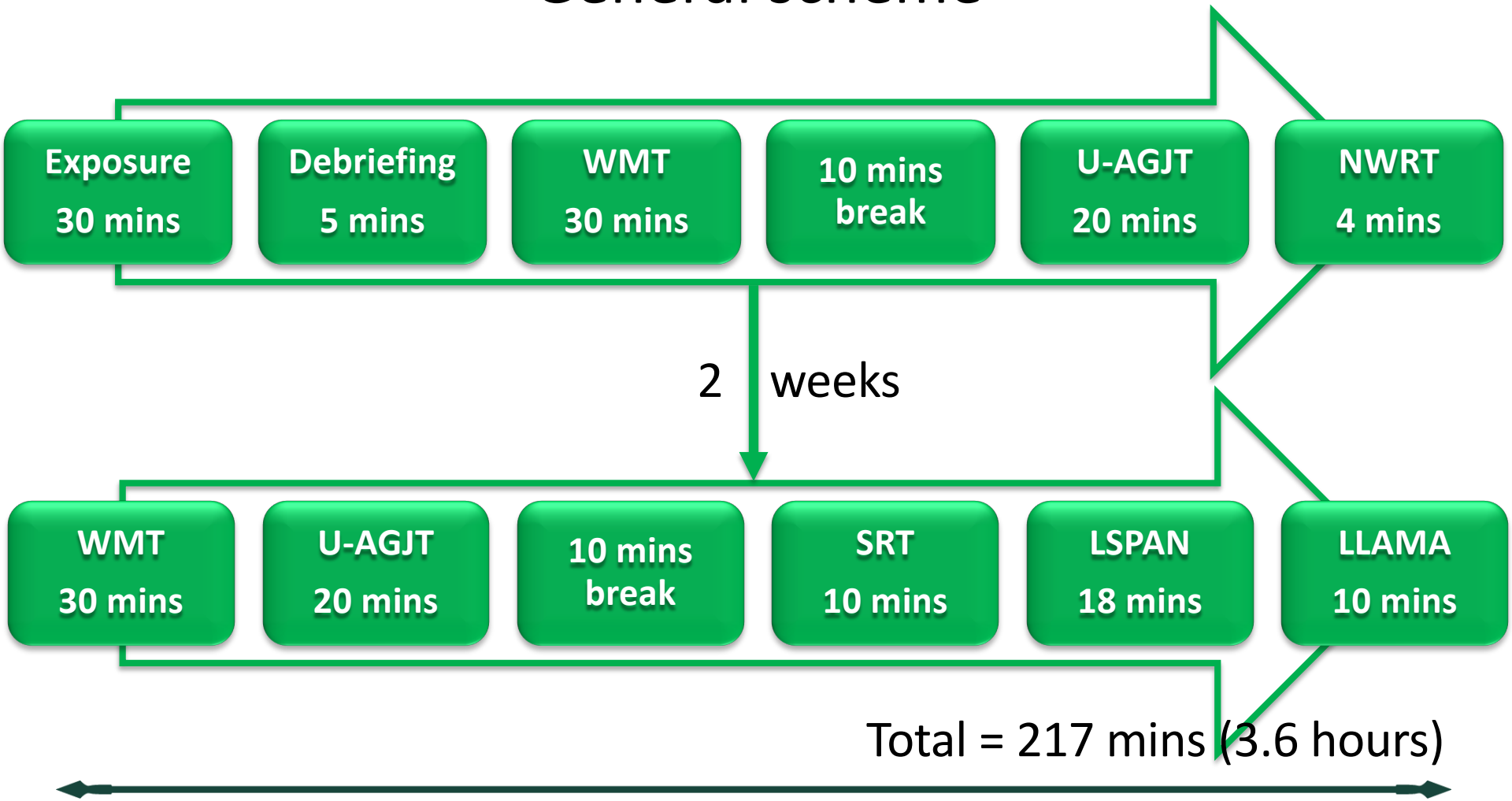
# Aptitudes

Explicit

- Language analytic ability (LAA)
  - LLAMA-F (Meara, 2005; from IRIS: Suzuki & DeKeyser, 2017)
  - Cronbach's alpha = 0.75
- Working memory (WM)
  - Listening-Span Task (from IRIS: Winke, 2013)
  - Cronbach's alpha = 0.79
- Phonological short-term memory (PSTM)
  - Nonword Repetition Task (Lado, 2017)
  - Cronbach's alpha = 0.79
- Implicit Sequence Learning Ability (Imp. LA)
  - Serial Reaction Time Task (Kaufman, et al., 2010)
  - SB reliability = 0.72

Implicit

# General scheme



# Analysis

- U-AGJT
  - *d*-prime score
  - Complexity: Simple vs. Complex
  - Four explicit and implicit cognitive aptitudes
- WMT
  - GSIs (Ungrammatical RT – Grammatical RT)
  - Complexity: Simple vs. Complex
  - Four explicit and implicit cognitive aptitudes

# Statistical Analysis

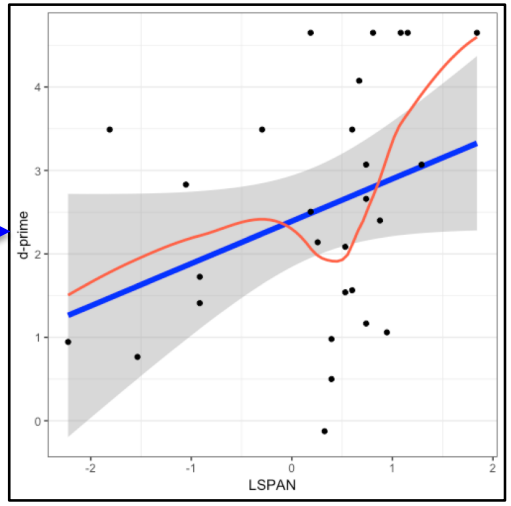
- Multiple regression (linear)
  - Traditional – all predictors entered at the same time
  - A model for Simple and Complex (U-AGJT & WMT)
  - Two testing sessions – 8 models
  - Alpha = .05
  - Effect size = $R^2$
  - During the assumption checking process, it turned out that some variables were not linearly related to the dependent variables
    - Quadratic term if the inclusion improves the model fit (AIC)

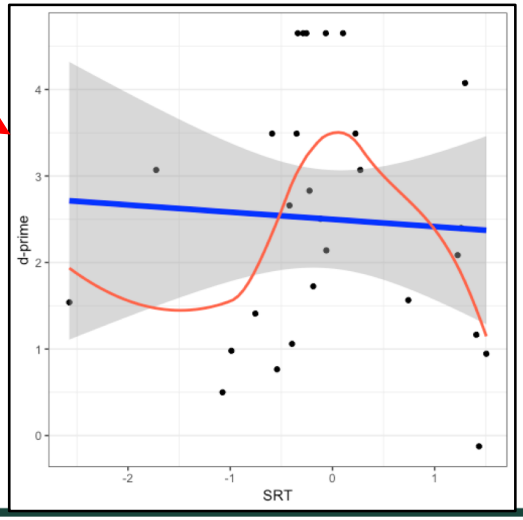
# Results:
# **GJT - EK**

# Immediate: U-AGJT

| Simple | *β* | *SE* | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|
| LAA | 0.30 | 0.19 | 1.69 | .12 | .05 |
| WM | 0.48 | 0.19 | 2.45 | .02* | .11 |
| $WM^2$ | 0.37 | 0.21 | 1.74 | .09† | .09 |
| PSTM | 0.05 | 0.18 | 0.27 | .79 | .01 |
| Imp. LA | -0.26 | 0.19 | -1.38 | .18 | .03 |
| Imp. $LA^2$ | -0.35 | 0.17 | -2.00 | .05* | .11 |

| Complex | *β* | *SE* | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|
| LAA | 0.13 | 0.19 | 0.65 | .52 | .03 |
| WM | 0.20 | 0.19 | 1.07 | .29 | .06 |
| PSTM | 0.35 | 0.19 | 1.81 | .08† | .11 |
| Imp. $LA^2$ | 0.08 | 0.20 | 0.43 | .67 | .01 |



# Delayed: U-AGJT

| Simple | *β* | *SE* | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|
| LAA | 0.39 | 0.18 | 2.14 | .04* | .06 |
| WM | 0.41 | 0.19 | 2.18 | .04* | .11 |
| $WM^2$ | 0.50 | 0.21 | 2.39 | .02* | .09 |
| PSTM | 0.05 | 0.18 | 0.27 | .79 | .01 |
| Imp. LA | -0.31 | 0.19 | -1.68 | .11 | .03 |
| Imp. $LA^2$ | -0.34 | 0.16 | -2.01 | .05* | .11 |

| Complex | *β* | *SE* | *t* | *p* | $R^2$ |
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| LAA | 0.50 | 0.18 | 2.81 | .01* | 17 |
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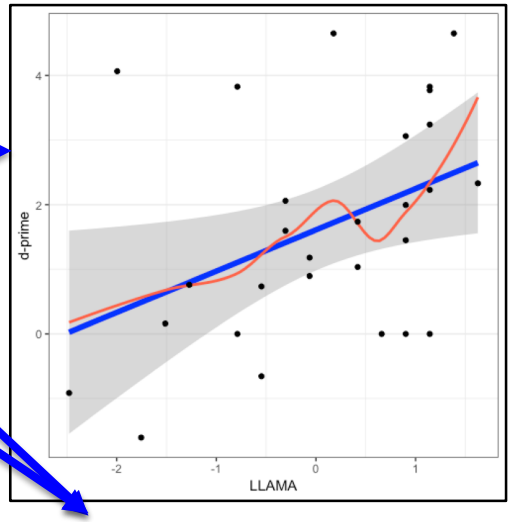
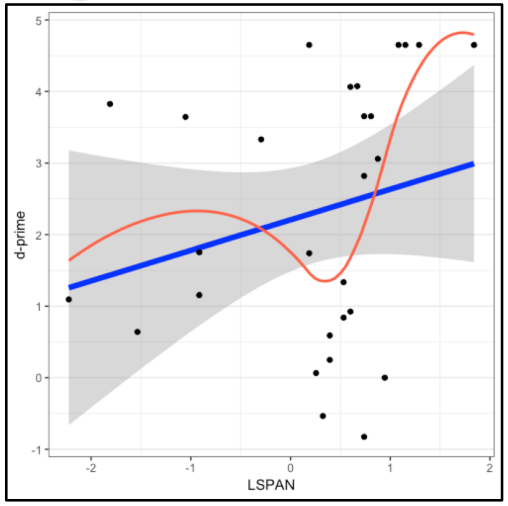
| $WM^2$ | 0.44 | 0.20 | 2.21 | .03* | .17 |
| PSTM | 0.19 | 0.17 | 1.09 | .28 | .04 |
| Imp LA | -0.06 | 0.18 | -0.33 | .74 | .00 |



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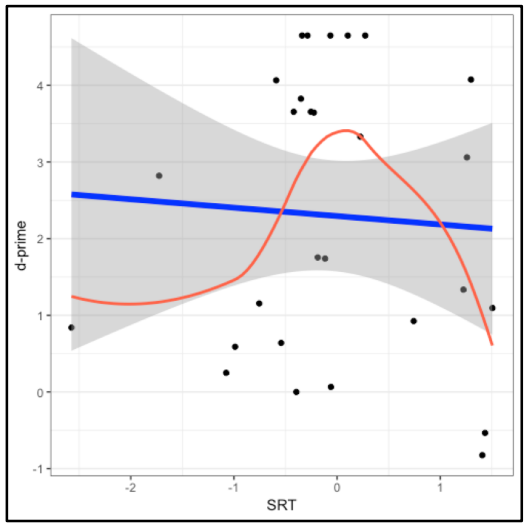

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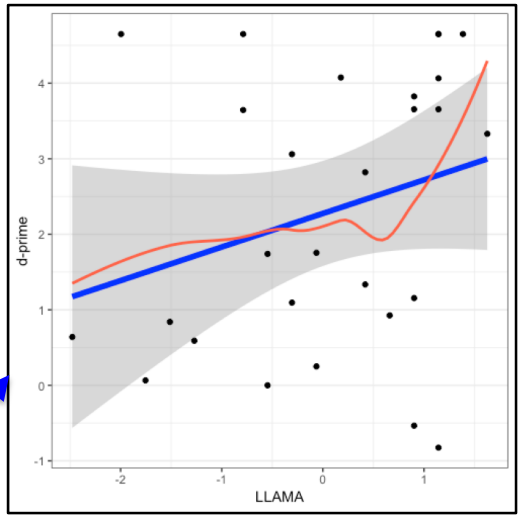
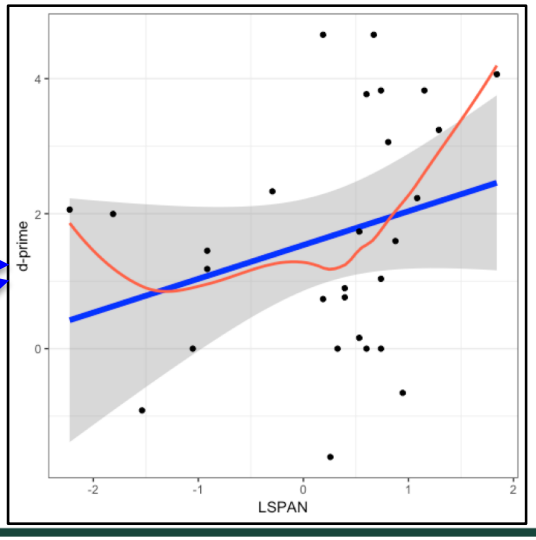


# Results:
# **WMT - IK**

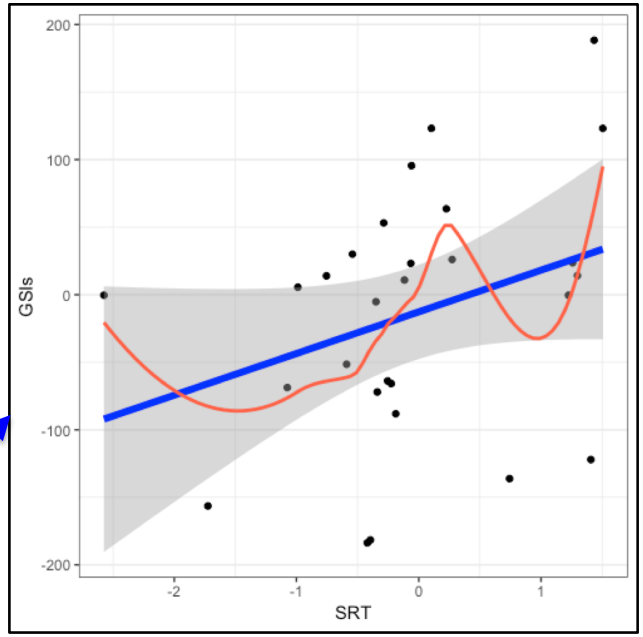
# Immediate: Word-Monitoring

- No variables turned out to be significant for neither of the construction types!!

# Delayed: Word-monitoring

| Simple | *β* | *SE* | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|
| LAA | -0.03 | 0.20 | -0.16 | .87 | .02 |
| WM | 0.13 | 0.19 | 0.65 | .52 | .02 |
| PSTM | -0.10 | 0.20 | -0.47 | .64 | .00 |
| Imp. LA | -0.38 | 0.20 | -1.90 | .07† | .13 |

| Complex | *β* | *SE* | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|
| LAA | -0.16 | 0.20 | -0.84 | .41 | .03 |
| $LAA^2$ | 0.31 | 0.20 | 1.55 | .12 | .09 |
| WM | -0.19 | 0.17 | -1.12 | .28 | .03 |
| PSTM | 0.27 | 0.18 | 1.52 | .14 | .03 |
| Imp. LA | 0.48 | 0.18 | 2.70 | .01* | .20 |



# Summary

| *U-AGJT* | Immediate | | | Delayed | |
|---|---|---|---|---|---|
| | Simple | Complex | | Simple | Complex |
| LAA | | | | * | * |
| WM | * | | | * *2 | * *2 |
| PSTM | | | | | |
| Imp. LA | *2 | | | *2 | |

| *WMT* | Immediate | | | Delayed | |
|---|---|---|---|---|---|
| | Simple | Complex | | Simple | Complex |
| LAA | | | | | |
| WM | | | | | |
| PSTM | | | | | |
| Imp. LA | | | | | * |

Positive

Negative

# Discussion

- As was the case for the previous research, the complex picture emerged regarding the role of IDs under incidental conditions
- This complexity seems to be explained by
  1. The nature of aptitudes (e.g., explicit vs. implicit)
  2. The nature of outcome measures (e.g., explicit vs. implicit)
  3. When learning is measured (e.g., immediate vs. delayed)
- Support to the claim by DeKeyser (2012) on the interaction of mental processes transpired by treatment and ID variables

# Conclusion

- Existing studies diverge as to
  1. Whether IDs play a role at all under incidental conditions
  2. How and when IDs play a role under incidental conditions
- Well, those mixed evidence can be explained by **learning processes transpired** or **knowledge developed** from incidental exposure, if we take into account:
  1. The nature of aptitudes (e.g., explicit vs. implicit)
  2. The nature of outcome measures (e.g., explicit vs. implicit)
  3. When learning is measured (e.g., immediate vs. delayed)
- "mixed" in fact make senses if we become careful enough ☺

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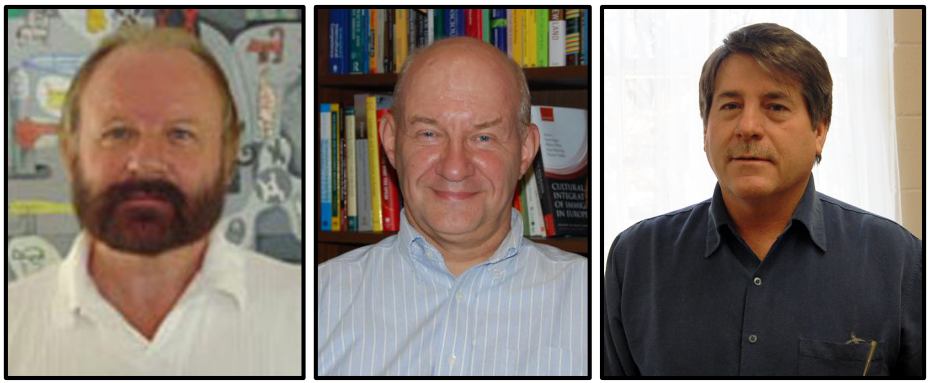

# Thank you!

Slides and references are available upon request.
Please contact maieryo@msu.edu or just *talk to me*!