


# **SOCIAL COGNITION & PHYSIOLOGIC SYNCHRONY DURING TEACHING INTERACTIONS**

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# In this Presentation

- Context
- Methods
- Results
- Discussion
- Q&A

# Context

## Learning Theories

Behaviorist &  
Mechanistic  
(Skinner, 1950)



Cognitive &  
Developmental  
(Piaget & Inhelder,  
1973; Vygotsky, 1978)



Dynamic Skill Theory  
(Fischer, 1980;  
Demetriou, et al,  
2010)

## Teaching Theories

Behaviorist &  
Mechanistic  
(Skinner, 1961;  
Thornton & Raihani,  
2008)



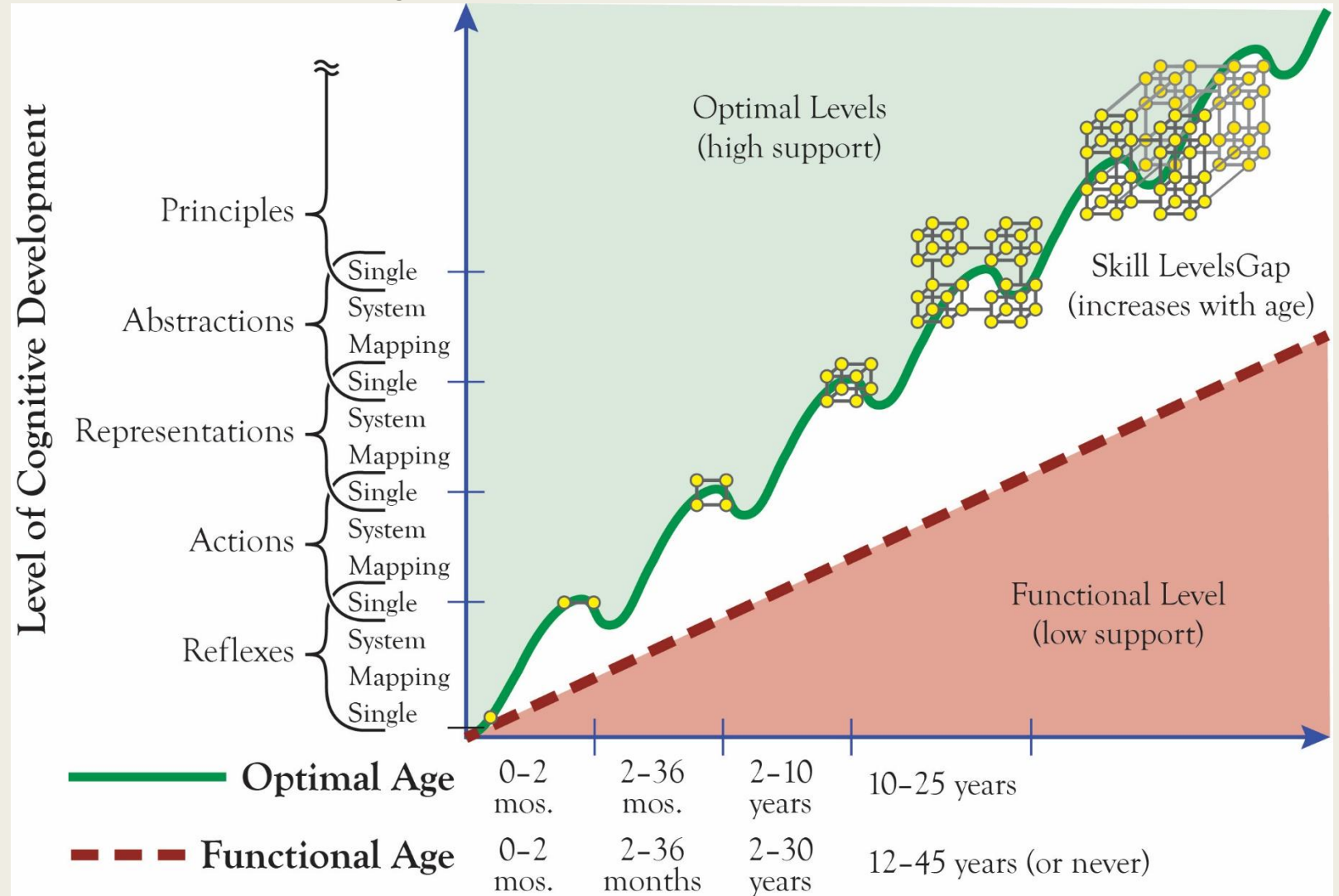
Teacher Thinking,  
Cognition & Knowledge  
(Lortie, 1975;  
Shulman, 1987; IRT;  
1986)



?

# Dynamic Skill Theory

## Skill Complexity Scale

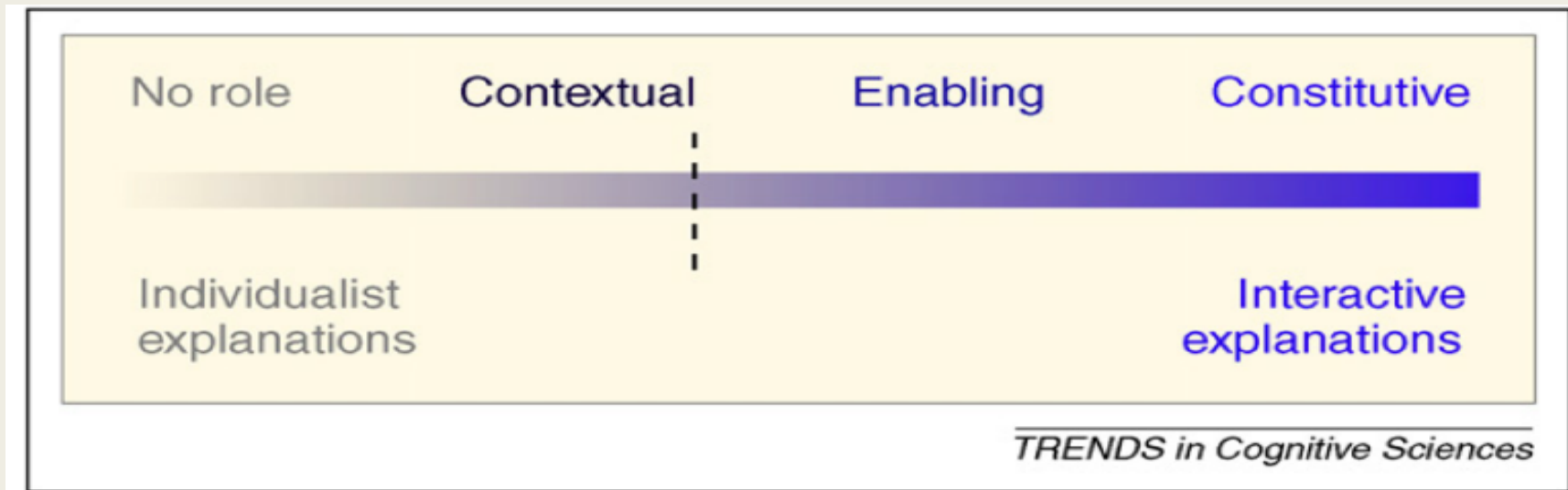


Source: November 1998 | Volume 56 | Number 3, How the Brain Learns Pages 56-60, Growth Cycles of Brain and Mind, Kurt W. Fischer and Samuel P. Rose.

# Social Emotional Cognition and Teaching

- Well-established social emotional cognitions of teaching
  - *Theory of Mind,*
  - *Empathy,*
  - *Social perspective taking, etc.*
  - *Many more less explored*
- Social emotional cognition can be considered:
  - *Non-interactive*
    - Individual's insight into their social interaction (i.e. teacher in relation to student)
    - Methods: observations, interviews, videos, journaling, etc.
  - *Interactive*
    - Social cognition during live interactions
    - Methods: EEG, fNIRS, biometrics
- ALL teaching is inherently a social interaction
  - *Potential new insights by framing teaching as an interactive social cognition*

# Social Interaction Constituting Social Cognition



**Figure 2.** Possible roles played by social interaction in social cognition. The dotted line represents the point from which individual mechanisms need to be re-thought in terms of the explanatory role of the interaction process. (Copyright 2010 H. De Jaeger, E. Di Paolo and S. Gallagher. Licenced under Creative Commons Attribution 3.0 Unported [<http://creativecommons.org/licences/by/3.0>]).

# Design considerations for social cognitive studies

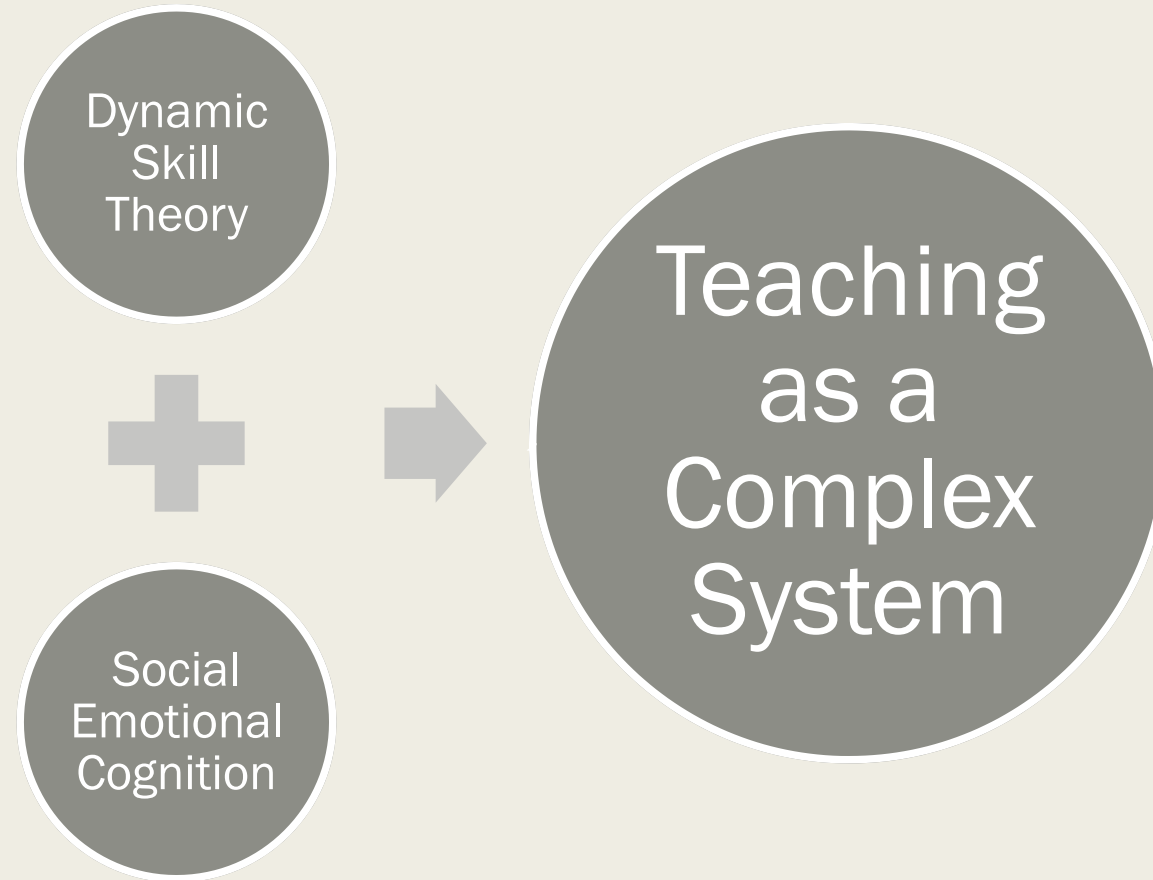
## Traditionally

- Identify social cognitive dimension of interest (empathy, ToM, SPT)
- Design interaction or intervention to elicit the known social cognitive trait
  - *Interactive or non-interactive*
- Measure the traits' presence, intensity via established scale

## Current studies

- Study expert teachers (peak social cognitive development)
- No preconceived social cognitive traits of “good teaching” (empathy, ToM, etc.)
- Offer support/scaffolding for teachers to elicit maximal social cognitions (non-interactive & interactive)
- Measure social cognitions holistically

# Putting it all together





# Research Question

- Study 1

- *What awareness of social cognition emerges from expert teachers during an adapted DST cognitive interview?*

# Methods: Study 1 Sample & Setting

Expert Teacher (n=23)	Type of School	Subject Area	Grade	Location
<ul style="list-style-type: none"> <li>• Active teaching</li> <li>• Endorsements from admin</li> <li>• 10yrs+ exp</li> <li>• Teacher attendance</li> <li>• Student test score data</li> <li>• Continued learning</li> <li>• Leadership role</li> <li>• Self-report love of teaching</li> <li>• CLASS™ observation (scores 6-7 in all areas)</li> </ul>	<ul style="list-style-type: none"> <li>• Public School (n=9)</li> <li>• Private (n=10)</li> <li>• Boarding (n=1)</li> <li>• Specialized (n=2)</li> <li>• Charter (n=2)</li> <li>• No-excuse (n=1)</li> <li>• University (private, public, Ivy)</li> </ul>	<ul style="list-style-type: none"> <li>• Math</li> <li>• ELA</li> <li>• History</li> <li>• Science</li> <li>• Art</li> <li>• Technology</li> <li>• Foreign Language</li> <li>• Special Education</li> <li>• Parent-Toddler</li> </ul>	<ul style="list-style-type: none"> <li>Lower Elementary (n=5)</li> <li>Upper Elementary (n=3)</li> <li>Middle (n=4)</li> <li>High (n=6)</li> <li>Graduate (n=4)</li> </ul>	<ul style="list-style-type: none"> <li>• Urban (n=5)</li> <li>• Suburban (n=14)</li> <li>• Semi-rural (n=1)</li> </ul>

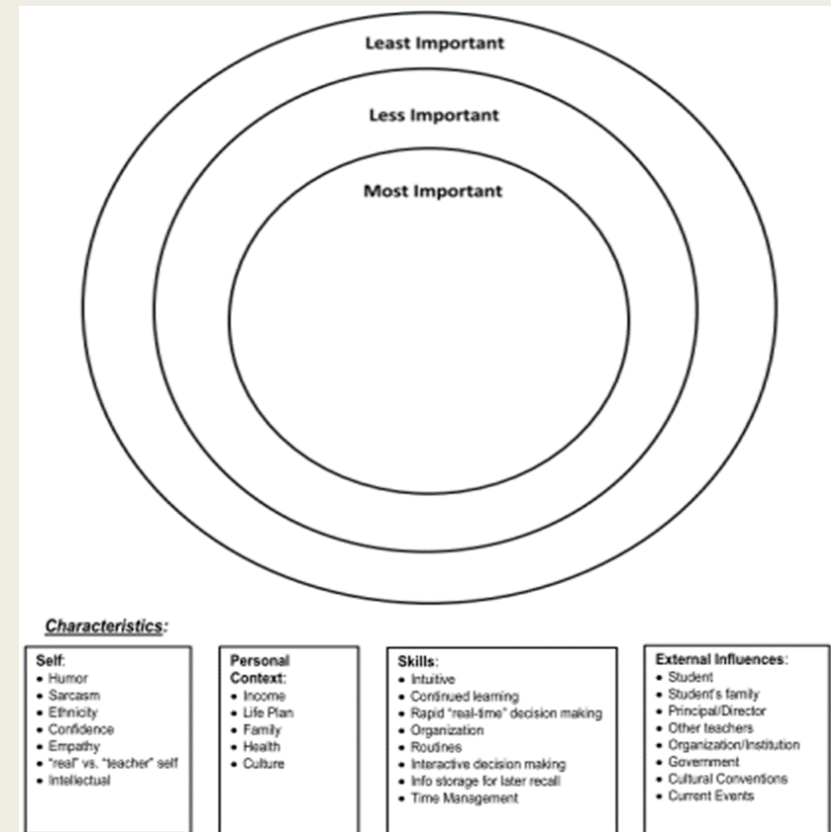
# Methods: Study 1 Tool

Version	Creation of final SiR2T
1	<ul style="list-style-type: none"><li>• Exhaustive literature search combining teaching concepts (teacher: cognition, thinking, knowledge)</li><li>• Dynamic systems literature</li><li>• Self-in-Relation Interview method</li><li>• Prototype SiR2T</li></ul>
2	<ul style="list-style-type: none"><li>• Iterative consultation &amp; refinement with practicing teachers (n=8)</li></ul>
3	<ul style="list-style-type: none"><li>• Two rounds of pilot interviews with teachers (n=9 &amp; n=10)</li></ul>
4	<ul style="list-style-type: none"><li>• Final refinement of the tool incorporating pilot teacher's feedback creating SiR2T</li></ul>

# Methods: Study 1 Procedures

## Interview Protocol:

- Part I (low support). Task: Open ended question about their teaching process. Responses given in free-form (1-2 paragraphs) emailed back to the interviewer.
- Email “Part II interview” included the SiR2T tool,
- Part II (high support) Phone/audio recorded (transcribed).



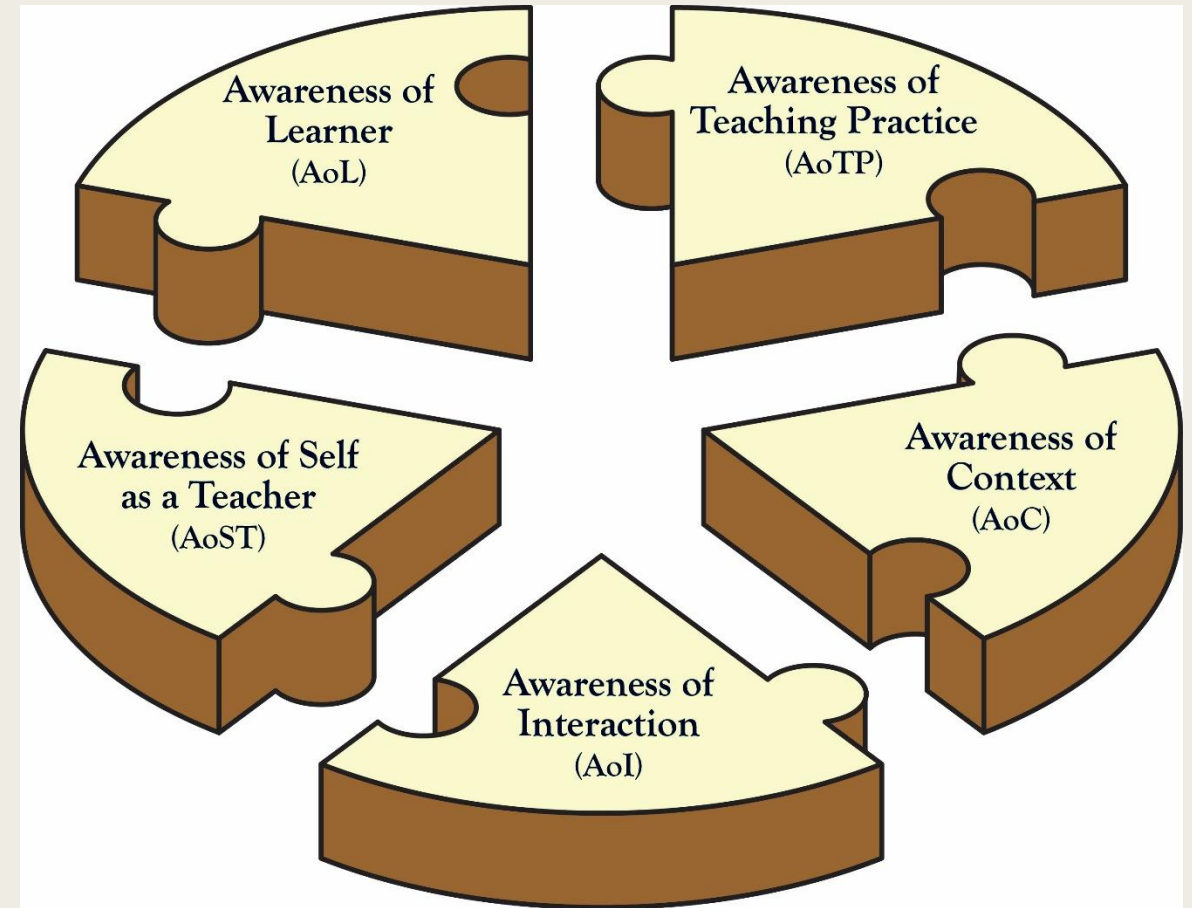
# Methods: Study 1 Analysis

## ■ Analysis

- *Grounded theory*
- *Emic coding*
- *2 coders*

# Results: Study 1

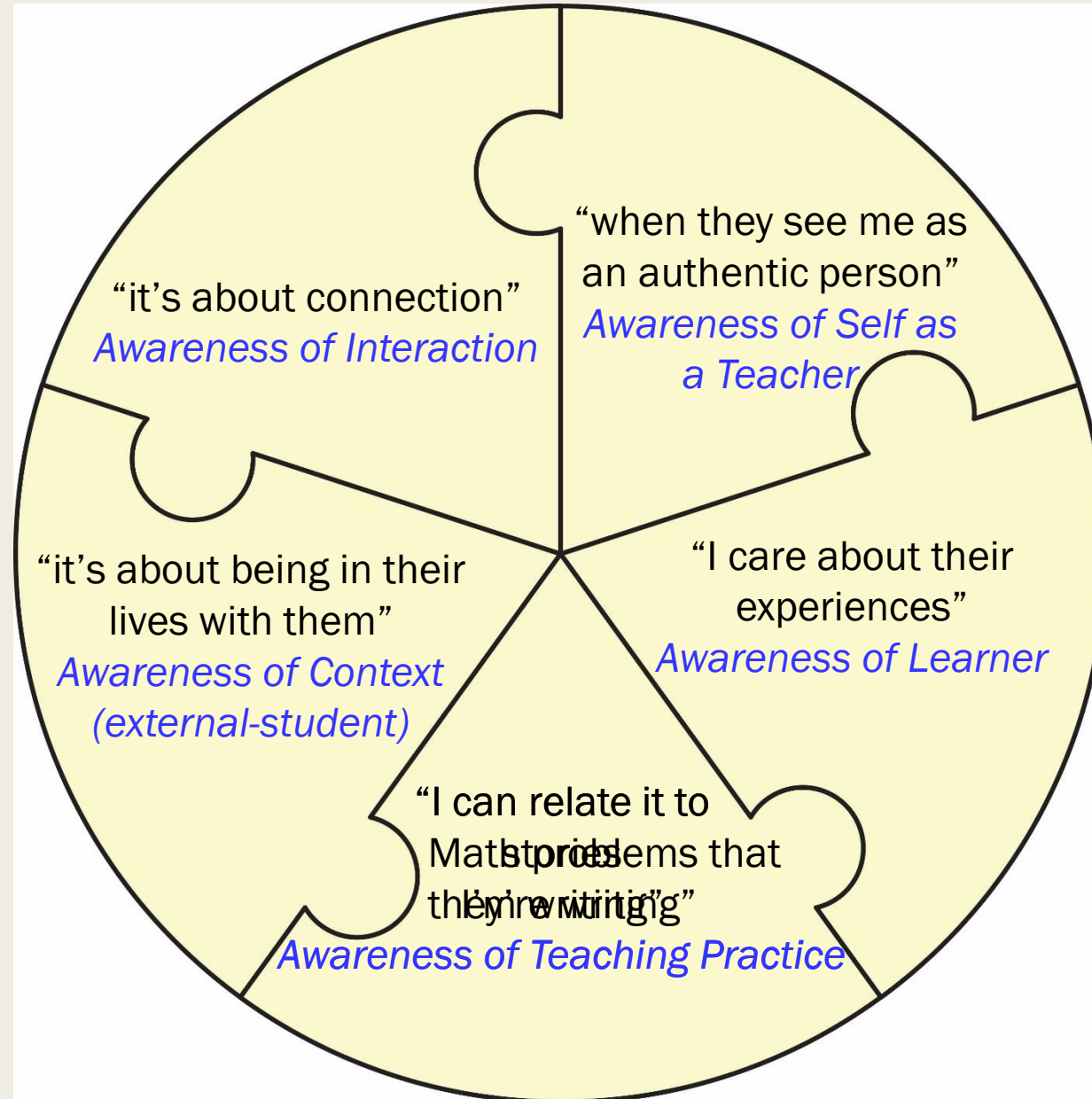
- 5 themes or Awarenesses
  - *Learner*
  - *Teaching Practice*
  - *Context*
  - *Interaction*
  - *Self-as-a-Teacher*



# Results: Study 1

Awareness of:				
Learner	Teaching Practice	Interaction	Context	Self-as-a-Teacher
<ul style="list-style-type: none"> <li>• <b>Feedback</b> <ul style="list-style-type: none"> <li>• Intentional</li> <li>• Unintentional</li> </ul> </li> <li>• <b>Needs</b> <ul style="list-style-type: none"> <li>• Physical</li> <li>• Emotional</li> </ul> </li> <li>• <b>Development</b> <ul style="list-style-type: none"> <li>• Individually-collectively</li> <li>• Present-future</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Tangible practices</b> <ul style="list-style-type: none"> <li>• Routines</li> <li>• Organization</li> <li>• Planning</li> </ul> </li> <li>• <b>Intangible practices</b> <ul style="list-style-type: none"> <li>• Classroom culture</li> <li>• Culture of Practice</li> <li>• Systems thinking</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Connection</b> <ul style="list-style-type: none"> <li>• Relationship</li> <li>• Bond</li> </ul> </li> <li>• <b>Working Together</b> <ul style="list-style-type: none"> <li>• Collaboration</li> </ul> </li> <li>• <b>Mutual effects</b> <ul style="list-style-type: none"> <li>• Reciprocity</li> <li>• Feedback</li> </ul> </li> <li>• <b>Synergy</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>External-student</b> <ul style="list-style-type: none"> <li>• Weather</li> <li>• Family</li> </ul> </li> <li>• <b>External-Institution</b> <ul style="list-style-type: none"> <li>• Physical space</li> <li>• Philosophy</li> </ul> </li> <li>• <b>External-large scale</b> <ul style="list-style-type: none"> <li>• Mandates</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Private self</b> <ul style="list-style-type: none"> <li>• Needs</li> <li>• Life plan</li> <li>• Values-identity</li> </ul> </li> <li>• <b>Public self</b> <ul style="list-style-type: none"> <li>• Authenticity</li> <li>• On display</li> </ul> </li> <li>• <b>Perceived self</b> <ul style="list-style-type: none"> <li>• Student perception</li> </ul> </li> </ul>

# Results: Study 1





# Discussion: Study 1

- Five unique social emotional themes emerged from expert teachers
  - *Some themes (Learner, Teaching Practice) encompass known constructs (social perspective taking, theory of mind, online decision making, etc.)*
  - *Others are less well explored (Self-as-a-Teacher, Interaction, Context)*
- The themes are distinct but the data suggests they are interwoven in expert teaching forming a complex system
- Awareness of interaction highlighted the phenomenon of synchrony as an unexplored but potentially important domain for expert teaching

# Research Questions

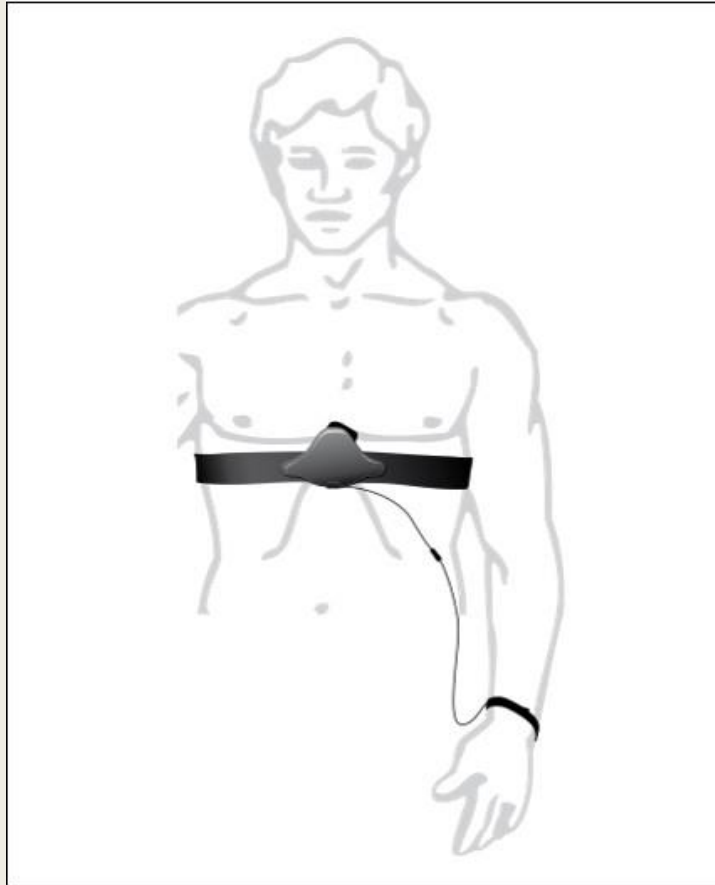
## ■ Study 2

- *Is there physiological synchrony, as measured by galvanic skin response, between expert teachers and their students during a teaching interaction?*
- *Is the degree of this dyadic physiological synchrony correlated with the teacher's social cognition as measured by a social perspective-taking and teacher-student relationship instrument applied to each teacher-student dyad?*

# Methods: Study 2 Sample & Setting

Expert Teacher (n=11)	Type of School	Subject Area	Grade	Location	Students (n=55)
<ul style="list-style-type: none"> <li>• Active teaching</li> <li>• Endorsements from admin</li> <li>• 10yrs+ exp</li> <li>• Teacher attendance</li> <li>• Student test score data</li> <li>• Self-report love of teaching</li> <li>• CLASS observation (scores 6-7 in all areas)</li> </ul>	<ul style="list-style-type: none"> <li>• Public School (n=6)</li> <li>• Private (n=5)</li> <li>• Boarding (n=1)</li> <li>• Specialized (n=2)</li> <li>• No-excuse Charter (n=1)</li> </ul>	<ul style="list-style-type: none"> <li>• Math</li> <li>• ELA</li> <li>• History</li> <li>• Science</li> <li>• Special Education</li> <li>• Technology</li> </ul>	<ul style="list-style-type: none"> <li>• Lower Elementary (n=3)</li> <li>• Upper Elementary (n=2)</li> <li>• Middle (n=2)</li> <li>• High (n=4)</li> </ul>	<ul style="list-style-type: none"> <li>• Urban (n=4)</li> <li>• Suburban (n=2)</li> <li>• Charter (n=1)</li> <li>• Semi-rural (n=1)</li> </ul>	<ul style="list-style-type: none"> <li>• Age 4-18</li> <li>• Chosen randomly</li> </ul>

# Methods: Study 2 Procedures



(Marci & Orr, 2006)

Step 0: Initial completion of SPT/TSR questionnaire.

Step 1: Watch baseline video

Step 2: Writing task (teachers also receive preparation for next task)

Step 3: Teacher interacts with student on task

Step 4: Modified SPT/TSR survey

# Methods: Study 2

Candidate Synchrony Measures	
The average of the magnitude of the positive correlations	The average of the magnitude of the negative correlations
The log of the number of positive correlations over the number of non-correlations	The log of the number of negative correlations over the number of non-correlations
<b>Log of ratio of magnitude of positive over negative correlations</b>	<b>Log of ratio of frequency of positive over negative correlations</b>

# Methods: Study 2

## ■ Analysis

### – *Synchrony data*

- Validate by comparing to random hypothetical dyads
- Look for significant increase in synchrony from low to high support
- Adjust for clustering of students within teacher

### – *Explore relationship between synchrony and social cognitive survey measures*

- Correlations between SPT/TSR domains and High Support synchrony measures
- Correlations between SPT/TSR domains and change in synchrony from Low to High Support

# Results: Study 2

## ■ Synchrony

- Baseline and low support = hypothetical/random e.g. background noise
- High Support condition
  - Significantly greater than hypothetical/random ( $p=.004$ , adjusted  $p=.001$ )
  - Increased from Low to High Support Conditions ( $p=.09$ , adjusted  $p=.06$ )
  - Findings robust to:
    - *Splitting the High Support Condition into 3 time periods equivalent to Low Support*
    - *Potential order/practice effect (same impact regardless of sequence position)*
    - *Excluding the first student to remove carry-over effects from Low Support*

# Results: Study 2

- Correlation to Social Emotional Cognitive Measures (TSR/SPT)
  - Multiple correlations between Synchrony and TSR/SPT
    - Moderate correlation coefficients but often nonsignificant p values due to small sample
    - However these measures were correlated with higher synchrony
      - Student reported positive relationship (pre-interaction),  $\text{corr}=.31$  ( $p=0.2$ )
      - Teacher reported perspective taking confidence (post-interaction),  $\text{corr}=.36$  ( $p=.04$ )
  - Correlations substantially strengthened when Synchrony data split at the median
    - Moderate correlations (0.3-0.6)
      - *Upper median of synchrony 11/15 domains*
      - *Lower median of synchrony 9/15 domains*
      - *Example: Teacher reported positive relationship in general*
        - Upper median:  $\text{corr} = -.54$ ,  $p=.05$
        - Lower median:  $\text{corr} = -.52$ ,  $p=.06$



# Discussion: Study 2

## ■ Interesting patterns

- *Student reported SPT (effort/propensity/motivation) consistently correlated with synchrony, though pattern was complicated*
- *Teacher reported SPT (confidence/motivation) correlated with synchrony particularly in upper median and among teachers able to create the biggest changes from Low to High Support*
- *Stronger correlations in upper and lower median as compared to combined data*
  - Suggests unique patterns/relationships between synchrony and the teachers individual social cognitive capacity
  - Noteworthy considering smaller sample sizes in split analyses

# Conclusions

## Study 1:

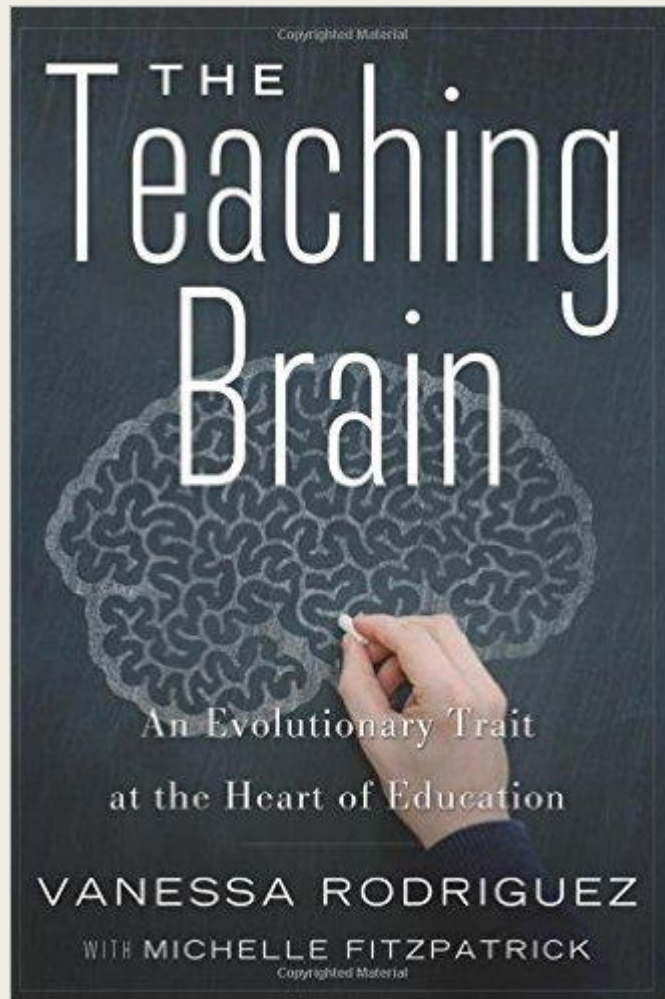
- Identified potential new schema for individual teacher cognitions built on foundation of DST and social cognition.
  - *5 Awarenesses*
- Highlighted importance of less well established social emotional cognitive domains
  - *Awareness: Self as a Teacher, Interaction, Context*

## Study 2:

- Extends the schema and provides preliminary evidence:
  - *Synchrony exists between teacher and student.*
  - *Is sensitive to level of support during teaching interaction.*
  - *Is correlated to individual social emotional cognitions*
  - *Relationships are complex and may be different depending on the teacher's cognitive capabilities*

# Implications

- These studies provide preliminary insight into teaching as a complex system comprised of dynamic, and social emotional cognitive processes.
- Ultimate goal of my research is to characterize teaching as a developmental and social emotional cognitive skill whose complexity can be better understood when viewed through a dynamic systems lens.



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# Questions



"I'm afraid I still have more questions than answers."