Non-local mind from the perspective of social cognition
Chatel-Goldman et al (2013)

Two main approaches in studying social cognition (Table 1)
1) **studying isolated minds**  
   - Considering one brain alone cannot account for all mechanisms subtending online social interaction.

2) **studying interacting minds**. Central question: to what extent is cognition shaped or even constituted by mutual interaction /co-regulated coupling
   - Discuss “non-local” social mechanisms = interpersonal brain and body coupling

They provide **taxonomy for existing research in social interaction** (FIG. 1)
- Classify the functions explored in the studies into distinct domains and stages of information processing

**Vertical dimension**: stages of social information processing
- Processing from lower to higher states of social cognition: from *perception* through *cognition* to *regulation*.
- Arrow (left side) = changes in attributes (automaticity and control, process speed, sensitivity to context, age of development, probably phylogenetic trajectory).
Figure 1: Each cylinder represents a research focus

<table>
<thead>
<tr>
<th>Focus / Conceptual approach</th>
<th>Emotion</th>
<th>Joint action</th>
<th>Theory of mind</th>
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<tr>
<td>Experimental paradigms</td>
<td>Pseudo-interactive approaches (+ subjective empathy tests)</td>
<td>Fine physical measures of interpersonal synchrony (motor actions, more ecological settings)</td>
<td>Paradigms based on Game theory (decision making)</td>
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<tr>
<td>Focus / Conceptual approach</td>
<td><strong>Information theory:</strong> empathy reduced to quantifiable transmission of emotion from sender to receiver; <strong>Simulationist</strong> and <strong>embodied account of social cognition:</strong> we feel or &quot;simulate&quot; the feelings or actions of others in order to understand them.</td>
<td><strong>Interactive and dynamical view</strong> of social abilities; Joint and shared attention (<strong>trending approach at the moment</strong>)</td>
<td>Studying what the subject infers about the mental state of others</td>
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<td>Challenges &amp; suggestions</td>
<td><strong>Challenge:</strong> Absence of objective measures of affect <strong>Suggestions:</strong> collection of autonomic data. Quantification of social effects on human physiology (e.g. Konvalinka et al. (2011) fire-walking Müller &amp; Lindenberger (2011) choir singing – cardiac and respiratory coupling)</td>
<td><strong>Challenge:</strong> Fails to recreate real-life interplay dynamics due to the use of turn-based non-ecological scenarios <strong>Suggestions:</strong> Should use truly interactive paradigms</td>
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<td>Data collection strategy</td>
<td>Unidirectional</td>
<td>Reciprocal</td>
<td>Turn-based</td>
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<td>Research examples</td>
<td>No hyperscanning studies to date? Anders et al., 2011</td>
<td>EEG-hyperscanning Tognoli et al., 2007 – elementary social coordination; Dumas et al., 2010; Dodel et al., 2011 – simulated combat, team coordination; Babiloni et al., 2011; Naeem et al., 2012</td>
<td>fMRI-hyperscanning King-Casas et al, 2005; Tomlin et al. 2006; Dual-EEG de Vico Fallani et al., 2010; Astolfi et al., 2010; Dual-NIRS Cui et al, 2012</td>
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</table>
BUT: Real-life interactions are most of the time unconstrained and co-regulated

Toward a holistic view of various mechanisms at play during social interaction
Truly interactive paradigms needed: authors seem to support joint-attention / interpersonal coupling paradigms the most.

Examples:
- **Neural underpinnings of joint attention**: dual-fMRI Saito et al., 2010 (gaze-following); dual-EEG Lachat et al., 2012 (dual-EEG, gaze-following alpha and mu as correlates of joint-attention)
- **Offline, unidirectional interaction** (but tasks were rather engaging): inter-brain coupling during verbal or non-verbal communication: Stephens et al., 2010 (speaker-listener coupling); Schippers et al., 2010 (game of charades (guessing from gestures) among romantic couples)

→ **Interpersonal coupling: a basis for social cognition?**
- Mirror neuron system and the mentalizing network (Keysers and Gazzola, 2007)
- Studying non-local mechanisms of social interaction: bringing online and reciprocal social interaction into experimental paradigms (Hasson et al., 2012, Di Palo and de Jaegher, 2012).

**Future directions**
- normal vs. impaired social abilities
- studies across species; joint dynamics across non-humans
- psychopharmacological factors and interpersonal coupling: oxytocin, vasopressin