
This version is available at https://strathprints.strath.ac.uk/57841/

Strathprints is designed to allow users to access the research output of the University of Strathclyde. Unless otherwise explicitly stated on the manuscript, Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Please check the manuscript for details of any other licences that may have been applied. You may not engage in further distribution of the material for any profitmaking activities or any commercial gain. You may freely distribute both the url (https://strathprints.strath.ac.uk/) and the content of this paper for research or private study, educational, or not-for-profit purposes without prior permission or charge.

Any correspondence concerning this service should be sent to the Strathprints administrator: strathprints@strath.ac.uk
The Emotional & Embodied Nature of Human Understanding: Making meaning in shared projects of discovery

Friday 9th September 2016
Children's Voices in Contemporary Australia
University of Melbourne

Dr Jonathan Delafield-Butt
jonathan.delafield-butt@strath.ac.uk
Senior Lecturer in Child Development
University of Strathclyde

Preamble.
In the end is the beginning....

“We choose to go to the moon, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win...”
(J. F. Kennedy, Rice University Speech, 12 September 1962)

Kennedy’s Principle of Goal-Directed Social Organisation

“We choose to go to the moon, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win...”
(J. F. Kennedy, Rice University Speech, 12 September 1962)
Kennedy's Principle of Goal-Directed Organisation

Americans with a Shared Goal

Organisation is Goal-Directed

- Common principle within and between individuals
- Generates coherence and synergistic efficiencies
- Enabled by shared timing and coordination of action
- Gives value, understanding, and meaning in common purpose (everybody belongs)

Overview – Fundamental Psychological Principles

- Principle 1: I like to move it!
  - Satisfaction in movement in acquiring ‘goals’.
- Principle 2: I like to move it with you!
  - Satisfaction in coordinated interpersonal sensorimotor acts, e.g. dancing
- Together: This gives meaning-making and social understanding in intersubjective engagement

"Every mental phenomena is characterised by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object, and what we might call... reference to a content, direction toward an object... or immanent objectivity." (Franz Brentano, 1874, p. 88).

Mind in Movement
Bower, Broughton, and Moore (1970) demonstrated that when a newborn infant's reach-to-grab was thwarted by a visual illusion, distress ensued. Infants adjust the pattern of their kick to elicit action in an overhead mobile, if the conditions are manipulated so that minimal response is given, distress ensues (Angulo-Kinzler, 2001; Fagen and Rovee, 1976; Rovee-Collier et al., 1978; Rovee-Collier and Gekoski, 1979; reviewed in Zeedyk, 1996). Even neonates move their arms to achieve particular sensory effects (van der Meer, 1997; van der Meer and van der Weel, 2011; van der Meer et al., 1995).

Actions are Prospective by Necessity

- Biomechanical inertial forces necessitate prospective control (Bernstein, 1967; von Hofsten, 1993; 2004)
- Actions are expensive; to act economically and with adaptive effect they must be guided by prospective perception (von Hofsten 1993; 2004; Lee, 1998; 2009)
- All units of action must be ‘goal’-directed (Lee 1998; 2009)
Primary Sensorimotor Intentionality

Pre-reflexive, pre-conceptual.

Future-oriented.

Simple.


Prospective Control in Limb Displacements

10 Normal Term Birth Babies; 480 movements
8 Prematurely Born Babies 'At Risk' for Neurodevelopmental Disorder, 384 movements

Primary Sensorimotor Intentionality:

A pre-reflective, pre-conceptual motor intentionality, perceptually prospectively controlled.

Intentional Agency Evident at Start of 2nd Trimester

- first tentative signs at 8-10 weeks in the first spontaneous, coordinated limb movements (de Vries, Visser, & Prechtl, 1982; Prechtl, 1986)
- discrimination in action patterns of limbs in 14 week GA twins between twin-object, and self-directed movements (Castella et al., 2010)
- action-planning evident in kinematics by 18-22 weeks GA (Zoia et al., 2007)
- anticipation of self-directed actions (Myowa-Yamakoshi & Takeshita, 2006)
- behavioural evidence of ‘bicycling’, reaching, grasping, exploring, etc. (Piontelli, 2010)

Prospective control in Foetal Movements

- indication at 8-10 weeks in the first coordinated limb movements (de Vries, Visser, & Prechtl, 1982; Prechtl, 1986)
- discrimination in action patterns of limbs in 14 week GA twins between twin-object, and self-directed movements (Castella et al., 2010)
- action-planning evident in kinematics by 18-22 weeks GA (Zoia et al., 2007)
- behavioural evidence of ‘bicycling’, reaching, grasping, exploring, etc. (Piontelli, 2010)

Primary Sensorimotor Intentionality

- motor intentionality of
  - a pre-conceptual, pre-reflexive, perceptually prospective kind
- that enables
  - development from a primary anoetic (not knowing/without intelligence) consciousness to
- perceptually aware:
  1. a viscerosomatic awareness of vital, somatic need;
  2. an exteroceptive awareness of the world of objects and other animals

Primary Sensorimotor Intentionality

- enables development of ‘sensorimotor intelligence’ (Piaget, 1953; 1954)
- through repetition of successful intention action
  - this is what Baldwin (1895) called the ‘circular reaction’

“The self-repeating or ‘circular’ reaction... is seen to be fundamental and to remain the same, as far as structure is concerned, for all motor activity whatever: the only difference between higher and lower function being, that in the higher, certain accumulated adaptations have in time so come to overlie the original reaction, that the conscious state which accompanies it seems to differ per se from the crude imitative consciousness in which it had its beginning.”

(Baldwin, 1895, p. 23).

The Centrencephalic Me

- upper brain stem and midbrain region is seat of the integrative ‘core self’ (Merker, 2007; Northoff & Panksepp, 2008; Panksepp & Northoff, 2009; Panksepp, 2011)
- the core SELF at the midbrain and upper brain stem is anatomically subcortical, but functionally supracortical.
- connected to skeletonmusculature by ca. 14 weeks G.A.
- controls primary prospective action
- conscious and acts with felt appraisal (Penfield & Jasper, 1954)
- site of affective learning and memory (Winn, 2012)
- evidenced in anencephalic children
- and foetal prospective motor control before cortical lamination
Emotional and Embodied Nature of Human Understanding. Jonathan Delafield-Butt

The Centrencephalic Me

- a cortex is not necessary to
  - be conscious,
  - have feelings,
  - act with intentions,
  - perceive and appraise the environment,
  - engage socially and purposefully,
  - learn
- c.f. surgically decerebrate cats and rats (Wood, 1964)

Development of Sensorimotor Intentionality

- cognitive development is a development from single action intentions (discrete actions) to projects of action units (serially ordered actions) (Pezzulo, 2011)
- serially-ordered action units organised from the beginning to produce distal goals (Jeannerod, 1999; Fogassi et al, 2005)
  - e.g. reach to grasp to place vs. reach to grasp to throw
  - n.b. deficit in prospective control in autism

Hierarchical Organisation of Sensorimotor Intentionality

Table 1: Levels of sensorimotor intentionality

<table>
<thead>
<tr>
<th>Level</th>
<th>Spatial</th>
<th>Temporal</th>
<th>Description</th>
<th>Sample Task</th>
</tr>
</thead>
</table>
| Primary       | Action        | Path           | A single continuous trajectory to a goal, e.g., an arm movement to a body space goal (e.g., throw)
| Secondary     | Movement      | Project         | Coordination and serial organization of multiple action units for a proximal goal, e.g., reach to grasp or reach to grasp to throw
| Tertiary      | Mental        | Mental project  | Coordination and serial organization of mental projects to achieve a higher-order, abstract, distal goal, e.g., creating a dance

Sensorimotor Intentionality

- Sensorimotor Intentionality develops:
  - first intentionality in single ‘action units’ (primary)
  - then envelopes multiple action units to make (secondary) projects
  - then projects of projects of action units (tertiary)
  - and so on as the child develops further cognitive skills, enable sophisticated planning for prospectively controlling the present moment to achieve future goals
- Tools of memory, planning, abstract reasoning and creative imagination enable more complex and abstract sensorimotor projects.

Neonatal Sensorimotor Intentionality

- Tertiary Sensorimotor Intentionality – NOT YET PRESENT
  - very rudimentary, vague
  - requires memory, planning, abstract reasoning and imagination
  - enables distant goals to organize action in the present.
    - e.g. studying now for a degree or job in the future
- Secondary Sensorimotor Intentionality – RUDIMENTARY
  - establishing and developing
  - enables simple sensorimotor projects, e.g. walking or grasping
    - e.g. mobility toward the breast, coordinated motor acts in social engagements
- Primary Sensorimotor Intentionality – EVIDENT
  - established and improving
  - developing precision with improved muscle tone and experience-dependent neurontal maturation
    - simple intentional action
      - e.g. arm gesture, sucking control, gaze & head orientation

Toddler Sensorimotor Intentionality

- Tertiary Sensorimotor Intentionality – ESTABLISHING
  - rudimentary beginnings becoming substantiated
  - requires memory, planning, abstract reasoning and imagination
  - enables distant goals to organize action in the present.
    - e.g. studying now for a degree or job in the future
- Secondary Sensorimotor Intentionality – EVIDENT
  - established and developing
  - enables simple sensorimotor projects, e.g. walking or grasping
    - e.g. mobility toward the breast, coordinated motor acts in social engagements
- Primary Sensorimotor Intentionality – EVIDENT
  - established and improving
  - developing precision with improved muscle tone and experience-dependent neurontal maturation
    - simple intentional action
      - e.g. arm gesture, sucking control, gaze & head orientation

Child Sensorimotor Intentionality

- Tertiary Sensorimotor Intentionality – ESTABLISHED
  - rudimentary beginnings becoming substantiated
  - requires memory, planning, abstract reasoning and imagination
  - enables distant goals to organize action in the present.
    - e.g. studying now for a degree or job in the future
- Secondary Sensorimotor Intentionality – ESTABLISHED
  - established and developing
  - enables simple sensorimotor projects, e.g. walking or grasping
    - e.g. mobility toward the breast, coordinated motor acts in social engagements
- Primary Sensorimotor Intentionality – ESTABLISHED
  - established and improving
  - developing precision with improved muscle tone and experience-dependent neurontal maturation
    - simple intentional action
      - e.g. arm gesture, sucking control, gaze & head orientation
Sensorimotor Satisfaction: Joy in Successful Secondary Sensorimotor Intentionality

Principle 1: I like to move it.

inherent satisfaction or joy in successful solo sensorimotor acts
(moving, grasping, walking, skiing, climbing, tight-rope walking)

Principle 2: I like to move it with you.

requires two sensorimotor systems with two timing systems to be in step and in tune with each other to generate shared meaning and joy.

From solo sensorimotor projects to shared meaning-making

"There is a series of hierarchies of organization; the order of vocal movements in pronouncing the word, the order of words in the sentence, the order of sentences in the paragraph, the rational order of paragraphs in a discourse. Not only speech, but all skilled acts seem to involve the same problems of serial ordering, even down to the temporal coordination of muscular contractions in such a movement as reaching and grasping. Analysis of the nervous mechanisms underlying order in the more primitive acts may contribute ultimately to the solution even of the physiology of logic."

Embody, Non-verbal Narratives

- Narratives have a discreet, finite nature like goal-directed sensorimotor projects.
- They:
  1. Initiate toward a shared, intersubjective ‘goal’.
  2. Build in intensity as the project proceeds.
  3. Reach a climactic point of maximal tension and release.
  4. Conclude and appropriate the effect of their activity, giving something new.
- The intersubjective ‘goal’ is the ‘coming together’ of two agencies in common meaning, creating coherence of affect, intention, and action between them (Stern, 1985; Trevarthen & Delafield-Butt, 2013).
Neurobiology of Embodied Social Meaning-Making

1. Mind in action
   - generative, affective, intentional engagement

2. Mirror Neuron System
   - mind reading by 'direct neural resonance'

3. Polyvagal System
   - direct social autonomic regulation

The Polyvagal System

Direct social regulation of autonomic systems through facial expression and gesture (Porges & Furman, 2011)

- e.g. regulation of heart beat, arousal, anticipation to act, etc.

Altogether we feel the other's feelings and intentions through direct social perception.

This is an affective and embodied social understanding.

Narrative Cycle

Introducing the idea that narrative is a fundamental aspect of human understanding, Delafield-Butt and Trevarthen (2013) emphasize the developmental importance of narratives in early childhood. This framework highlights the role of narratives in shaping and understanding social interactions, grounded in the Polyvagal Theory developed by Porges (2011). The Polyvagal System provides a neurobiological foundation for how the nervous system supports and regulates social interactions, including theMirror Neuron System, which plays a crucial role in understanding others' intentions and actions through neural resonance.

Overall, the interplay between these neurobiological systems and the Narrative Cycle underscores the importance of affective and embodied social understanding in human development.
Co-created Narrative Projects

- narratives are units with a discreet, finite structure like goal-directed sensorimotor projects
- they
  1. initiate toward something, a 'goal'.
  2. build in intensity as the project proceeds
  3. climax with maximal tension and release.
  4. conclude and appropriate the effect of their activity, giving something new.
- the 'goal' is mutual understanding, creating coherence of affect, intention, and action between.

Sharing Intentions and Sharing Time in a Common Project

- individual sensorimotor intentions directly perceptible by the other by direct neural resonance (Gallese et al., 2009; Gallese, 2000; Gallese and Sinigaglia, 2010)
- enables the experience of the other within the oneself, direct intersubjectivity (Bråten, 2009, Gallagher, 2008)
- arousal, interest, and intention between individual coordinated through the polyvagal system

Narratives Are Embodied Projects of Meaning-Making

- the same narrative structure is found in all shared projects, even with objects and in learning
- shared goals structure the project
- they are produced through rhythmic cycles of action, expression, or gesture
- they reach a moment of peak excitation at their goal
- they conclude to quiescence again
  - the memory of the act held in special memory

Co-created Narrative Projects

- these form social schemas (c.f. Piaget)
- experience with individuals in contexts gives discreet goals and expectancies
  - enabling anticipation and prospective planning
- their experience is held in memory
- they enable learning the patterns and rituals of a culture
  - e.g. classroom culture, nursery room culture, primate lab culture
- they enable learning the patterns of individuals, made in special relationship
  - can build trust, confidence, and for the foundation of learning.
Embody Narrative in Learning: Descending the Stairs, and Counting

The case of a Nurture Group teacher and her student descend the stairs.

- **Introduction** as the teacher explains the task ahead.
- **Development** as they descend the stairs, their footsteps falling into rhythm as they count the stairs together.
- **A climax** marked by excitement in vocal pitch as they reach end, quickly
- **concluding** as they depart.

Embody Narrative: Learning to Play Connect 4

A Nurture Group teacher and her student engage in Connect 4 gameplay:

- 5 games are played, each with a narrative structure of introduction, development, climax, and resolution
- focus on 1 game to illustrate its musicality and rhythm
- shared joy on completion leads to learning these patterns
- learning is process

Embodied Narrative: Learning to Play Connect 4

Over-arching narrative of the complete gameplay session

- each gameplay makes a narrative
- and altogether they make a narrative of game playing that lasts just over 4 minutes
Two Types of Cognition (Bruner, 1990)

(1) Narrative
- "line mode" (Donaldson, 1992)
- proceeds through time
- necessarily embodied
- built on the structure of experience
  - Situation, motivation, perception, action, and its result
- always coloured with vital affectivity

(2) Logico-scientific
- conceptual
- static, timeless
- becomes disembodied
- built on knowledge from experience
  - accumulation of the result of action
- abstract, generalised facts
  - not necessarily situated, affective, motivated, etc.
**Autism as a Disorder of Intentional Movement**

- Motor patterns in iPad play predict autism with 93% accuracy.

**Autism: A Disorder in Intentional Movement and Affective Engagement**

- Disrupted motor timing
- Disrupted expressive intention
- Disrupted social and affective engagement

**Initiation Through Imitation**

**Engagement I**

**Initiation and Build Through Imitation**

**Engagement 4**

**A Complete, Co-created Narrative**

**Engagement II**
Emotional and Embodied Nature of Human Understanding. Jonathan Delafield-Butt

Mutual Joy in Intersubjective Unification

Engagement IS

Developing Trust and Meaning in Embodied Narratives

Shared Understanding – Mind Reading

Directions Exchanged at Synchronous ‘Frontier’

Making Contact

- one’s feelings and intentions made in actions are mirrored in the mind of the other (e.g. Winnicott, 1971) by ‘direct neural resonance’ (Gallese 2001, 2004; Gallagher, 2008)
- they create a serial ordering that builds a shared sensorimotor project (Trevarthen & Delafield-Butt, 2013)
- intensity reaches a climax where simultaneous expression is given on both sides – togetherness (Delafield-Butt & Trevarthen, 2015; 2013)
- this concludes the project, the two now holding that completed shared act in memory, generating attachment and companionship
- the shared act becomes an ‘object’; a social sensorimotor schema giving social, affective value in embodied relations (Reddy, 2006; Delafield-Butt & Adie, 2016)

Summary

- Agency
  - Action under one’s own power for one’s own purpose.
- Embodiment
  - Experience structured by the body, its needs and capacities made in motor action.
- Affectivity
  - Evaluative appraisals of vital value.
- Intelligence
  - Learning meaning of objects, persons and actions, through narratives of action

Conclusions

- There exists an invariant sensory-motor intentionality, disrupted in autism
  - structures experience-dependent learning and development of cognition and social cognition.
  - 1st Level, single intention-actions (pre-conceptual)
  - 2nd Level, projects of intention-actions (becoming conceptual)
  - 3rd Level, projects of projects of intention-action (conceptual)
- Sharing narratives with common goals generates meaning and value
  - generates learning, trust, and companionship
  - creates shared joy and understanding
  - giving embodied, affective meaning
  - these shared stories are necessary for human life to thrive
Narrative Structure is Invariant
Emotional and Embodied Nature of Human Understanding. Jonathan Delafield-Butt

Semiotematic Intentionality & Prospective Control
Prof. Dave Lee, Director, PMARC, University of Edinburgh
Prof. Colwyn Trevarthen, Psychology, University of Edinburgh
Dr. Nivedita Gangopadhyay, CSR, University of Copenhagen
Prof. Ian Laing, Consultant Paediatrician, Simpson’s NICU
Dr. Yvonne Freer, Neonatologist, Simpson’s NICU
Prof. Colwyn Trevarthen, Psychology, University of Edinburgh

Narrative Projects
Prof. Colwyn Trevarthen, Psychology, University of Edinburgh
Jillian Adie, University of Strathclyde
Prof. Koichi Negayama, Waseda University
Dr. Susanne Harder, Psychology, University of Copenhagen
Dr. Mette Vaever, Psychology, University of Copenhagen
Dr. Simo Koppe, Psychology, University of Copenhagen
Dr. Susanne Zeedyk, University of Dundee

Funders:
Royal Society of Edinburgh
European Union (FP6, TACT Project)
Psychoanalytic Association Research Advisory Board
Danish Research Council for the Humanities
Carnegie Trust for the Universities of Scotland
Japan Society for the Promotion of Science