Semiotic Relations As Controls of Interactions

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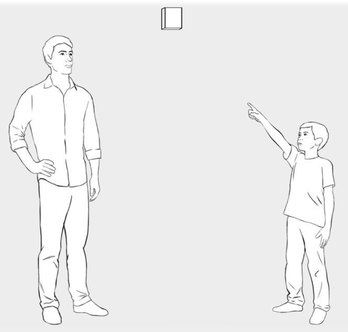
HIGHLIGHTS:

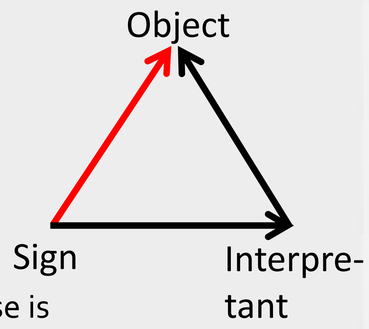
- Semiotic relations are understood as **controls** on behavioural dynamics of interactants
- Main Objective: to understand development of pointing in semiotic terms
- Contrasting the traditional analysis of pointing as ontogenetic ritualization with a more encompassing view of pointing as control of a dyadic system
- The principles of contiguity and similarity explain the development of infant's pointing and have useful implications for robotic implementations



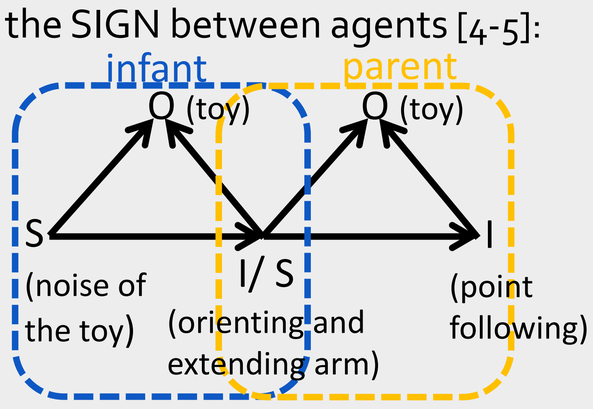
INTRODUCTION

Pointing is fundamentally social. Infants' actions gain meaning due to embedding by the caregivers into holistic sensible events [1; 2]. Here we contrast two ways of explanation and implementation of pointing behaviour: 1) ontogenetic ritualization and 2) conventionalization and show that analysing them in semiotic terms helps clarify both the theoretical and implementation differences. The importance of making a distinction between two types of association: by contiguity and by similarity.

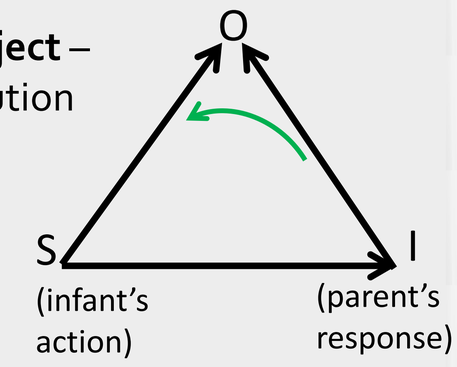
I. Semiotics [3]:
- components of a SIGN,
- types of relations between a Sign and an Object (contiguity (indexality), similarity (iconicity), rule (symbolicity),
- definition of an action [4]: behaviour is a Sign, purpose is an Object, and instrument is an Interpretant.



II. Semiotics of interactive behaviour: distribution of components of the SIGN between agents [4-5]:



III. Semiotic transformation of the Object – development of control and co-constitution of meaning:
anticipation of the effects of one's action, i.e. other's reaction (Interpretant), starts to control actions and **transforms the Object** of infant's action



DISCUSSION

- pointing develops from the orienting response [11]; becomes an intentional, communicative act due to caregivers' embedding in holistic events (development of conventional patterns) [14]; in repeated interaction noncommunicative behaviour evolves into communicative signal [2],
- two semiotic relations, i.e. contiguity (indexicality), similarity (iconicity), constrain behavioural dynamics of interactants and enable the infant (or robot) to develop regular and conventionally meaningful patterns of behaviour, sensible on a collective level,
- in ontogenetic ritualization motivation remains individual and behaviours are context-specific and fixed, thus each motive requires specified sequence,
- conventionalization allows for the co-constitution of meaning and acquiring bi-directional signals, thus effects on the level of dyad, and is motive (e.g. imperative, declarative) and context flexible.

Limitations and directions of future works:
- agent's intrinsic motivation should be specified in more detailed fashion,
- similar analyses should be applied to the development and implementation of the gaze (point) following.

pointing as an ontogenetic ritualization [6-7]	**pointing as a conventionalization** [2; 8-10]
• **abbreviation** (shortening action sequence; initial individual action becomes communicative signal) **Characteristics**: •idiosyncratic (dyad-specific), one-way •rigid sequence context and addressee dependent (lack of generalization) •semiotically: Object (purpose of an action, i.e. individual motivation) **remains the same**; Sign (controlled behaviour) becomes abbreviated thanks to the anticipation of the other's behaviour (or the other's anticipation)	• s**chematization** (in repeated exchange between interactants the action becomes simplified, stylized, and more regular) **Characteristics**: • based on common meanings (parents select meaningful actions); bi-directional; mutual constraining of actions, •flexible modification and context sensitivity •semiotically: Object transformation (parents attribute purpose to intentionless behaviour; in recurring 'negatiations' the infant adopts this purpose), the Sign becomes more regular
Development of pointing production [7]: 1. Infant tries to reach an object, 2. Parent consistantly provides the object, 3. Parent starts to anticipate the infant's reaching, on the basis of the initial step, by providing the object to the infant, 4. The infant starts to anticipate the parents' anticipation and produces the initial step.	**Development of pointing production:** 1.The infant points as part of an orienting pattern [11]; exploratory behaviour [12], 2. Parent co-orients and selectively imitate the infant's orientation (matching of orientations, [13]), 3. Imitation highlights behaviour and lets the infant segregate them into discrete units of actions, 4. Infants (re)use these units of actions in the following interactions.
Scenario of implementation [15]: 1. Trying to reach objects, 2. Failing to reach objects, 3. Interacting with an adult human a) adult understands robot's intention b) adult moves the object into robot's reaching range, 4. Ultimately knowing how to point.	**Scenario of implementation**: 1. Robots orients to something 'interesting' (motivation unspecifiad; event saliency), 2. Human co-orients and treats robot's behaviour *as if* [14] 3. Robot detects similarities between orientations (seperats 'units of action'); remembers consequences of action, 4. Robot re-uses 'units of action' controlled by consequences of actions.
Semiotic analysis (limited) of the [15] implementation: 1. Contiguity (reaching is caused by the object), 2. Contiguity (attempt to reach), 3. a. inference (Symbol), 3.b. extrapolation of robot's arm, 4. Anticipation (contiguity) of the object being moved.	**Semiotic analysis of implementation**: 1. Contiguity (orientation is caused by object), 2. Similarity of orientations and contingency (contiguity) of reactions, 3. Contiguity and similarity (between what do and see); contiguity of effects, 4. Anticipation (contiguity) of effects.

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