

2002 August 10-11
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Communications Research Laboratory, Japan

2nd International Workshop on EPIGENETIC ROBOTICS
MODELING COGNITIVE DEVELOPMENT IN ROBOTIC SYSTEMS

Email: er2002@epigenetic-robotics.org www.epigenetic-robotics.org

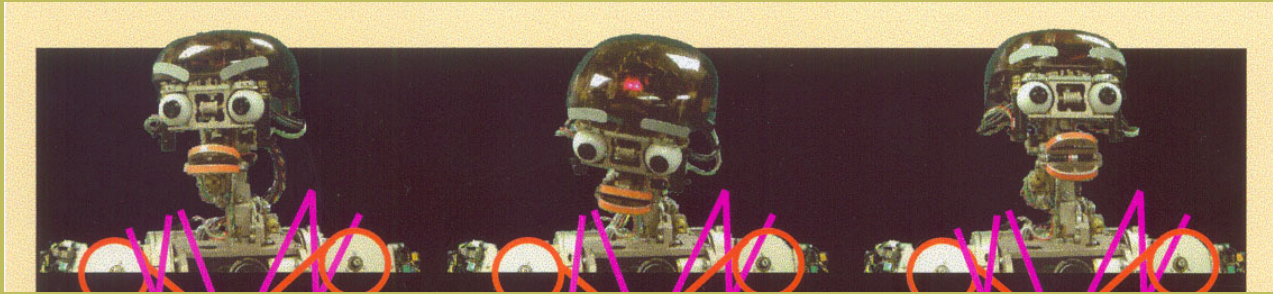
Epigenetic Robotics 2002

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Scotland

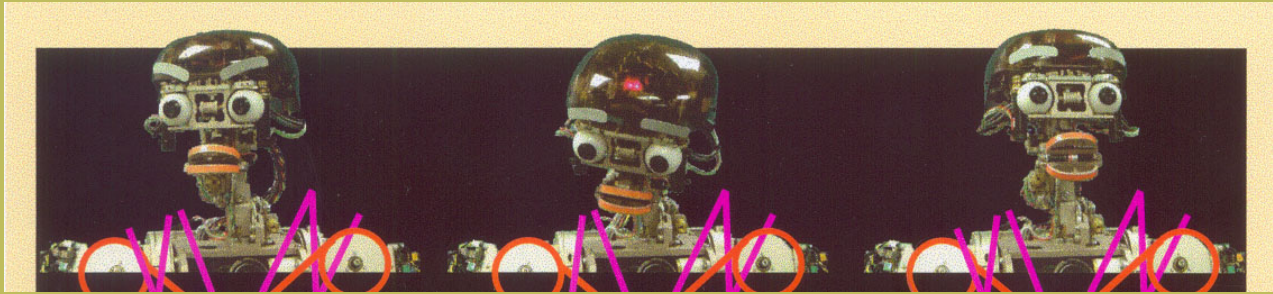
Christopher G. Prince

<http://www.cprince.com/PubRes/EpigeneticRobotics2002/intro>

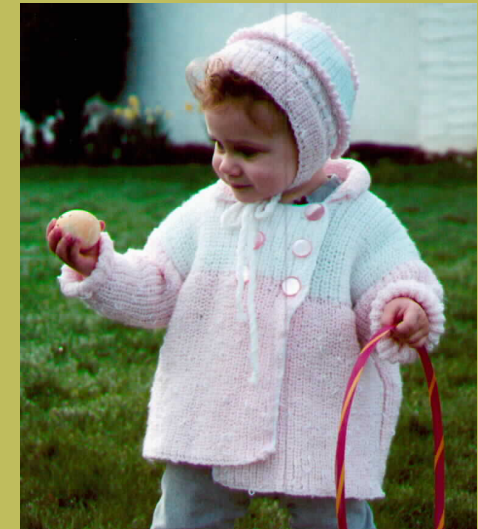
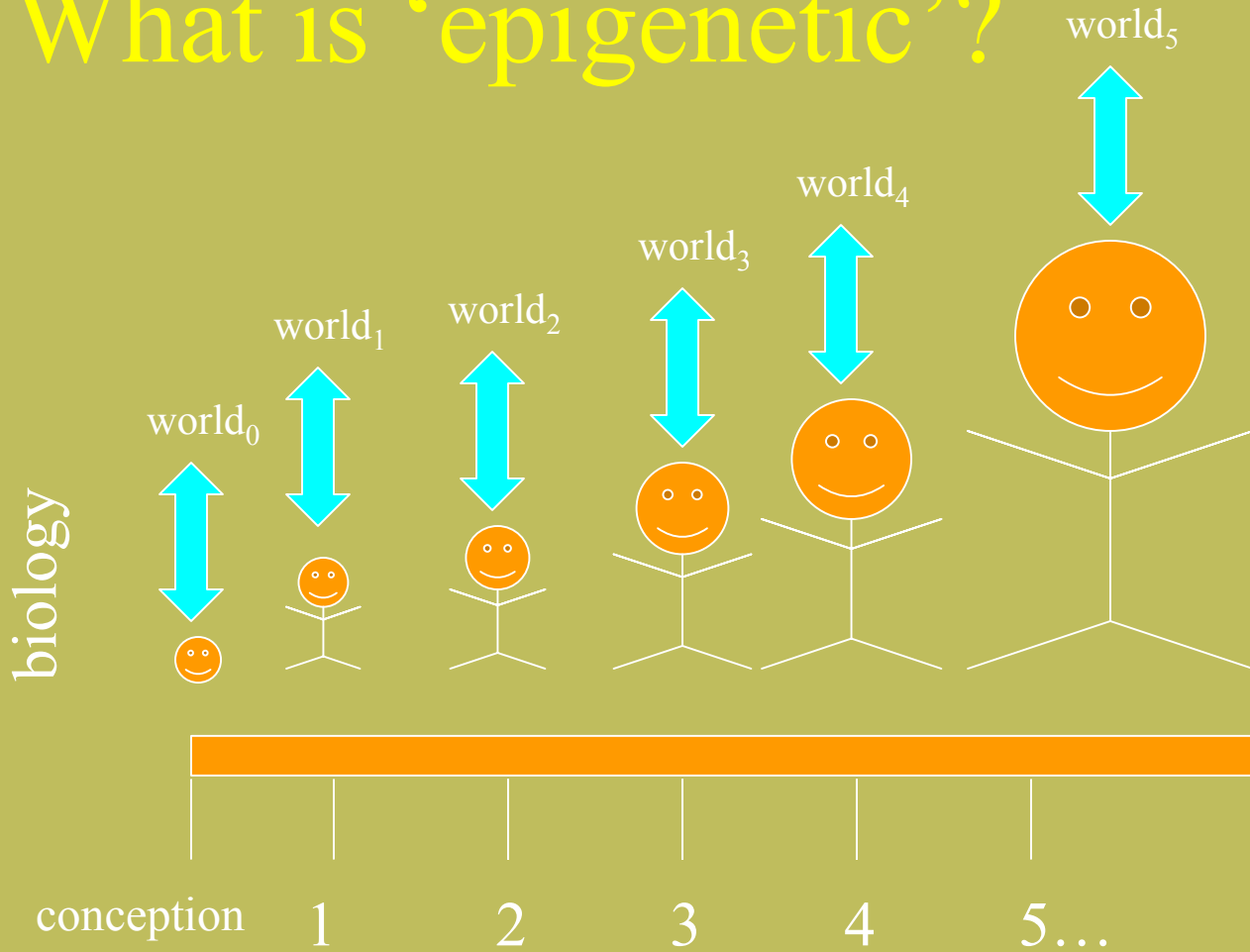


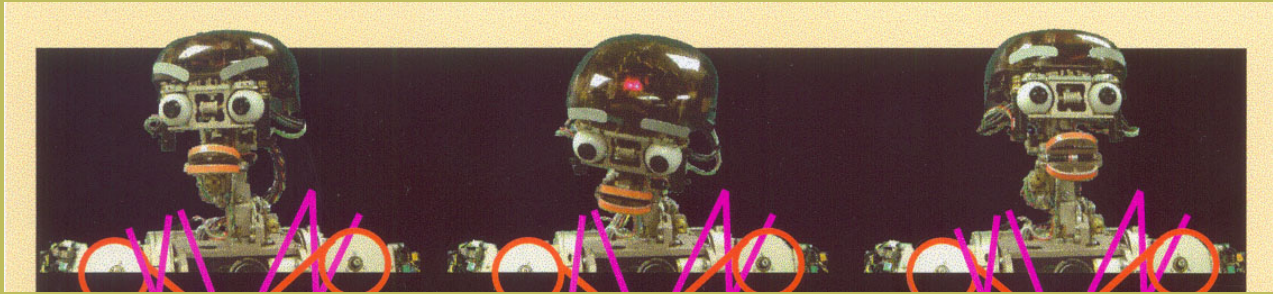
Epigenetic robotics

- A.k.a. developmental robotics
- Principles from biological & psychological development
- Development relies on:
 - Some 'innate' components
 - An environment
 - Interaction between innate components & environment
 - E.g., language development (Elman, Bates, Johnson, Karmiloff-Smith, Parisi, & Plunkett, 1996)



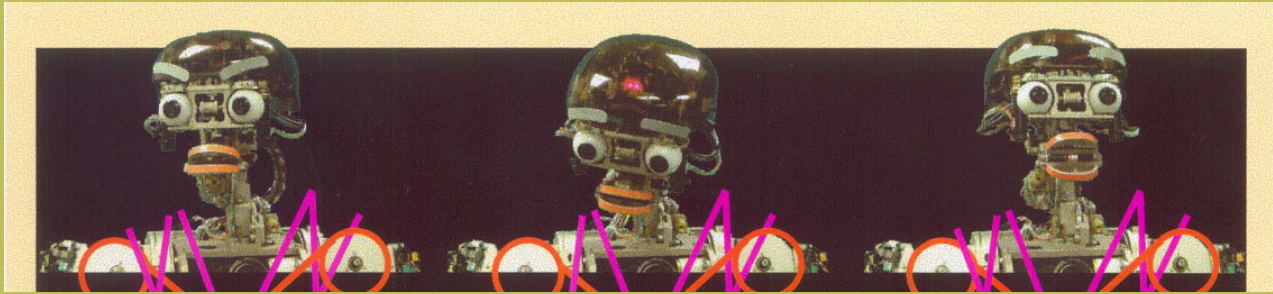
What is 'epigenetic'?



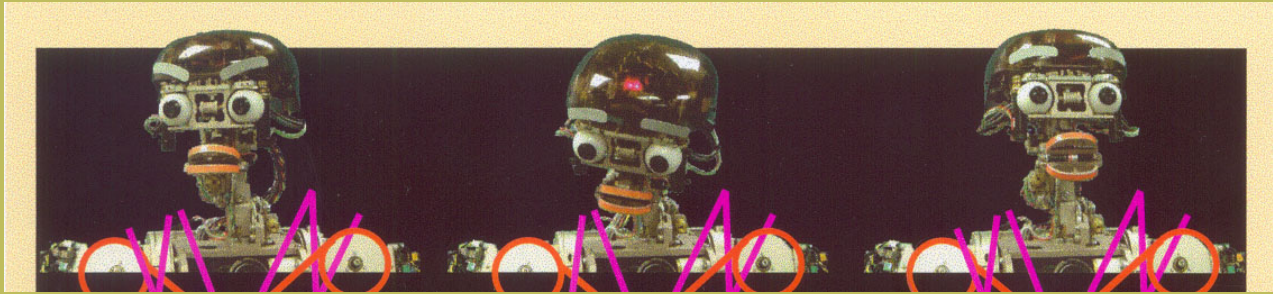


Why?

- Formal models for developmental psychology
 - Often psychological models are informal
 - E.g., Hollich, Hirsh-Pasek, & Golinkoff (2000)
 - Formal models, including robots, can help us think about child development
- Engineering rationales
 - Benefits for Human Computer Interaction (HCI)

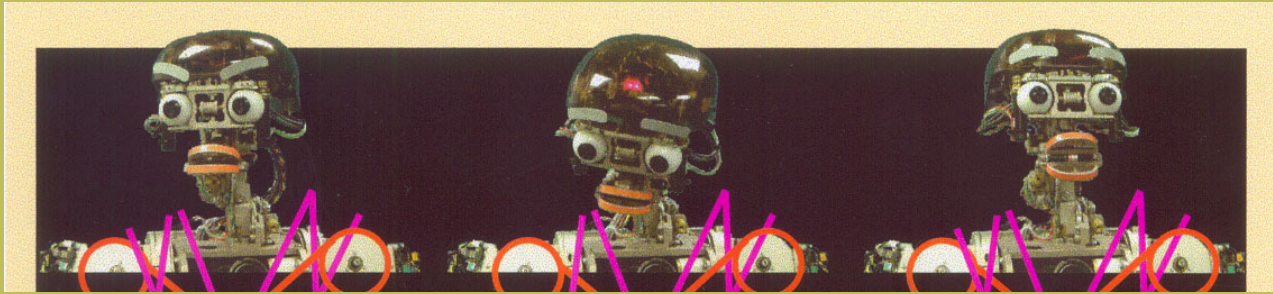


- “...combining a limited amount of *a priori* knowledge with learning ha[s] not been extensively explored in robot[ics] ..., especially in the context of nonlinear redundant systems” (Berthouze & Kuniyoshi, 1998)



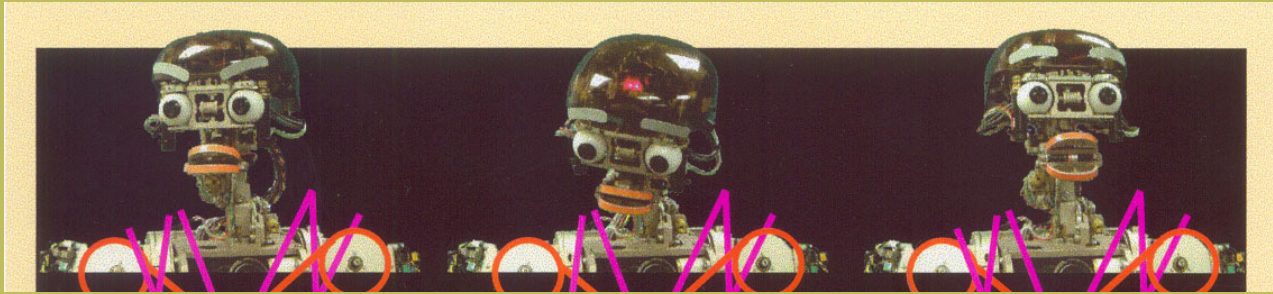
Questions (Zlatev & Balkenius, 2001)

- What embodiment, situatedness, and development are most adequate?
- Can epigenetic robotics provide true animal-like intelligence (“strong AI”)?
- Is consciousness necessary for complex cognitive development?



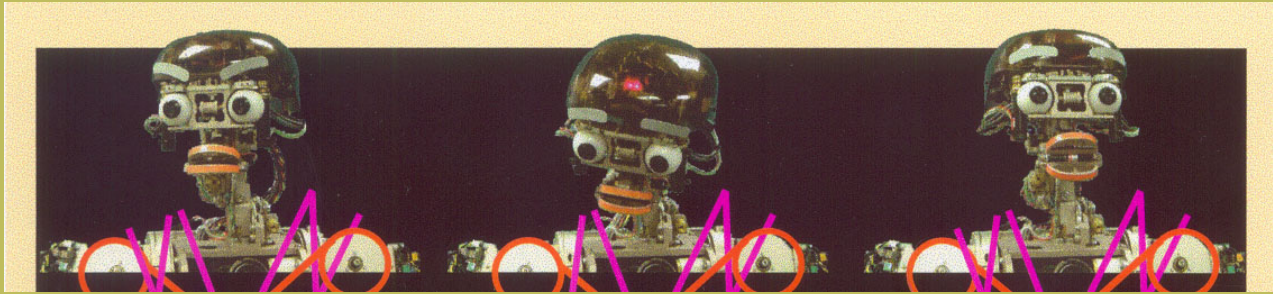
What skills should be ‘innate’ in our robots?

- Innate implicit knowledge only?
 - Schlesinger (EPIROB-02)
- Perceptual segmentation skills?
 - Developmental approach: Metta & Fitzpatrick (EPIROB-02)
- Other examples
 - Mirror neurons (Marom, et al., EPIROB-02; Kozima, et al., EPIROB-02)
 - Animate/inanimate distinction (Scassellati, 2001)



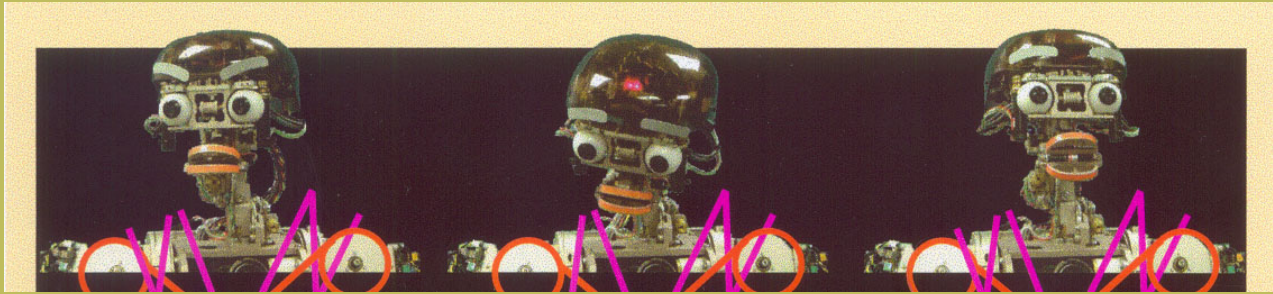
What learning strategies are useful and when?

- Distributed learning
 - Metta, Sandini, Natale, & Panerai (2001)
 - Andry, Gaussier, & Nadel (EPIROB-02)
- High dimensionality learning
 - IHDR (Weng & Zhang, EPIROB-02)
 - Schaal (SAB-02)



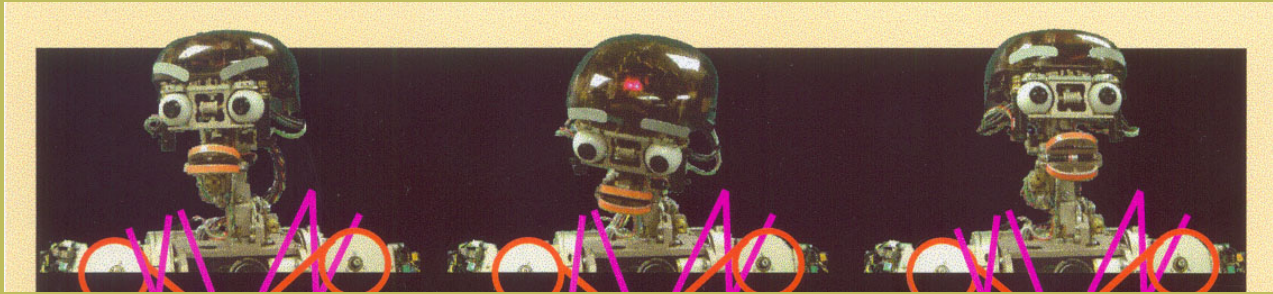
Of what use is *sensorimotor* immaturity in robots?

- Can gradual improvements in sensori-motor system quality improve the quality of a resulting adaptive controller?
 - Gradual release of motor degrees of freedom (DOF)
 - Berthouze & Kuniyoshi (1998)
 - Lungarella & Berthouze (EPIROB-02)
 - Gradual improvement of sensory acuity
 - E.g., Dominguez & Jacobs (2002)
- See also: Bruner (1974); Turkewitz & Kenny (1982)



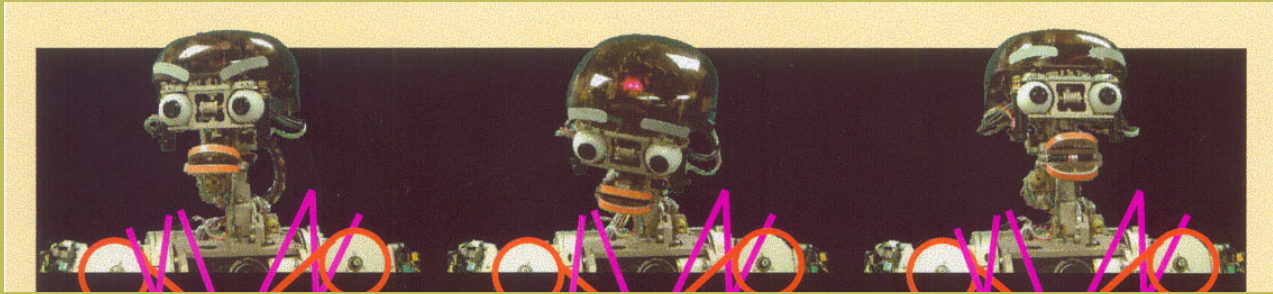
Of what use is *cognitive immaturity* in robots?

- Can gradual improvements in a robot's skills improve its performance on tasks?
 - Learning
 - Attention
 - Memory



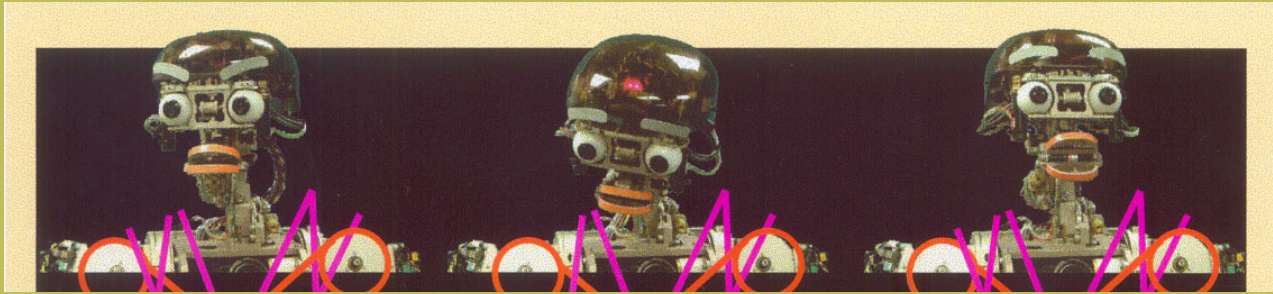
How do we motivate our robots?

- Human external teacher
 - Weng & Zhang (EPIROB-02)
- Value systems
 - Huang & Weng (EPIROB-02)
 - Zlatev (2001)



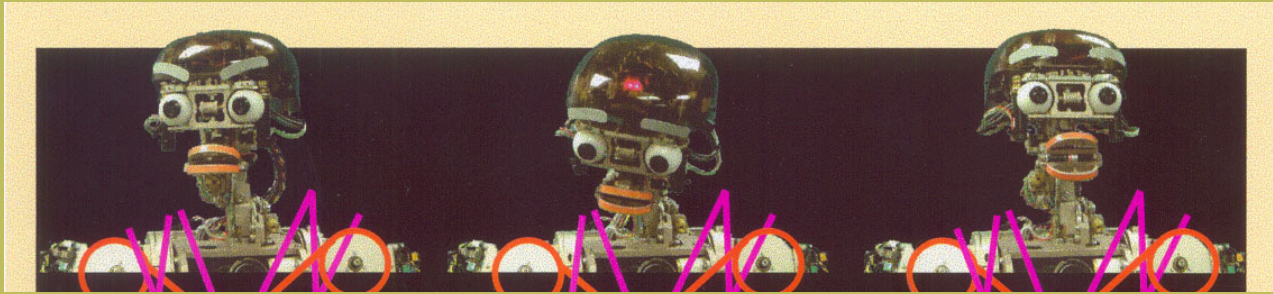
How do we build or develop more complex behaviors?

- Language
 - Varshavskaya (EPIROB-02)
- Use of developmental architectures
 - Kulakov & Stojanov (EPIROB-02)



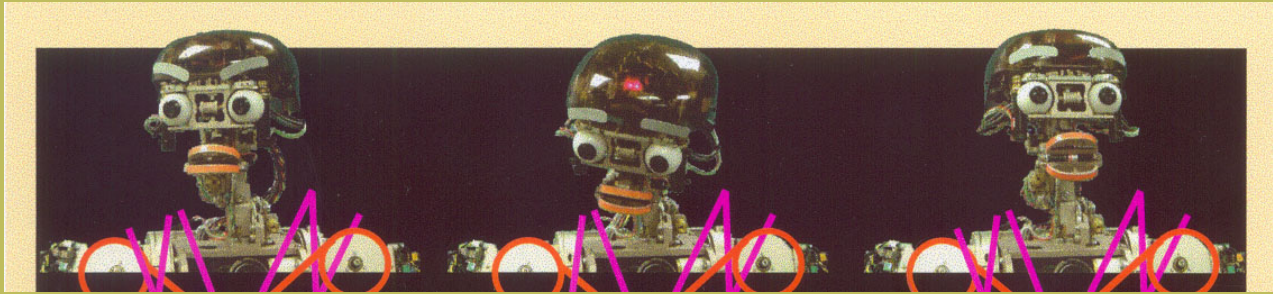
Can developmental algorithms be simpler than other methods of programming robots?

- Schaal (SAB-02)
- Weng et al. (2001)



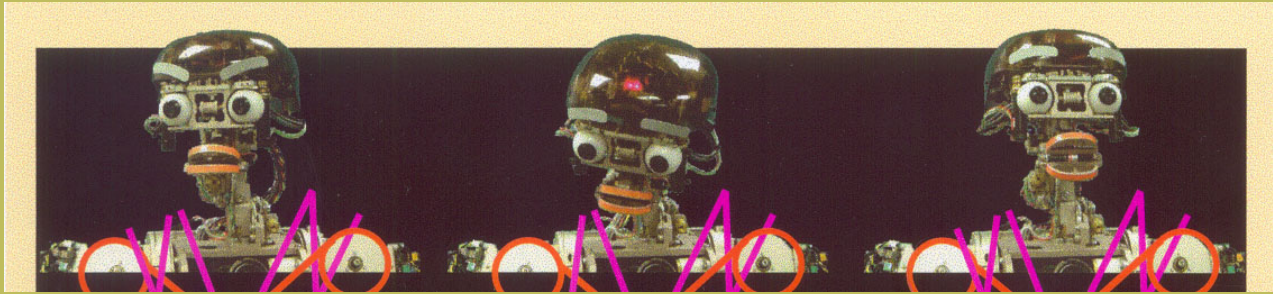
What are the practical applications?

- Robot models of abnormal development (e.g., Scassellati, submitted)
- Human-computer interaction
 - joint attention (e.g., Kozima & Yano, 2001)



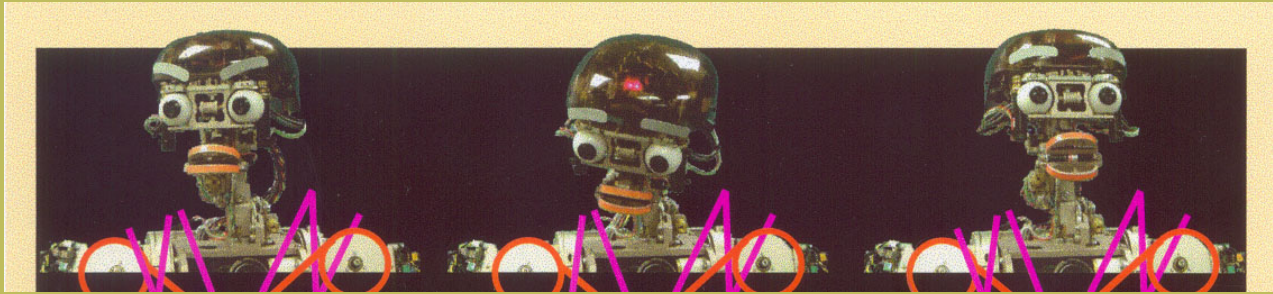
The workshop

- Invited Speakers
 - Luc Steels
 - John Weng
 - Colwyn Trevarthen
- Oral papers (14); 25 min + 5 minutes discussion
- Poster papers (11); room G.02; posters up ASAP
- Meals: Please wear your name tags (with red dot)



Future Business

- Open research questions
 - Please send them to me (chris@cprince.com) or Yiannis Demiris (y.demiris@ic.ac.uk)
 - Or fill out one of the forms we are making available
 - Also: program committee for next EPIROB
- Business Meeting
 - After lunch on Sunday at the pub
- <http://www.epigenetic-robotics.org>
- <http://www.mentaldev.org>



Thanks to

- Organizing Committee
 - Christian Balkenius, Yiannis Demiris, Hideki Kozima, Yuval Marom
- Program Committee
 - Christian Balkenius, Luc Berthouze, Aude Billard, Cynthia Breazeal, Kerstin Dautenhahn, Yiannis Demiris, Peter Gärdenfors, Philippe Gaussier, Hideki Kozima, Karl MacDorman, Yuval Marom, Chrystopher Nehaniv, Jacqueline Nadel, Christopher Prince, Rolf Pfeifer, Deb Roy, Stefan Schaal, Georgi Stojanov, Gert Westermann, Jordan Zlatev