Thursday is Science day

### COMP 20090 lectures will nevertheless be held as usual, at 10:00 and again at 12:00



COMP 47230 Introduction to Cognitive Science (Graduate)

### Learning and Development



#### Topic I: The Altricial - Precocial Spectrum

#### Altricial

- Helpless at birth
- Underdeveloped







#### Precocial

- Able to cope at birth
- Relatively developed







The difference is NOT intelligence, or sophistication, or closeness to humans.

Every animal has its ecological niche. Some processes may require *being and living* in that niche in order to suitably constrain development.

Some niches do not offer the luxury of parental care and guidance.

Precocial skills (walking, suckling, etc) do not require much fine tuning, and are relatively invariant.

Altricial skills may show huge variation in the mature animal.



Distribution of the brown rat

#### Two Ways of Looking at This

[1] Altricial skills are the hallmarks of flexible, adaptable behavior, and contrast with inflexible, rigid instinct.

or

[2] Altricial skills illustrate the tight intertwining of an animal and its environment. For humans, this includes the social environment, and language is part of that intertwining.



Social cognition crucially involves this brain area. Its physiological development occurs at the same time as the social development of the individual.

#### **Pre-frontal cortex:**

Also often implicated in the exercise of conscious control of behavior (we will later meet Mr Phineas Gage ...)

Prefrontal

area

Central

sulcus

Primary

cortex

somesthetic

Taste

area

Somesthetic association area

> Visual association

area

Visual

Primary

motor

cortex

Premotor

oreo

Immature or damaged PFC  $\rightarrow$  inability to exercise selfcontrol

#### **Learning and Development Topic 2:**

# Two Big Theories of Learning and Development in Humans



Lev Vygotsky



(1896-1980)

(1896-1934)



Development, maturation and change *within* the individual

#### Lev Vygotsky



#### Development of the child *within* a society and culture



What changes take place within the child? In which sequence? At which times?



### Cognitive Structures: from simple, concrete to complex, abstract





#### **4 Developmental stages**



#### Adaptation

#### Accommodation

Mental structures are adjusted based on novel experience



#### Assimilation

Experience is incorporated into existing structures

#### Sensorimotor stage (0-2 y)

The child interacts with their environment through physical actions

Emphasis on the concrete and the physically present



Unaware that objects persist when not seen

Pre-operational stage (2-7)



Language use has started: the child uses symbols

Thinking is fanciful and wishful

Understanding of time is limited

Reasoning is restricted to concrete operations in the here-and-now

#### Concrete operational stage (7-II)



# Abstract thinking and reasoning appear

Reasoning supported by practical, physical aids

#### Formal operational stage (II-I5)



Abstract reasoning about abstract concepts

Logic and reason well developed (?)



Development, maturation and change *within* the individual

#### Lev Vygotsky



#### Development of the child *within* a society and culture

#### Lev Vygotsky







Learning is done in a social context.

Cognitive functions develop first between people, and only later become internalized

#### Lev Vygotsky

#### **Zone of Proximal Development**





A child who can do something (say, X) alone, can do more (say, X+Y) together with a teacher or competent peer. Y belongs to the Zone of Proximal Development. Tasks within the ZPD gradually enter the child's own repertoire.

#### Lev Vygotsky

Q:What are the implications of the notion of the Zone of Proximal Development for educators?



A: Don't just look at what a child can do alone, but what they can do in an appropriate inter-personal context

Skills & abilities will manifest first in an inter-personal context. Internalisation comes later.

#### **Cultural Mediation**

Meaning and significance come from the web of social relations we live within.

We first encounter meaning in an interpersonal context, and later appropriate this for our selves: *internalization* 









This idea works well with the observations of the anthropologist Clifford Geertz:

"Man is an animal suspended in webs of significance he himself has spun, [and] I take culture to be those webs." Clifford Geertz

#### Vygotsky on Language and Thought

Inner speech develops from vocal speech

Young children literally think out loud

Inner language becomes compressed





Joint attention in early language learning





Development, maturation and change *within* the individual

Concern with the inner cognitive economy of the individual

Lev Vygotsky



Development of the child *within* a society and culture

Provides a means for understanding how our physical, social & cultural environments become saturated with meaning

#### Learning & Development, Topic 3: Innateness

#### An Age Old Debate

#### Rationalism

Nature Innateness Built-in Knowledge Built-in Concepts

#### Empiricism

Nurture Tabula rasa Knowledge gained through senses Concepts based on experience

#### Untangling the Innate and the Acquired

#### Identical Twins

#### **Fraternal Twins**



Caution required!!!!

Nature versus nurture is a lie. Music is not melody versus rhythm, wine is not grapes versus alcohol and we are not environment versus genes. We are their sum, their product and their expression. They dance together and we are their performance, but neither is an adversary. The art of understanding this elegant ballet is complex and arcane but you may never realise this from reading the quoted results of genetic studies, because the extent to which a trait is heritable, that is, accounted for by genetics, is usually expressed as a simple percentage.

Vaughan Bell, The Psychologist, July 2009

Genes mean *nothing* without an organism in an environment. There is no rational sense in which we can separate biology from culture, or nature from nurture.

Simplistic and misguided interpretation of twin studies is common.

#### **Learning and Development Topic 4:**

The Human Speechome project

#### Scientists studying their own children:



#### Charles Darwin

#### Sigmund Freud





Attempt to capture almost the entire linguistic output and environment of a child over three years

I Video cameras
I4 Microphones
200 GB data per day
Over 140,000 hours of data
Ca. 2005 - 2008







One child's development of one word: "water"



#### Rich audiovisual sampling.

Here: the word "ball"





Figure 8: Change in mean length of one caregiver's utterances in relation to word births. Error bars are 95% confidence intervals.



Deb Roy

One sample finding: caregivers simplify their utterances prior to the "birth" of a word

c.f.Vygotsky's ZPD!

The human speechome project allows a direct observation of the linguistic environment of the child.

It is thus very relevant to the "poverty of the stimulus" argument by Chomsky, which claims that the linguistic environment is simply too poor to allow language learning on the basis of it.

As is to be expected, the situation is not quite as simple as was previously thought.

#### **Learning and Development Topic 5:**

Experiments demonstrating social behavior in very young infants

Also illustrating the difficulties in interpreting infant behavior

In these studies, fascinating glimpses are caught of the emerging social nature of the infant.

Each seminal study suggests that the infant is deeply social from a very early age.

Very difficult problems remain in the description of infant behavior, in its interpretation, and in replicating results from one study to the next. Example I: Murray and Trevarthen, "Emotional Regulation of Interactions between Two-Month Olds and their Mothers" (1985)





Mother's Room



#### Basic finding:

### Infants interact happily with the mother in the *live* condition, but show signs of distress and disinterest

They are clearly sensitive to the real live presence of their mother

Mother's Room





Some studies claim to have found similar effects

Other studies have failed to replicate these findings

Much depends on how you interpret infant behavior

Note the importance of developing methods of measurement that are not subjectively biased!



## Example 2: Meltzoff and Moore, Imitation of facial and manual gestures by human neonates, (1977)



Fig. 1. Sample photographs from videotape recordings of 2- to 3-week-old infants imitating (a) tongue protrusion, (b) mouth opening, and (c) lip protrusion demonstrated by an adult experimenter.

Infants tested were 2-3 weeks old

They thus had absolutely no experience of seeing themselves



Fig. 1. Sample photographs from videotape recordings of 2- to 3-week-old infants imitating (a) tongue protrusion, (b) mouth opening, and (c) lip protrusion demonstrated by an adult experimenter.

As before, there are grave problems in interpreting the infant's "response".

Recent meta-studies have claimed that only tongue protrusion is reliably copied. Is this still "imitation"?

(Very young chimps seem to react similarly!)

The study of "imitation" raises several interesting issues.



Fig. 1. Sample photographs from videotape recordings of 2- to 3-week-old infants imitating (a) tongue protrusion, (b) mouth opening, and (c) lip protrusion demonstrated by an adult experimenter.

The "Correspondence Problem":

How do you define a successful imitation? Why does one sequence of movements, rather than another, count as an instance of a specific behavior?