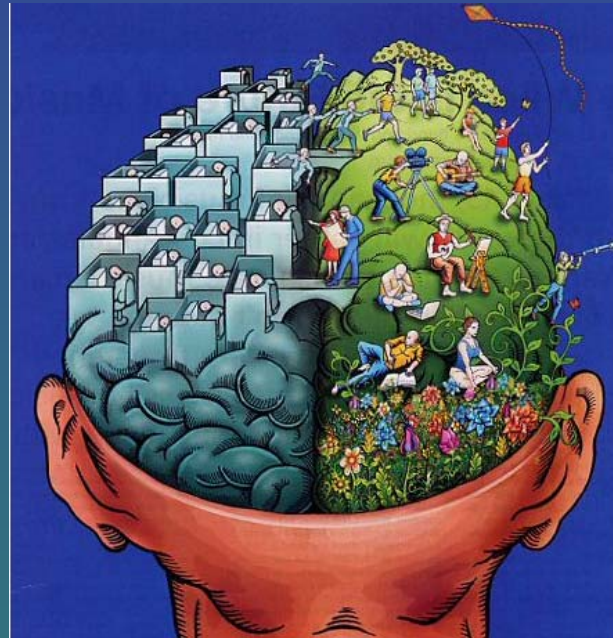


Å overse hvordan hjernen lærer er hodeløst

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Department of Psychology,
Norwegian University of Science and Technology



Learning from a biological perspective



Development

'Development is about creating something more from something less'

(Smith & Thelen, 2003 p. 343)

The lecture

- Theories
 - Probabilistic Epigenesis
 - Neural Darwinism
- Which consequences has this theories for our understanding of skill development
 - Empirical supports from research: motor skills, cognitive skills
- How can we have effect on development/learning
- Conclusion

Skill

- Skill refers to an action or a task that is carried out voluntary – with a clear goal or intentions
- The term skill refers to the level of proficiency on a specific task or limited group of tasks (Fleishman, 1966, p. 148)
- Action capacities (Csikszentmihalyi, 2008)
- Quantitative changes – new skills
- Qualitative changes - being better at specific skill

Ability

- Ability refers to a more general trait of the individual which has been inferred from certain response consistencies (e.g. correlations) on certain kinds of tasks (Fleishman, 1966, p.147/148)
- Schmidt (1991) argue that abilities are underlying, inherent, relative stable properties, while skills are trainable
- One example – the visual system (Stein & Walsh, 1997) – developmental disorder



Development/learning

- Theories – research
- Many theories have given us an exact description on HOW development happens
- What is often missing in such a theories is WHY development happens. Which factors do trigger this changes

- Probabilistic Epigenesis (Gottlieb, 1998)
- Neural Darwinism (Edelman, 1987, 1992)



EPIGENESIS

Epigenesis

- ◆ **Predetermined**

---> 1970

von Baer (1828, in
Gottlieb, 1997)
vertebrates

- ◆ **Probabilistic**

1970-->

Hans Driesch (1890,
in Gottlieb, 1997)

- ◆ There exists a *one way relationship* between structure and function, structure gives rise to and determines function. The development of behaviour is explained entirely in terms of processes such as the growth, migration and connections of neurones (Gottlieb, 1970; 1997)

- ◆ *Two-way exchange*, not only does structure affect function but function can influence and change structure (Gottlieb, 1970; 1997).

Probabilistic Epigenesis

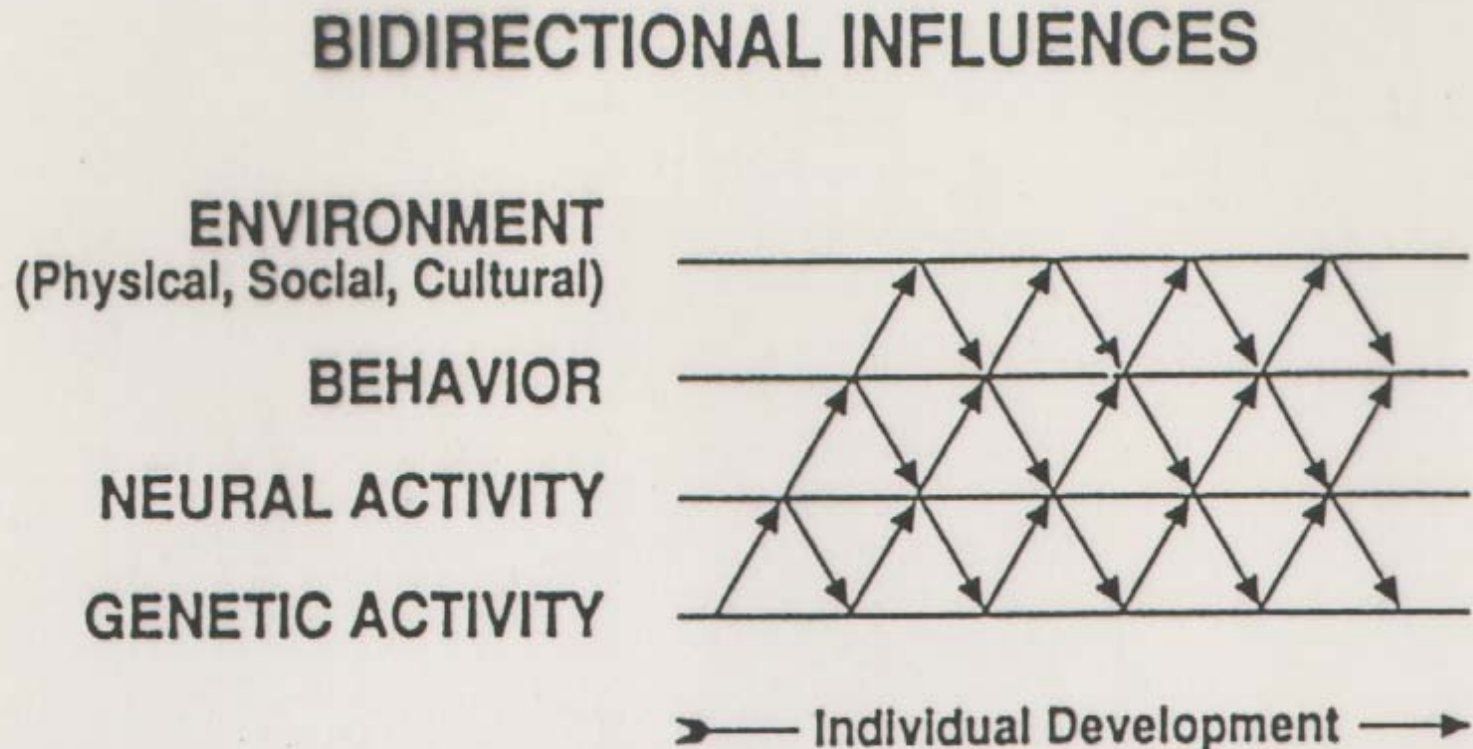
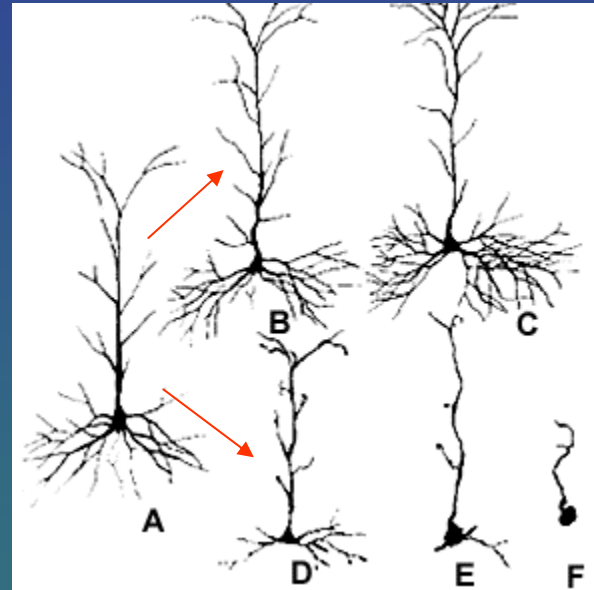
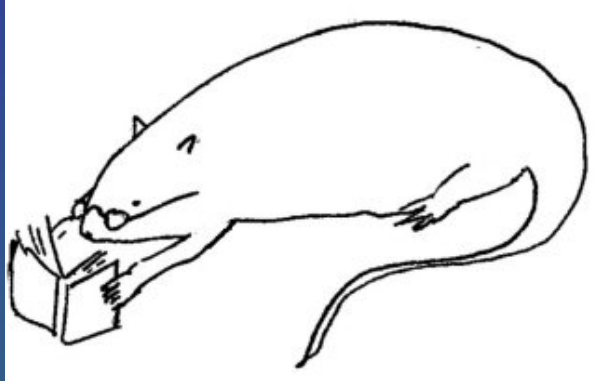


FIG. 8.5. A developmental-psychobiological systems framework. From *Individual Development and Evolution: The Genesis of Novel Behavior* by Gilbert Gottlieb. Copyright © 1991 by Oxford University Press, Inc. Reprinted by permission.

Gene and environment



Stimuli ↑

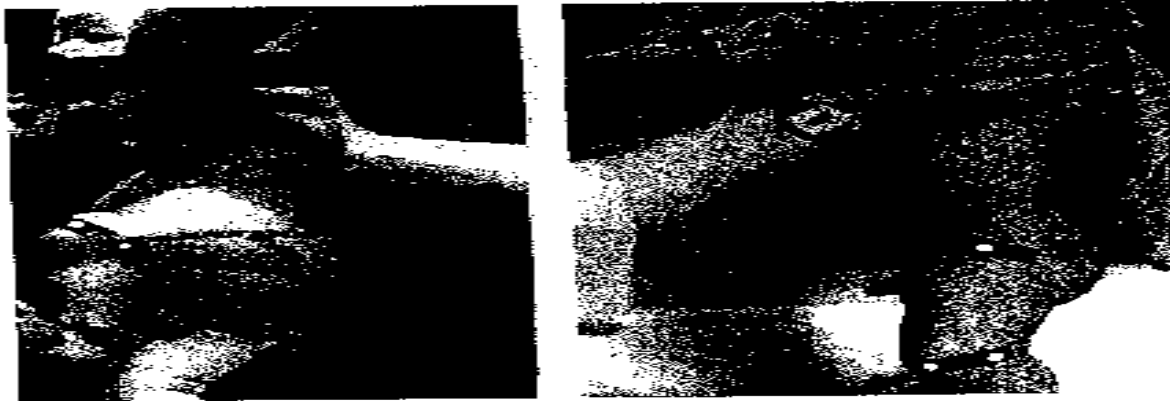
Stimuli ↓

Dynamical System Theory

– Esther Thelen

38

Thelen mener at en slik modning av nervesystemet ikke skjer av seg selv. Hun mener også at det kan finnes ganske naturlige forklaringer på tilstedeværelsen eller fraværet av de ulike refleksene. For å vise dette tok hun for seg den såkalte «stepping»-refleksen (se figur 7).



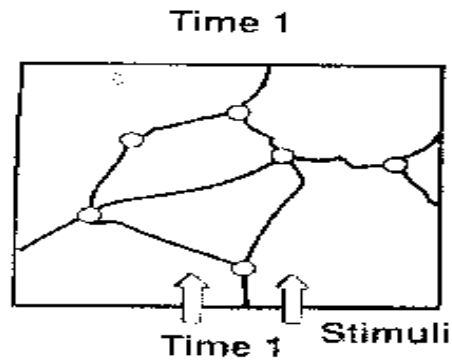
Figur 7: Stepping-refleksen

Denne refleksen artet seg slik at hvis barnet holdes under armene og senkes ned slik at føttene får kontakt med underlaget, vil vi se gange-lignende bevegelser. Det som er spesielt med denne refleksen er at den forsvinner ved ca. 10 måneders alder for så å komme tilbake fra ca. seks måneder. Thelens ide var at dette kunne skyldes at barna i denne perioden var for tunge til å bære sin egen kroppsvekt, mens de ved 6–7 måneders alder hadde utviklet nok muskelstyrke til igjen å kunne bære sin egen vekt. Det etter hvert svært kjente eksperimentet (Thelen, Fisher & Ridley-Johnson, 1984), der Thelen demonstrerte nettopp

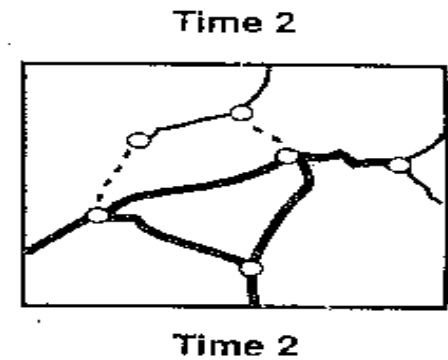
Edelman

Experiential Selection

(Yielding Secondary Repertoire)



Changes in Strength of
Population of Synapses



The anatomical asymmetry in planum temporale of musicians

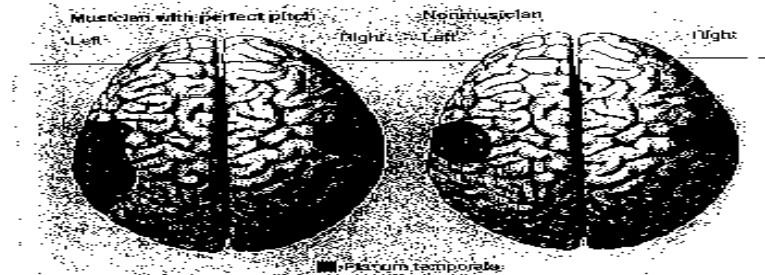


Figure 16.8. The anatomical asymmetry detected in the planum temporale of musicians by magnetic resonance imaging. In most people, the planum temporale is larger in the left hemisphere than in the right; this difference was found to be greater in musicians with perfect pitch than in either musicians without perfect pitch or control subjects. (Adapted from Schlaug et al., 1995.)

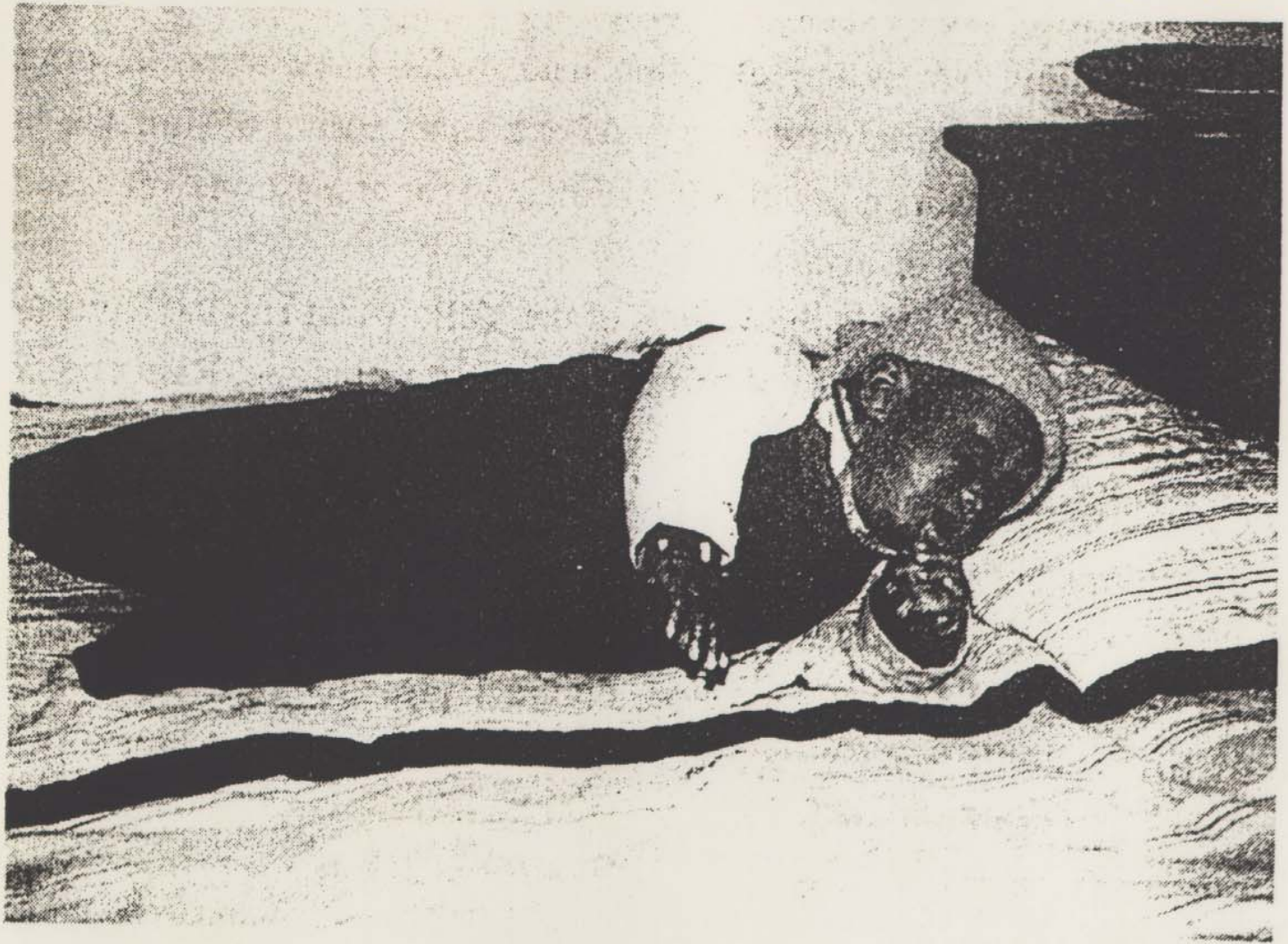
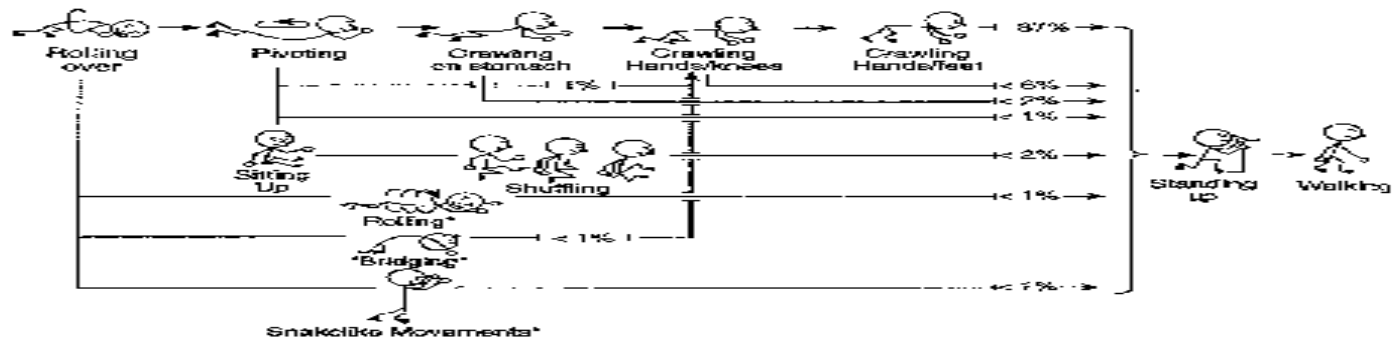


Figure 1 A picture of a baby in a sandbag (courtesy of J. Mei).



Individual differences



■ **FIGURE 9.2** Pathways to locomotion of term and preterm infants, with asterisks indicating infants with cerebral palsy only.
 From "Early Development of Locomotion: Significance of Prematurity, Cerebral Palsy and Sex," by R.H. Largo, L. Molinari, M. Weber, L. Comenale Pinto, and G. Duc, 1985, *Developmental Medicine and Child Neurology*, 27, p. 187. Copyright 1985 by MacKeith Press. Reprinted by permission.

Edelmans theory

- Edelmanns theory on 'neural Darwinism' argues that the process of learning can be explained as a process of selection that takes place inside the neural system. The theory emphasizes how stimuli and practice increase connections within specific areas of the brain
- Practice of a task strengthens the neural network that are used for that particular

Task specificity

- It is possible to argue that Edelman's theory supports the perspectives of 'task specificity' of learning (Sigmundsson, 2005; Haga, 2008)
- By saying that training is specific, we mean that every particular skill is specific and should be trained specifically (Larkin & Hoare, 2002)
- Motor skill learning- by training specific tasks – **neuro-motor** and **perceptual – motor** subsystems involved in that specific task may be tuned in (Sporns & Edelman, 1993)

Consequences – skill development

- Which consequences have this theories for our understanding of skill development
- Empirical supports from research: motor skills, cognitive skills
- Low correlation between different skills for example cognitive skills and motor skills
- Low correlation between different subtasks within a skill for example within motor skills and mathematical skills

Between skills

- Kavale and Mattson (1983) – cognitive skills and motor skills
- Gunnarsdottir and Gunnarsson (2003) – cognitive skills and motor skills
 - motor skills (age 6) – Icelandic (age 9);
 $r=0.217$
 - motor skills (age 6) – mathematic (age 9);
 $r=0.291$
- Karlsdottir and Stefansson (2003) –
reading simple word 1 class and **writing** 5 class

Effect of physical activity on learning?

Professor Stephen William Hawking



Indirect – NOT DIRECT – coupling between physical activity and cognitive learning! (Kavale & Mattson, 1983)

Motor skill – balance

Table 6.2-1 Results from the experiment by Drowatzky and Zuccato (1967) showing the correlations among six different tests of static and dynamic balance.

Test	1 Stork Stand	2 Diver's Stand	3 Stick Stand	4 Sideward Stand	5 Bass Stand	6 Balance Stand
1	—	0.14	-0.12	0.26	0.26	0.03
2		—	-0.12	-0.03	-0.07	-0.14
3			—	-0.04	0.22	-0.19
4				—	0.31	0.19
5					—	0.18
6						—

From J. N. Drowatzky and F. C. Zuccato, "Interrelationships Between Selected Measures of Static and Dynamic Balance," in *Research Quarterly for Exercise and Sport*, 1967, Vol. 38, pp. 509-510. Copyright © 1967 American Alliance for Health, Physical Education, Recreation, and Dance. Reprinted by permission.

Motor skills

- Revie and Larkin (1993)
 - Clumsy children made improvements to the task actually taught

Motor skills

	PC	TB	BT	CBB	RBG	OB	JC	WHR
PC	1	,155	-,031	,032	,233*	,028	-,015	,014
TB		1	,203	,081	-,005	,362**	,348**	,057
BT			1	,243*	,109	,130	,071	,160
CBB				1	,155	,395**	,079	,401**
RBG					1	,045	-,136	,614**
OB						1	,270**	,177
JC							1	-,034
WHR								1

* Correlation is significant at the 0.05 level (2 tailed)

** Correlation is significant at the 0.01 level (2 tailed)

(Haga et al. 2008)

Cognitive skills

Correlation (Pearson) between the 9 sub task of Basic Knowledge in Mathematics test (10 year-old children, N=68). The sub task are: Addition (simple) (A); Subtraction (S); Addition Oral (AO); Subtraction Oral (SO); Addition in a Text (AT); Subtraction in a Text (ST); Multiplication Oral (MO); Understanding the Clock (UC); Understanding the Calendar (UCA)

	A	S	AO	SO	AT	ST	MO	UC	UCA
A	1	,55**	,44**	,46**	,27*	,18	,34**	,32**	,19
S		1	,39**	,44**	,17	,24	,43**	,40**	,22
AO			1	,57**	,16	,41**	,45**	,25*	
SO				1	,24*	,48**	,57**	,47**	,19
AT					1	,14	,11	,17	,14
ST						1	,42**	,53**	,09
MO							1	,47**	,46**
UC								1	,48**
UCA									1

Cognitive skills

- Karlsdottir and Stefansson (2003)
 - Reading competence – low correlations between subtask within reading

Learningprocess

Implications

Motivation

Generalisation



Automatisation



Acquiring and refining the skill

Repetition

Understanding the skill








Trying and practising

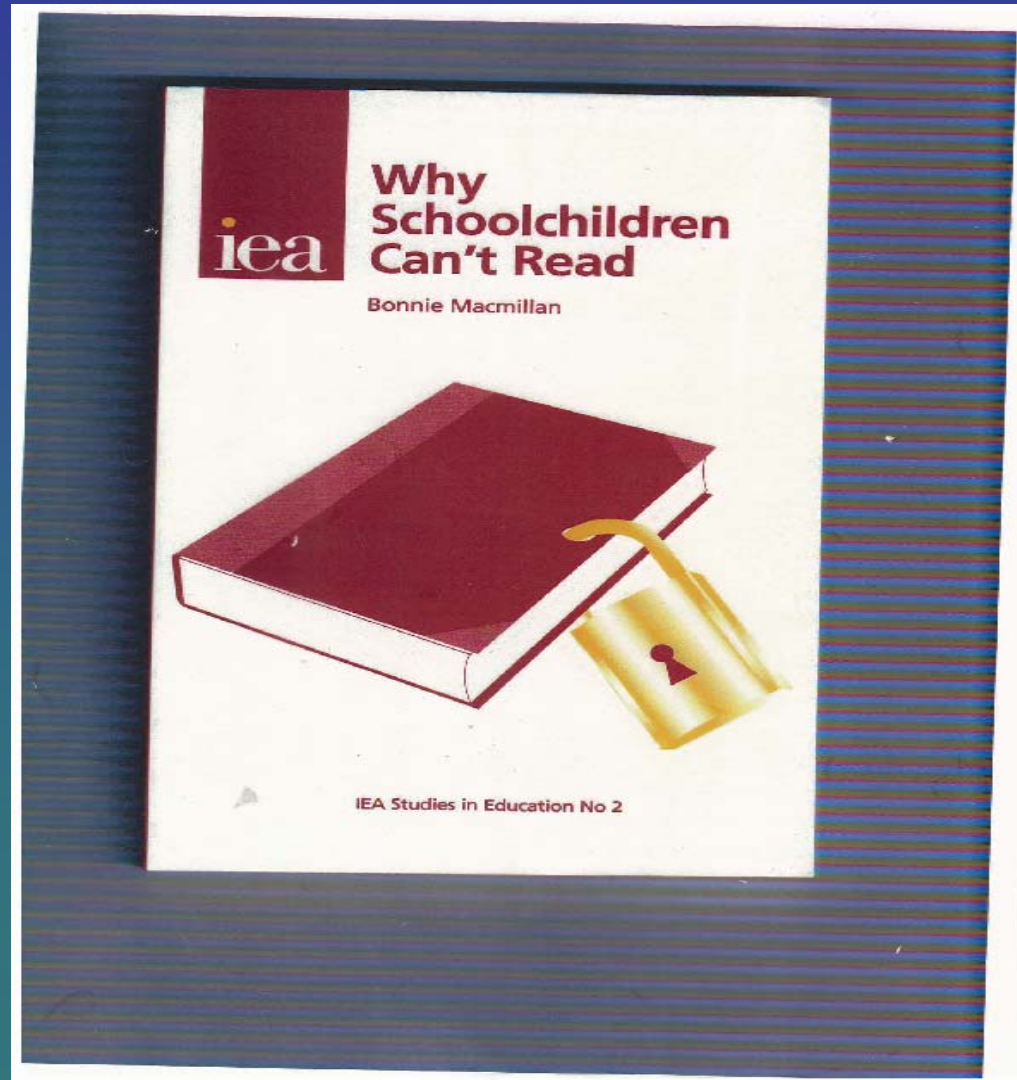
Copying



Reading in 1 class – 6 years old

	lóa	Sis! las: Lóa, lóa, lóa.
	sñil	Lás! sé sñil.
	risi	Sár á risa.
	risar	Lisa las: Risar, risar.
	árar	Óil é árar.

Specific training – starting with letter and the sound



Practical mathematic – Mads 7 years –old



Kavale and Mattson (1983)

- Perceptual motor- training were not effective
 - overall had a near zero effect – on academic achievement
 - the effect on motor skills was also modest
 - to little training – and to little specific training

Generality and Specificity

Generality:

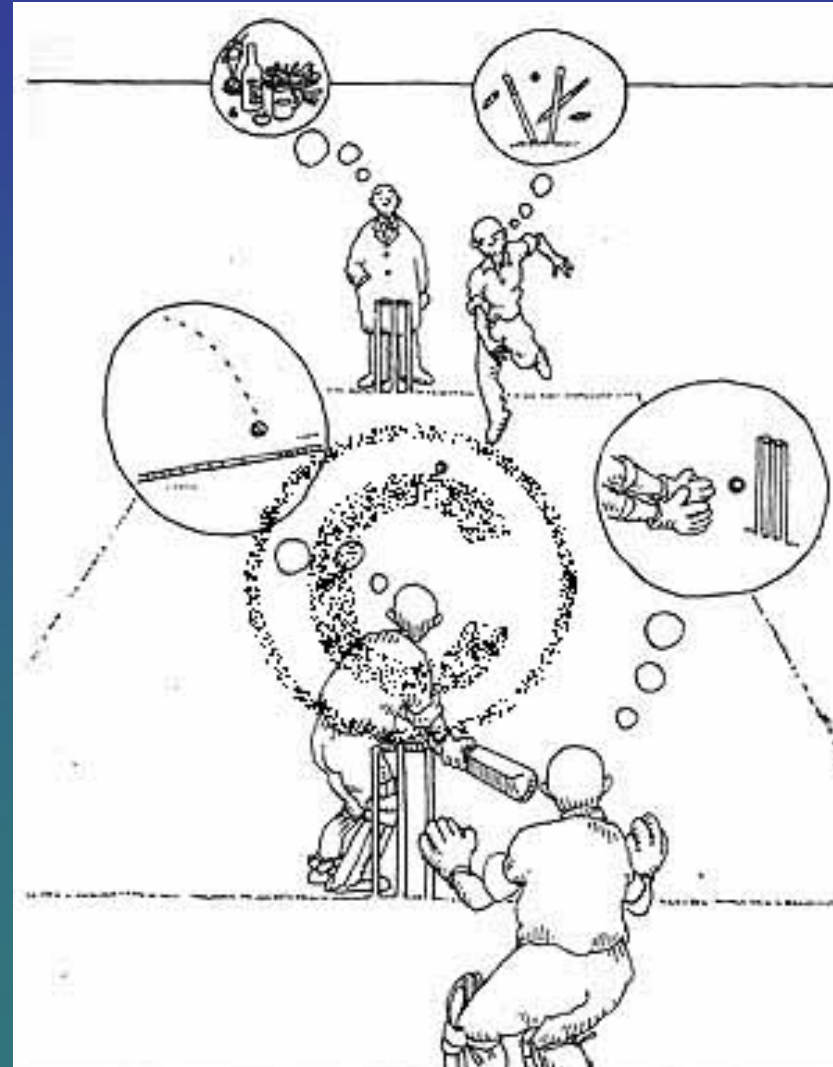
Concentration,
focus, interest

How do we create that?

Specificity:

You develop what you
train

How do we learn/train in



Learning principles

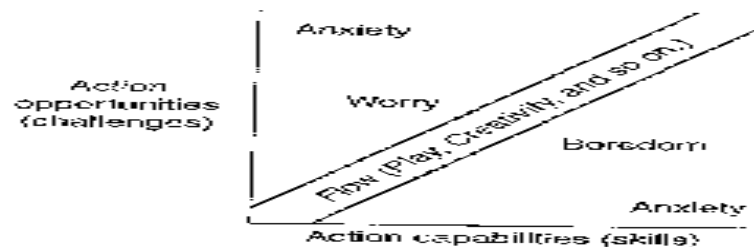
- A review of intervention methods – general principles for teaching (Sigmundsson et al. 1998)
- (1) Intensive – daily sessions



Learning principles

- (2) The level of difficulty is set so that the child can manage the task, and the difficulty of the task is gradually increased as a result of the child's success

Figure 1. Model of the Flow State. When a person believes that his action opportunities are too demanding for his capabilities, the resulting stress is experienced as anxiety; when the ratio of capabilities is higher, but the challenges are still too demanding for his skills, the experience is worry. The state of flow is felt when opportunities for action are in balance with the actor's skills; the experience is then autotelic. When skills are greater than opportunities for using them, the state of boredom results; this state again fades into anxiety when the ratio becomes too large.



(Csikszentmihalyi, 2008)

Learning principles

- (3) Frequent positive feedback is given



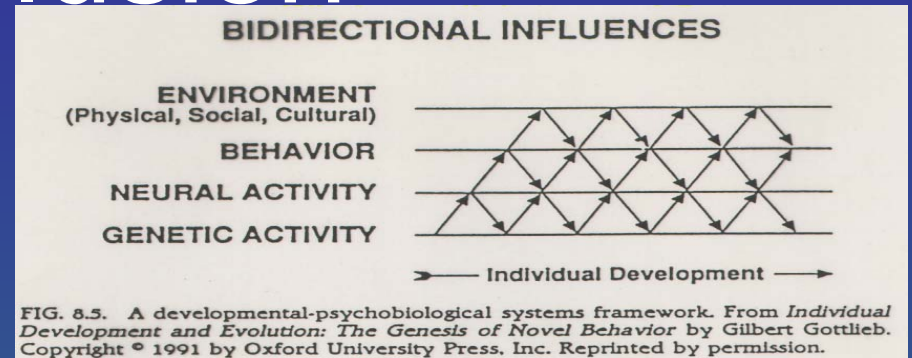
Learning principles

- (4) Selfmonitoring of daily achievements is encouraged in the child

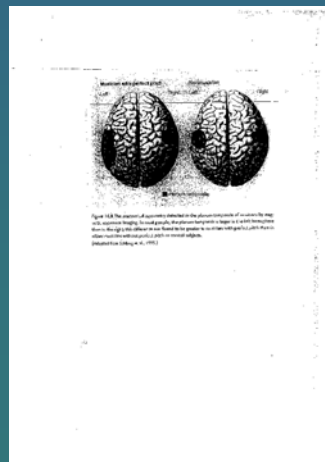
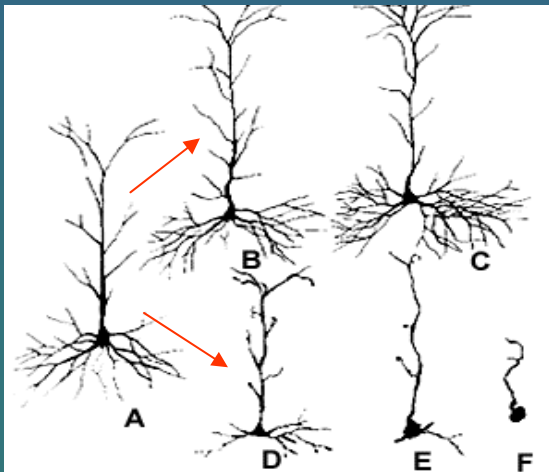
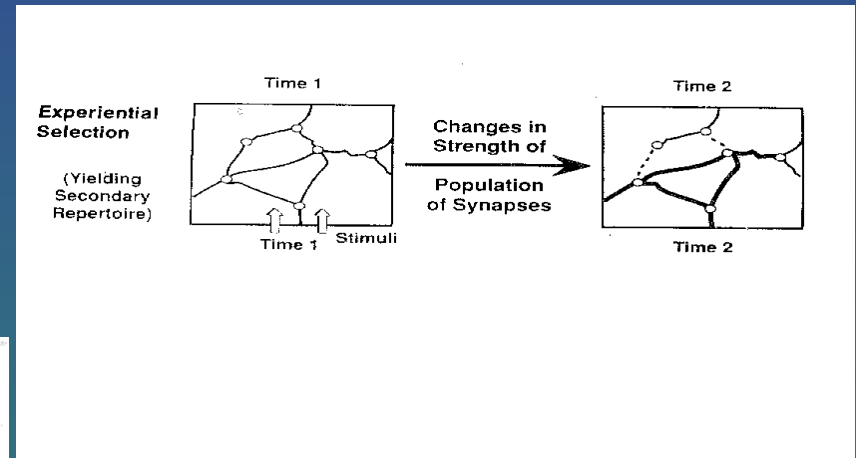


Conclusion

- Gottliebs theory

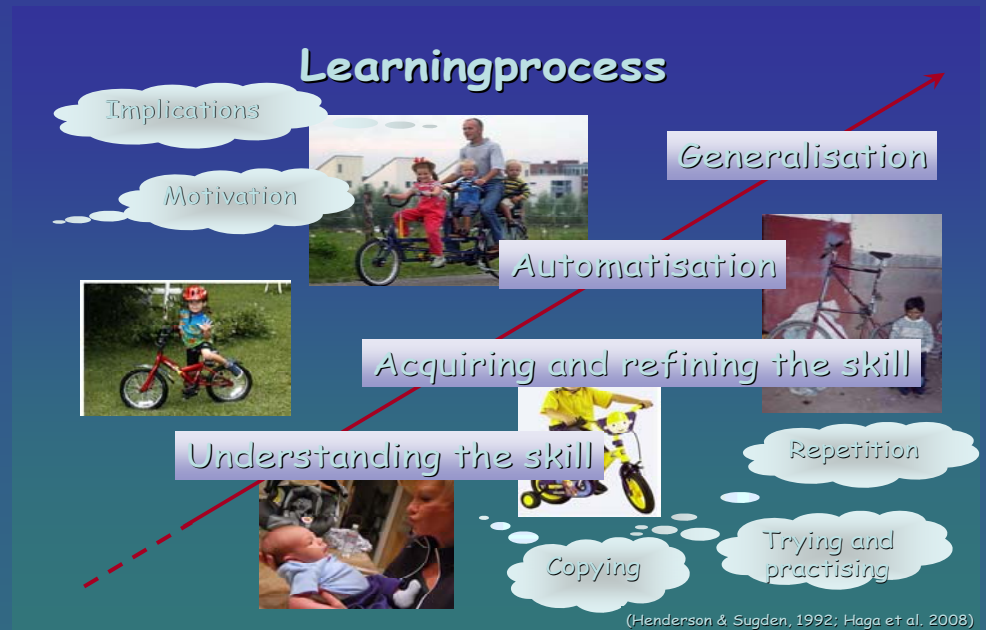


- Edelmans theory



Conclusion

- Skill development



- Task specificity

– Empirical support for task specificity



"be the best that you can be"

