



Kunnskap for en bedre verden

Utdanningsnakk – samtaler om kunnskapsbasert undervisning

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UTDANNINGSSNAKK

The Role of Innovation in
Teaching: Creating Interactive
Problem-Solving Exercises

26.april 2024 kl. 08.30

s.ntnu.no/utdanningsnakk-2604



**JONATHAN
WRIGHT**

Webinarserien «Utdanningsnakk»

- Et bidrag til **kunnskapsbaserte** undervisningsmetoder i høyere utdanning.
- For oss som **underviser** i høyere utdanning.
- Gratis og åpne for **alle**.
- Sendes i hovedsak hver **tredje fredag** kl. 08:30-09:00.
- **Opptak** legges ut på <https://www.ntnu.no/merittering/utdanningsnakk>
- Ønsker om tema/format eller om å bidra selv:
 - Ta kontakt på merittering@ntnu.no

Praktisk info

- Presentasjon i 20-25 minutter, spørsmål/diskusjon i 5-10 minutter
- Q&A i Zoom for kommentarer og/eller spørsmål
- **Alt** blir tatt opp og lagt ut 
 - Ikke still spørsmål med eget navn hvis du ikke ønsker det med på opptaket



Kunnskap for en bedre verden

The Role of Innovation in Teaching: Creating Interactive Problem-Solving Exercises

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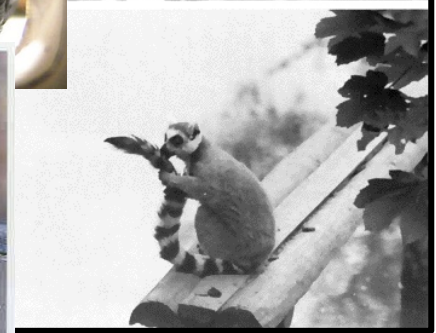
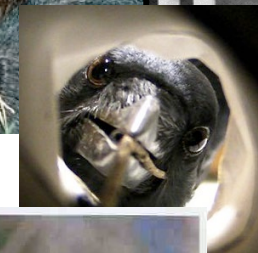
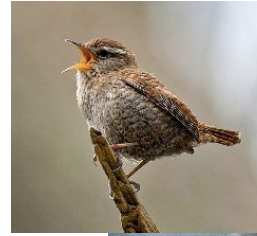


Innovation

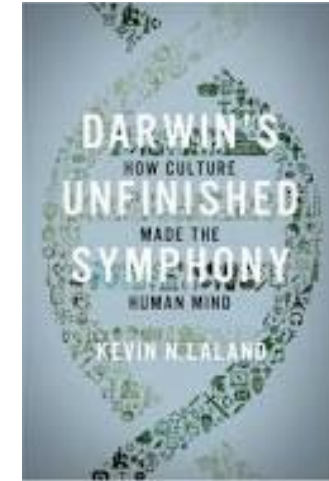
Reader & Laland (2003)



- **‘Innovation’ is a new or modified behaviour to solve a novel environmental problem**
 - e.g. sweet potato ‘washing’ by the Japanese macaque “Imo”, new bird song variants, new tool-use in chimps, etc
- **Successful innovative behaviours spread via social learning (i.e. cultural transmission)**
 - e.g. opening milk-bottle tops in blue tits in the UK, tail-dipping to drink water in ring-tailed lemurs
- **Innovative species (e.g. corvids) are large-brained & ecologically invasive, just like humans...**
 - successful innovators simply try out more potential solutions, & successful societies culturally spread & retain the best ones



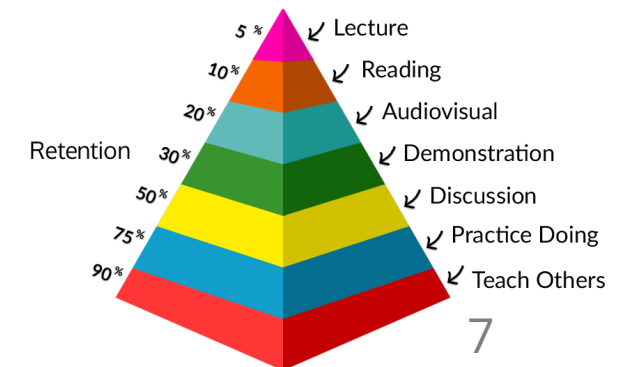
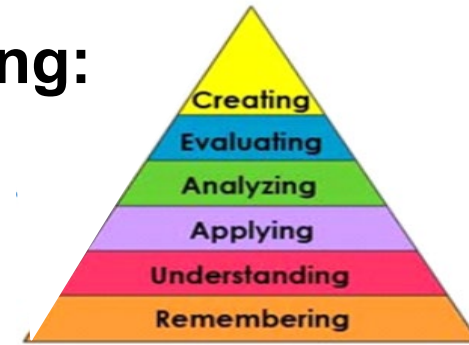
The Role of Innovation in Teaching



- **Humans are natural innovators**
 - e.g. the evolution of human language to facilitate cultural transmission

- **Teaching should exploit this evolutionary basis of social learning:**

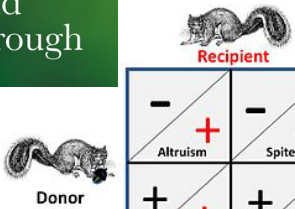
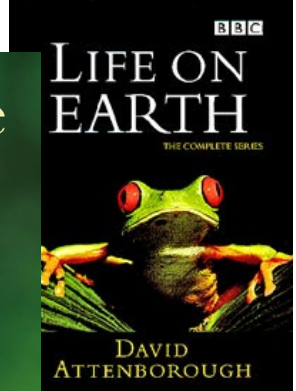
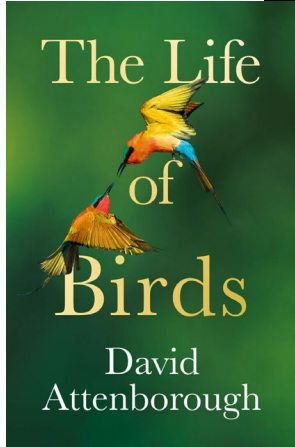
1. **As educators, we innovate novel teaching solutions for new teaching problems, and then culturally share**
 - i.e. in Utdanningsnakk, & the educational research literature!
2. **Students have evolved to learn in this same way**
 - (a) **learning via active instruction & interactive tasks**
 - (b) **innovating themselves & then teaching others**





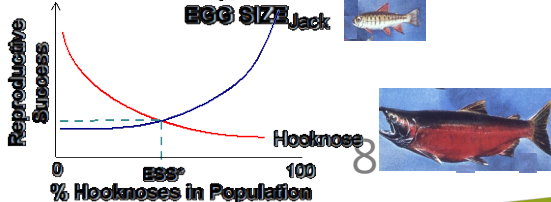
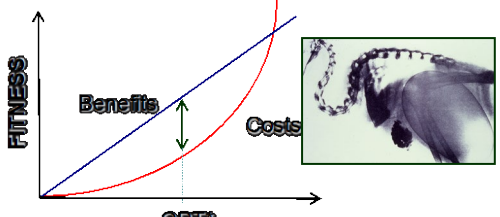
The Development of BI2044 Etologi



- Was a traditional course with lectures + practical classes
- Courses in animal behaviour are popular & easy to teach, because they can be superficially entertaining for students – e.g. cool natural history & slides of charismatic/cute animals, etc.
- However, we should be teaching students how to think, & specifically how game theory in social evolution relates to the behavioural strategies we see in natural populations
- One answer is problem-solving games where the students play the part of the animal, trying to collect as many ‘food’ tokens as possible in order to survive & win the game



-	-
+ (Altruism)	- (Spite)
+ (Cooperation)	+ (Selfishness)





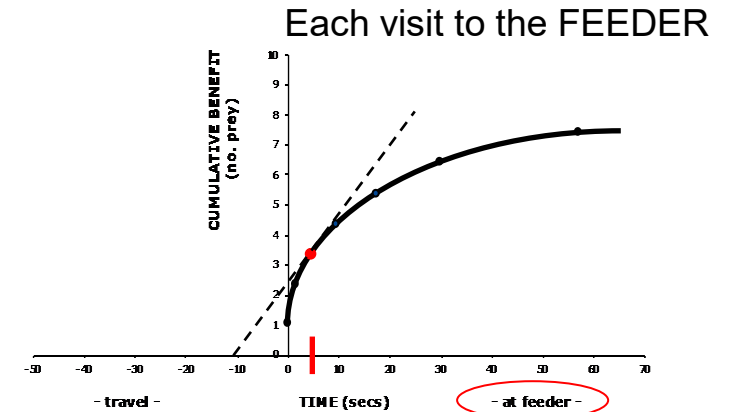
Marginal Value Theorem

Kacelnik (1984)



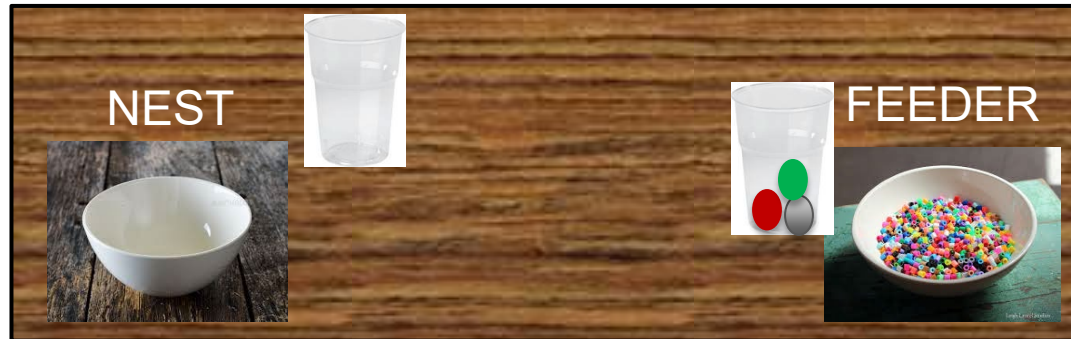
The aim of the STARLING is to maximise the TOTAL number of prey in the NEST by the end of the 10min trial given the number of trips possible...

The decision is what is the optimum load size (cumulative prey) per trip...?



Trip	Load Size
1	3
2	4
3	3
4	3
5	3
6	4
7...	

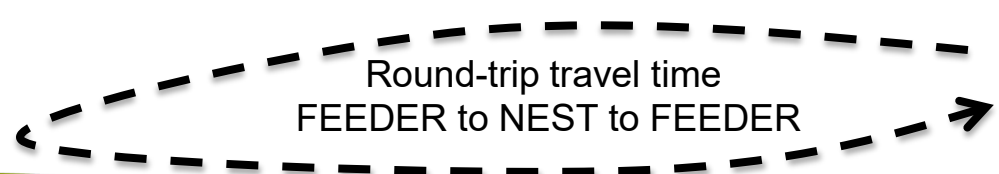
Cup = STARLING beak

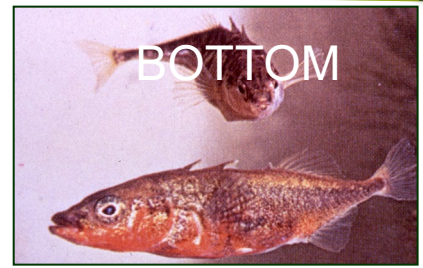


TOTAL = 47
in 10mins

Prey No.	Secs	Gap
1	0	0
2	1	1
3	3	2
4	7	4
5	15	8
6	31	16
7	63	32
8	127	64
9	255	128
10	511	256

Distances = 5, 15, 45 secs





Ideal Free Distributions

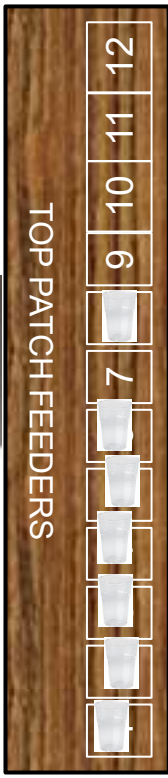
Milinski (1979)

The aim of each STICKLEBACK is to maximise the TOTAL number of prey collected by the end of the 10min trial by feeding from either the TOP or BOTTOM patches

?prey per ?secs



Random Allocation of Prey to Occupied Slots in Patch



“Variable Patch Profitabilities”

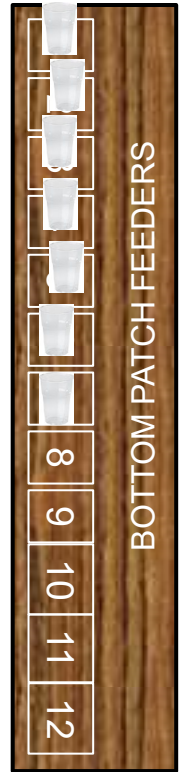
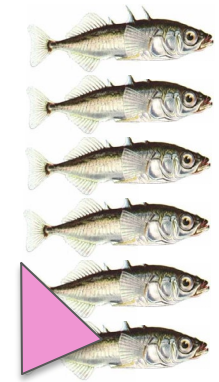
Always start with 6:6, and then the decision at any time is whether to stay and when to move to the other patch...?

Scan Samples		At End of 10min Trial	
Time(secs)	Top:Bottom	FishID	#prey
30	6:6	1	11
60	7:5	2	9
90	6:6	3	10
120	5:7	4	7
150	4:8	5	13
180...	5:7...	6...	8...

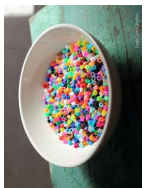


“Unequal Competitors”

Cup = STICKLEBACK stomach (and goes with them whenever they move)



?prey per ?secs



Random Allocation of Prey to Occupied Slots in Patch

10





Producer-Scrounger Game

Giraldeau & Beauchamp (1999)



The aim of each SPARROW is to maximise the TOTAL number of prey collected by the end of each GAME by deciding to play PRODUCER or SCROUNGER each round

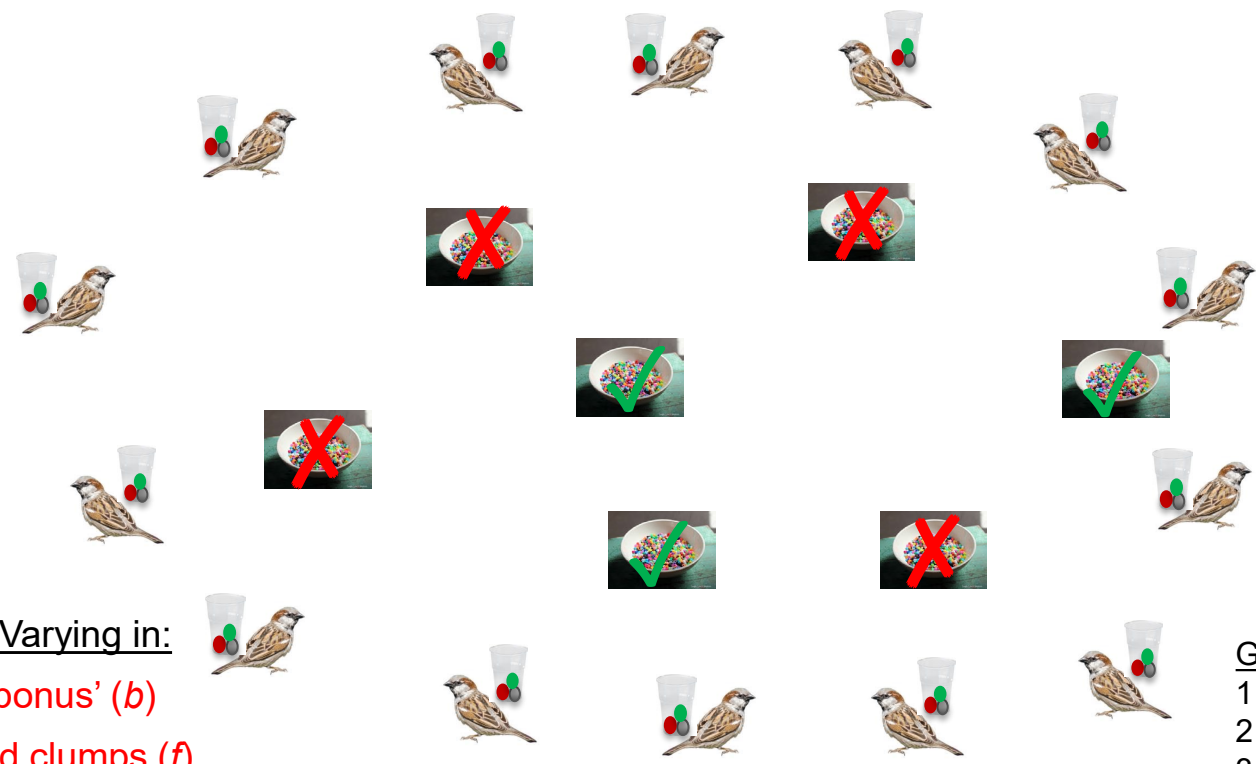
Cup = SPARROW stomach
(and goes with them whenever they move)

10 rounds per GAME, each starting with everyone around the outside

(1) sparrows decide whether to be producers

(2) see if producers successfully find food

(3) scroungers join successful producers



5 GAMES Varying in:

'Producer bonus' (b)

Size of food clumps (f)

Probability of producers finding food (p)

Game	f	b	p
1	16	4	0.5
2	24	4	0.5
3	24	6	0.5
4	24	8	0.33
5	24	8	0.166

Round	Tactic	Pay-Off
1.	P	0
2.	S	2
3.	P	4...

Public Goods Game

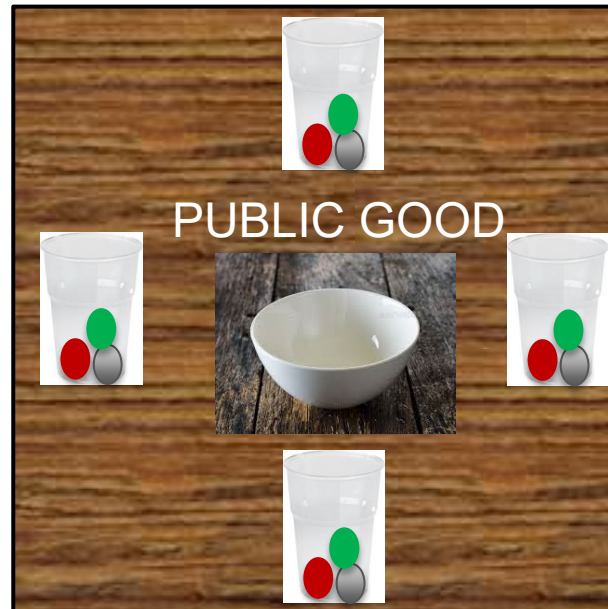
Fehr & Gächter (2005)



The aim for each player is to maximise the TOTAL number of additional beads they collect by the end of each EXPERIMENT

Over 10 rounds each player makes separate decisions whether to contribute 2 beads to the public good ('cooperate') or not ('defect')

At the end of each round the total public good is doubled (from a beads store) and shared out equally among all players



In 'hidden' investment a covered cup already containing 20 beads is passed around

In 'open' investment everyone says "en, to, tre" before revealing investments

4 EXPERIMENTS varying in:

Hidden vs Open investments (1 vs 2)

Same vs Different other players (2 vs 3)

Stay vs Move to Different table (3 vs 4)

Individual Datasheet

Round	Tactic	Pay-Off
1.	C	2
2.	D	3
3.	C	1
4.	C	0
5.	D	1
6.	C	-1...

BI2044 Ethology Practical Exercises

- **Individual students have to discover for themselves the optimal strategy, but they can & do also talk to each other during the games**
- **A fun & effective way to teach complex game theory & how it relates to behavioural mechanisms ('rules-of-thumb') used by animals in nature**
- **These practical exercises are now scheduled at the start of the course, because they establish an informal & interactive classroom atmosphere**
- **The students also collect data, & the results are presented & discussed in a follow-up class a few days later** (& winners rewarded with beer &/or chocolate...!)
- **Each student writes-up one practical & they then mark each other's reports, with follow-up group & class discussions on marking, etc.**

Innovative Interactive Teaching

- Conclusions

- **Traditional teaching methods can always be improved upon with a bit of imagination & trial-and-error learning on what works best in the classroom, with any useful teaching innovations then being culturally shared**
- **Greater student engagement & interaction leads to better attendance & improved learning outcomes, even when back in traditional lecture classes, where students interact more to teach & learn from each other**
- **Interactive/problem-solving classes can be tricky to get right initially, but in the long-run they are less work to teach, more effective & popular with the students, & often a lot more interesting & fun to teach!**

Thank-you – questions/comments?

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TILBAKE

HØST 2024