Learning Dynamics of Costly Signals
Intuition:

Suppose...
- long tails hinder flight for all
- less so for healthy males.
- females mate with those with long tails
- only healthy grow long tails

=> noone can benefit by deviating

(will formalize soon...
Zahavi

The Handicap Principle (1975)

“...a highly paradoxical theory... That theory is the Handicap Principle... I used to think it was nonsense, and I said so in my first book, The Selfish Gene. In the Second Edition I changed my mind...”

- Richard Dawkins
The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2001

George A. Akerlof, A. Michael Spence, Joseph E. Stiglitz
Shorter tails better at “hawking”
Can costly signaling emerge from social learning?
$S_n < S_{n+1}$
$S_n << S_{n+1}$ if low
1, 2

High

1

P

Low

1

S_0, S_1, S_2, S_3

S_n < S_{n+1}

S_n << S_{n+1} if low
$S_n < S_{n+1}$

$S_n << S_{n+1}$ if low

1. **High**
   - P
   - 1 → 1
   - 1 → S<sub>0</sub>
   - 1 → S<sub>1</sub>
   - 1 → S<sub>2</sub>
   - 1 → S<sub>3</sub>
   - S<sub>3</sub> → 2
   - 2 → Accept
   - 2 → Reject

2. **Low**
   - 1 → 2
   - 2 → 2

**Decision Process:**
- If $S_n < S_{n+1}$, process moves to $S_{n+1}$.
- If $S_n << S_{n+1}$, process moves to 2.
Sn < Sn+1
Sn << Sn+1 if low
e.g. 0,3,6,9 and 0,1,2,3

e.g. P=1/3

e.g. 5,5,-5

Accept

Reject
\[ <s_0, s_1, \{s_2, s_3\}> \]
(0,0,0)

\[ <s_3, s_1, \{s_3\}> \]
(5,0,-10/3)
Nash Equilibrium = \( <, , > \) s.t. none benefit by unilaterally deviating

\(<s_0, s_2, \{s_2, s_3\}>\)

\(<s_0, s_3, \{s_3\}>\)

\(<s_0, s_0, \{}\rangle\)

\(<s_0, s_1, \{s_1, s_2, s_3}\rangle\)
e.g. $N_L=100$ $N_H=100$ $N_2=150$
Low 1’s
$1-w+w$ (payoffs) e.g. $w = .1$
$1 - w + w(payoffs)$ e.g. $w = 0.1$
With probably $\mu$ choose random strategy
$<s_0, s_2, \{s_2, s_3\}>$
\langle s_0, s_0, \emptyset \rangle
\[ \langle s_0, s_3, \{s_3\} \rangle \]
Efficient Separating!
Suppose all $<s_0, s_0, \emptyset>$

Then any female who experiments with $\{s_2\}$ does equally as well. So may spread by chance.

Then High can experimentally send $s_2$ does well, so will be imitated!

Likewise, for $<s_0, s_3, \{s_3\}>$

But if $<s_0, s_2, \{s_2, s_3\}>$, then REALLY complicated to leave...
As soon as receiver drifts to accepting 2 or 3

Enough receivers must have “neutrally drifted” to accept 1 so worth for good but not bad types

As soon as receiver drifts to accepting 1 or 2

Very quickly

After bad start
Sending 1,
receivers stop
Accepting 1

If in meantime
Receivers stop
Accepting 2 (by drift), then
Both good and
Bad better
Sending 0

Since good but not bad sending 1, receivers start accepting 1, to point where bad start sending
Robust?

1) payoffs
2) Noise
3) Experimentation rate
4) reinforcement learning
Reinforcement Learning
Even works for super high experimentation rates!
Does depend on interesting new condition:

Do females prefer to pair with random male?

\[ P = \frac{1}{2} \]

\[ \langle s_0, s_0, \{\} \rangle \]
\[ \langle s_0, s_0, \{s_0\} \rangle \]
\[ \langle s_0, s_2, \{s_2, s_3\} \rangle \]
\[ \langle s_0, s_3, \{s_3\} \rangle \]

No longer easy to leave pooling!
Can explain puzzling behaviors!
Efficient Separating!
When no acceptance at pooling!
Evidence?

Who cares?