Dynamique des interactions sociales : du choix individuel au comportement collectif

Dynamics of social interactions: from individual choice to collective behavior

Lecture 2: **Mimetism**

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Mimetism

Different types of mimetism (A. Orléan)

- **Conformity, Social norms** - peer group pressure; conforming to the prevailing conventions; tradition, culture transmission

- **Informational influences** - private and public informations
  → herd behavior, information cascades

- **Preferential imitation**
  externalities in agent’s utility function
Mimetism

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- **Conformity, Social norms** - peer group pressure; conforming to the prevailing conventions; tradition, culture transmission

  «*in Roma do as the romans do*»

  «*politically correct*»

  «*Penser contre son temps c'est de l'héroïsme. Mais le dire, c'est de la folie.*» Eugène Ionesco
Mimetism

- Conformity, Social norms - peer group pressure; conforming to the prevailing conventions; tradition, culture transmission

Social psychology: Ash conformity experiment (1951, 1955)

When individual judgment conflicts with a group, the individual will often conform his judgment to that of the group
Mimetism

• Conformity, Social norms - peer group pressure; conforming to the prevailing conventions; tradition, culture transmission

Social psychology: Ash conformity experiment (1951, 1955)

When individual judgment conflicts with a group, the individual will often conform his judgment to that of the group

Neurobiological correlates of social conformity (Berns et al 2005)

http://www.ccnl.emory.edu/greg/

- brain regions classically associated with perception can be altered by social influences

- independence (non-conformity) is found to be associated with subcortical activity changes indicative of emotional salience (amygdala activation ↔ emotional load associated with standing up for one’s belief)
Mimetism

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- Conformity, Social norms - peer group pressure; conforming to the prevailing conventions; tradition, culture transmission

  - *endogeneous norm: autoreferential mimetism:* conformity to the emerging majority

  *stock markets*

  « C'est bien la pire folie que de vouloir être sage dans un monde de fous » (D. Erasme)
  « C'est une grande folie de vouloir être sage tout seul » (La Rochefoucauld)
Mimetism

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- Conformity, Social norms - peer group pressure; conforming to the prevailing conventions; tradition, culture transmission

- Informational influences - private and public informations → herd behavior, information cascades
  (Banerjee 1992, Orléan 1995)

- Preferential imitation
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Informational influences

Sequential rational decisions $\rightarrow$ information cascades

(Banerjee 1992; Bikhchandani, Hirshleifer & Welch 1992)

Simple version

Issue: choosing between restaurant A and restaurant B

Private information (on quality of A compared to B):

« A better than B » or « B better than A »

Public information:

prior knowledge on the quality of A % B (e.g. B is likely to be better than A)

every arriving agent can see the number of customers in each restaurant

Common knowledge: reliability of private information = 70%
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(information cascades)

Common knowledge:
- reliability of private information = 80%
- B more likely to be better than A (say 55 % chance)

Hypothesis: actually A better than B (*unknown true state of nature*)

First agent: let private information = B
            → he goes to B

Second agent: private information = A
              public info.: one customer in B.
              rational reasoning:
              the customer must have entered because he got ‘B’
              his private information is as good as mine
              → I go to B

All the agents go to B, eventhough 70% will have received the correct private signal
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Informational influences

Simultaneous decisions (Orléan 1995)

Issue: choosing between two possible behaviors / hypothesis
Exple: stock market, hypothesis High vs. Low

Private information: each agent $i$ receives a signal,

\[ \sigma(i) = +1 \quad \text{or} \quad \sigma(i) = -1 \]

« $H$ more likely than $L$ », or « $L$ more likely than $H$ »

Public information:

- prior knowledge on $H \% L$ (e. g. $H$ and $L$ equally likely)
- common knowledge: reliability of private information $= p = 70\%$

at every time step, every agent can observe the total number of agents making the choice $H$
Assume true (unknown) state ('state of nature') is $H$.

Common knowledge: reliability of private information = $p > \frac{1}{2}$

prior distribution: $\rho(H) = \rho(L) = \frac{1}{2}$

If private information alone:

**optimal (rational) decision rule** for a given agent $i$?

$$P(\sigma(i) = 1 \mid H) = p$$  = proba. to receive the correct information

$$P(\sigma(i) = -1 \mid H) = 1-p$$  = proba to receive the erroneous information

$$P(H \mid \sigma(i) = 1) = P(H \mid 1) = P(1 \mid H) \frac{\rho(H)}{p(1)} \quad \text{(Bayes rule)}$$

similarly

$$P(H \mid \sigma(i) = -1) = P(H \mid -1) = P(-1 \mid H) \frac{\rho(H)}{p(-1)}$$

where

$$P(1) = P(1 \mid H) \rho(H) + P(1 \mid L) \rho(L) = \frac{p}{2} + \frac{(1-p)}{2} = 1/2$$

$$P(-1) = P(-1 \mid H) \rho(H) + P(-1 \mid L) \rho(L) = \frac{(1-p)}{2} + \frac{p}{2} = 1/2$$

Hence:

$$P(H \mid \sigma(i) = 1) = p, \quad P(H \mid \sigma(i) = -1) = 1-p$$

⇒ Decide 'H' if signal is 1, decide 'L' if signal is -1

(just as intuition tells us...)
Mimetism - Informational influences

Assume true (unknown) state ('state of nature') is H

Common knowledge: reliability of private information = $p > \frac{1}{2}$

prior distribution: $\rho(H) = \rho(L) = \frac{1}{2}$

If private information alone: decide 'H' if signal is 1, decide 'L' if signal is -1

For $N$ agents, probability that $M$ agents receive the correct information

$= C_N^M \cdot p^M \cdot (1-p)^{N-M}$

where

$C_N^M = \frac{N!}{M! \cdot (N-M)!}$

N = 100

p = 0.7
Mimetism - Informational influences

probability that, among the $N$ agents, a fraction $f$ receive the correct information

For large $N$,

$f \equiv \frac{M}{N} = p + \text{fluctuations of order } \frac{1}{\sqrt{N}}$
Mimetism - Informational influences

Hence, if one observes $f$, one can make the correct choice with very small probability of error:

if $f > \frac{1}{2}$, decide 'H', if $f < \frac{1}{2}$, decide 'L'

But if everyone does the same, instead of using his private information, there is no more any information in the collective behavior (in the value of $f$) → paradox (Grossman & Stiglitz 1980)

For large $N$,

$$f = \frac{M}{N} = p + \text{fluctuations of order } \frac{1}{\sqrt{N}}$$
Mimetism - Informational influences

Model (Orléan 1995): propensity to imitate $\mu$

As before: private signal $\sigma(i)$
   public information: $f$ = fraction of agents making choice 'H'

Behavioral rule:

If private and public information are in favor of the same hypothesis
   $(\sigma(i) = +1 \text{ and } f > \frac{1}{2}, \text{ or } \sigma(i) = -1 \text{ and } f < \frac{1}{2})$
   decide accordingly
   (decide 'H' \text{ or } decide 'L')

Otherwise:
   $\mu = \text{probability to follow the majority:}$
   $\sigma(i) = -1 \text{ and } f > \frac{1}{2}, \text{ P(make the choice 'H')=} \mu, \text{ P(make the choice 'L')=} 1-\mu$
   $\sigma(i) = +1 \text{ and } f < \frac{1}{2}, \text{ P(make the choice 'L')=} \mu, \text{ P(make the choice 'H')=} 1-\mu$
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Dynamics

At each time $t$:

- new private signal $\sigma(i, t)$ for each agent $i$, randomly chosen, (+1) with proba. $p$, (-1) with proba $1-p$

- public information: $f(t)$ = fraction of agents having made the choice 'H'

- Behavioral rule: applied by all the agents in parallel

For large $N$ (assuming that 'H' is the true, unknown value)

if $f(t) > \frac{1}{2}$, then $f(t+1) = p + (1-p) \mu$

if $f(t) < \frac{1}{2}$, then $f(t+1) = p (1- \mu)$
Mimetism - Informational influences

true 'state of nature' is $H$

$p$ = fraction of agents receiving the correct information ($p > \frac{1}{2}$)

$f(t) = \text{fraction of agents making the choice 'H'}$

if $f(t) > \frac{1}{2}$,
then $f(t+1) = p + (1-p)\mu$

if $f(t) < \frac{1}{2}$,
then $f(t+1) = p (1-\mu)$

First case:

$\mu < \mu^* \equiv 1 - 1/2p$

(then $p(1-\mu) > \frac{1}{2}$)
Mimetism - Informational influences

Fixed point?

\[ \mu < \mu^* \equiv 1 - \frac{1}{2p}, \quad \text{a unique fixed point, } f = p + (1-p) \mu \]

true ‘state of nature’ is H

\[ p = \text{fraction of agents receiving the correct information } (p > \frac{1}{2}) \]

\[ f(t) = \text{fraction of agents making the choice ‘H’} \]

If \( f(t) > \frac{1}{2} \),

then \( f(t+1) = p + (1-p) \mu \)

If \( f(t) < \frac{1}{2} \),

then \( f(t+1) = p \ (1-\mu) \)
Mimetism - Informational influences

Fixed point
\[ \mu < \mu^* \equiv 1 - \frac{1}{2}p, \]  
a unique fixed point, \[ f = p + (1-p) \mu \]

true 'state of nature' is \( H \)
\[ p = \text{fraction of agents receiving the correct information (} p > \frac{1}{2}) \]
\[ f(t) = \text{fraction of agents making the choice 'H'} \]

if \( f(t) > \frac{1}{2} \),
then \[ f(t+1) = p + (1-p) \mu \]

if \( f(t) < \frac{1}{2} \),
then \[ f(t+1) = p (1-\mu) \]
Mimetism - Informational influences

true 'state of nature' is $H$
$p = \text{fraction of agents receiving the correct information} (p > \frac{1}{2})$
$f(t) = \text{fraction of agents making the choice 'H'}$

Second case:
$\mu > \mu^* = 1 - 1/2p$

Then $p(1-\mu) < \frac{1}{2}$
Mimetism - Informational influences

true 'state of nature' is $H$

$p$ = fraction of agents receiving the correct information ($p > \frac{1}{2}$)

$f(t)$ = fraction of agents making the choice 'H'

if $f(t) > \frac{1}{2}$,

then $f(t+1) = p + (1-p)\mu$

if $f(t) < \frac{1}{2}$,

then $f(t+1) = p (1-\mu)$

Fixed point?

$\mu > \mu^* = 1 - 1/2p$

two fixed points
dynamics

\[ f \] (H) (L) (H) (L) (H)

\[ \mu < \mu^* \]
dynamics

Figure 6. Évolution de $f$ au cours du temps ($\mu = 0.8$ et $p = 0.7$).

$\mu > \mu^*$
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  Schelling, Granovetter