Cooperation without awareness and decisions from experience in minimal social situations

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The minimal social situation (MMS)
Sidowski, Wyckoff & Tabory (1956)

Payoffs to players depend not on their own actions but exclusively on the actions of their co-players.

Fig. 1. Mutual Fate Control game.

Thibaut & Kelley (1959)
Payoffs: sick or well child

Alf’s son is allergic to peanuts
Beth’s daughter is allergic to cheese
**Alf’s Payoffs**

Whether he chooses raisins or cheese makes no difference to his son’s health – which is really influenced by what Beth chooses to give to her daughter to eat.
Beth’s Payoffs

Whether she chooses popcorn or peanuts makes no difference to her daughter’s health – which is really influenced by what Alf chooses to give to his son to eat.
Findings and Theory

• Early research showed that learning and cooperation could occur (Sidowski, 1957, 2 rooms, electric shocks and points, 75% C choice, 200 rounds).

• Research had inadequate experimental controls and no incentive payments.

• Theory: A Win-Stay, Lose-Shift (WSLS) decision rule (Thibaut & Kelley, 1959) predicts adaptive learning of cooperation in dyadic MSS.

• WSLS is essentially a formalization of Thorndike’s (1898) law of effect.
Win-stay, lose-shift (WSLS)

- **Player 1**
  - D
  - Lose-shift
  - Win-stay

- **Player 2**
  - C
  - Lose-shift
  - Win-stay

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Deterministic WSLS

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Noisy WSLS

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Fig. 1. Mutual Fate Control game.
Our experiments were designed to test some key predictions about adaptive learning in MSS groups of different sizes.

Win-Stay Lose-Shift theory predicts that adaptive learning should occur in two-player and four-player groups, and in a small proportion of six-player groups, but not in three-player groups.
Method Experiments 1-4

- Participants in lab at interconnected PCs
- Choice of pressing J or K
- Cash reward or nothing
- 200 rounds with feedback
Experiment 1 Results

- Time series analysis showed that learning occurred slowly over 200 rounds in 2 player groups.
- No learning in 3, 4, or 6-player groups in spite of financial incentives.
Experiment 1: proportions of win-stay, lose-shift, win-shift, and lose-stay choices over trial blocks for two-player, three-player, four-player, and six-player groups.
Experiment 2

- Replication of #1 but participants told that they were in interactive decision making (not told payoff structure).

- As in #1, only the 2-player group learned to cooperate.

- In 2-player groups learning occurred in the first 50 trials.

- Adaptive learning is not noticeably better under informed than strict MSS conditions.
Experiment 3

• Replication – with participants able to discuss after rounds 10 and 20, then at round 30 told about their interdependence.

• Significantly more cooperation in 2-player groups (63% vs. ~50% in groups of 3 or 4).

• 2 player groups reached 80% cooperation after told of interdependence.
Experiment 4 – Larger cash payoffs and also cash losses made no difference, larger groups could not learn to cooperate.

Conclusion:
Learning occurred rarely in multiplayer groups, even when players were informed that they were interacting strategically and were allowed to communicate with one another but were not aware of the game's payoff structure.

Why?
WSLS with implementation noise
2 players can correct the error, larger groups can not.
Monte Carlo simulation

Computational algorithm, 10,000 replications, looking for values that match the experimental data.

Players do use a noisy version of the WSLS decision rule.

Initially ~20% misimplementation noise (errors) after rewarding rounds and ~50% after unrewarding rounds.

But noise decays exponentially as decisions become more deterministic and less exploratory.
Conclusions

• The simulations explain not only our own results but also those of previous investigators.

• As in almost all domains, behavior tends to follow the law of effect. However, in the MSS, players begin by implementing the WSLS decision rule rather noisily, frequently deviating from it after rewarding rounds and more frequently after unrewarding rounds, but gradually implementing it more rigorously over successive rounds.
Over time cooperation can occur between two people unintentionally, and without awareness of their interdependence.

Larger groups need to communicate and to plan.

Full paper: