A Nudge or a Crutch? Interim Payments and Learning in Sequential Decision Tasks

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Motivation

- In many circumstances, achieving the best outcome requires an optimal path of right choices along a sequence of decision nodes

  - Education

  - Health

  - Retirement Savings

  - Farm Management

Motivation

- Incentives along the way can help

  - Paying kids to read or to attend school improves test scores, while paying them to test well does not (Fryer 2011)

  - Paying people to go the gym leads them to exercise more even after payments stop and improves health (Charness & Gneezy 2009)

Motivation

- Companies offer incentives ("teasers") to lure consumers *off* the optimal path

  - Cable and Satellite TV
  - Mortgages
  - Health Clubs
  - Credit Cards

Motivation

- Offering incentives for intermediate steps
    - To entice incorrect decisions (companies)
    - To entice correct decisions (choice architecture)

- Claim: these positive interim payments
    - Lead to better decisions
    - Lead to better outcomes
    - Lead to long-term improvements
    - Lead to learning

Our Questions

How interim payments change …

- **WHETHER** people learn
  - Do interim payments help (hurt) learning?
  - Do they change learning or the timing of learning?

- **WHAT** people learn
  - Reflexive learning: memorization of patterns
  - Mindful learning: transferable knowledge

Transferability of Learning

- Generally, literature finds very little transfer
  - Graduates with economics courses show no better general economic reasoning skills (Voss et al 1986)
  - Schoolchildren practicing algebra problems cannot solve slight variations (Cooper & Sweller 1987)
  - Chess players can't apply backward induction in lab (Levitt, List & Sadoff 2011)

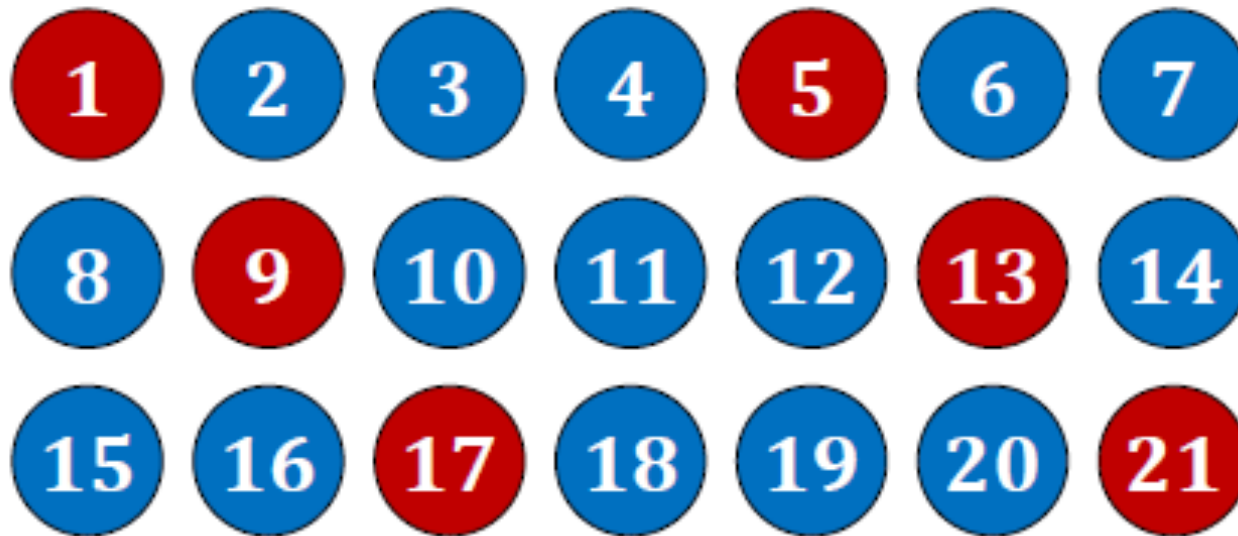**Dufwenberg Sundaram Butler, Gneezy Rustichini Vostroknutov, Levitt List Sadoff**
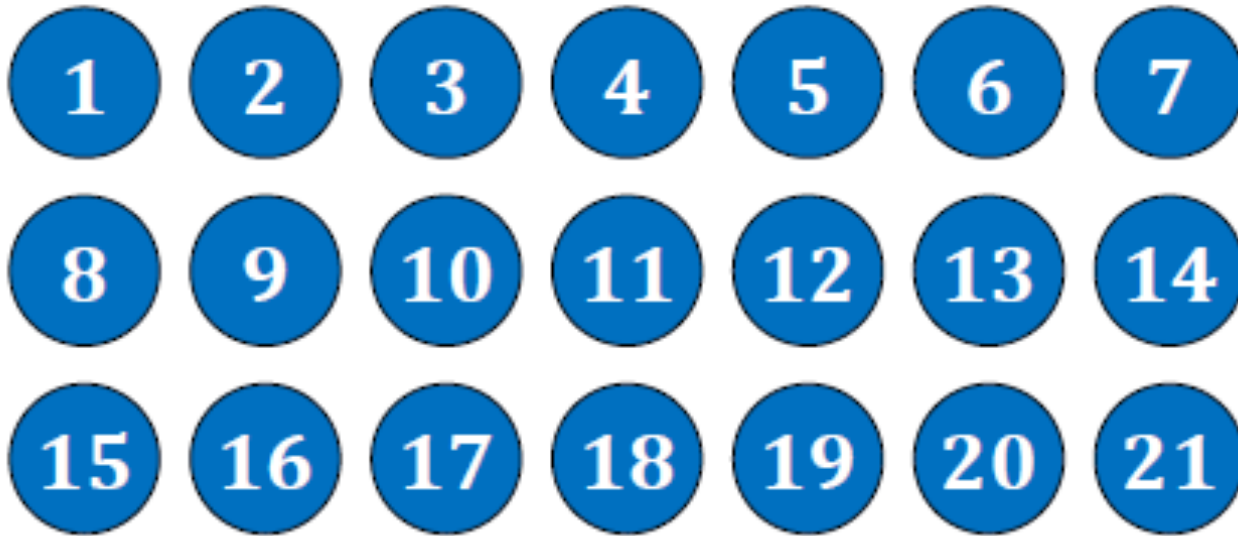
Players alternate turns

Each turn: Remove 1 to 3 lowest stones

Player that removes last stone (21) wins 100 points

Dufwenberg Sundaram Butler, Gneezy Rustichini Vostroknutov, Levitt List Sadoff

Player & Computer alternate turns
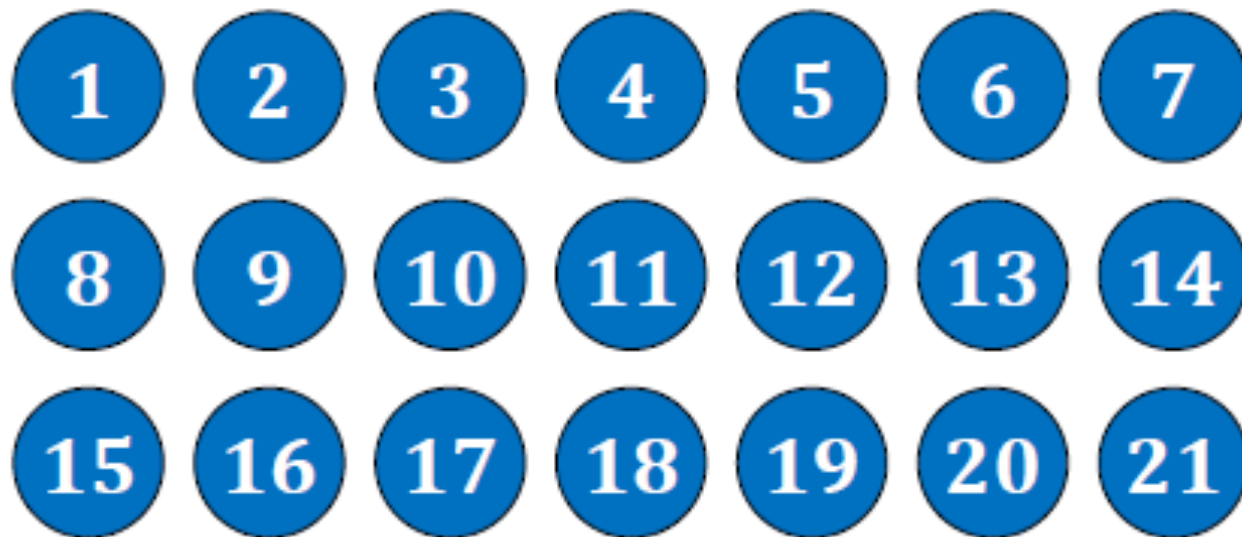
Each turn: Remove 1 to 3 lowest stones

Player that removes stone 21 wins 100 "points"
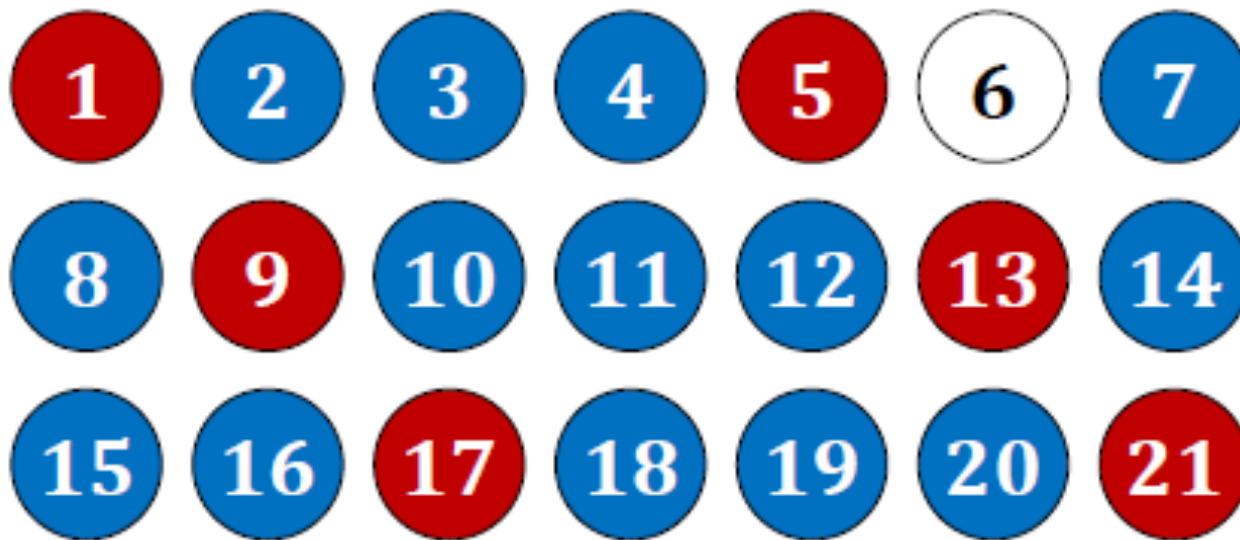
On-path interim payment:

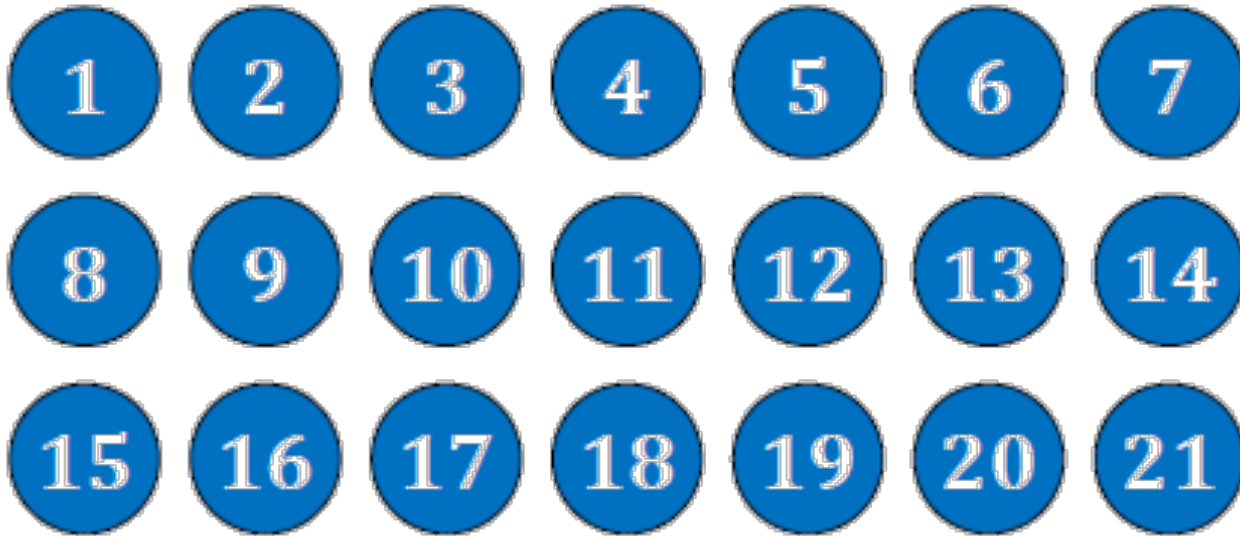The optimal path requires taking the interim payment

Off-Path Interim Payments

Off-path interim payment:

Taking the interim payment implies losing the game. Interim payment worth 50 "points."

Game 2:

Player & Computer alternate turns

Each turn: Remove 1, 2, 3, or 4 lowest stones

Player that removes the last stone (21) wins

Experiment Design (Experiment 1)

Game 1:

Subjects play 30 rounds of a race game

2 (**on-path** or **off path interim payment**)

x 2 (early or late interim payment)

x 2 (action space 1-3 or 1-4 stones per turn)

+   2 (**no interim payment**, both action spaces)

Game 2:

Subjects play 15 rounds of identical game

except action space changes

1-3   becomes   1-4

or   1-4   becomes   1-3

- Optimal path changes
  - 1-5-9-13-17-21   vs.   1-6-11-16-21
- On-path IPs become off-path & vice versa

Experiment Design (Experiment 1)

- Run at the University of Tennessee
- 100 "points" for winning, 50 for interim payment
- 150 points = $1

- N = 220
- Average: $18.48
- Average: 1 hour

Treatment (Game 1)	N
On Path IPs	84
(Early 3 & 4 / Late 3 & 4)	
Off Path IPs	91
(Early 3 & 4 / Late 3 & 4)	
No IPs	45
(3 & 4)	

Epiphanies

- Through repetition, have an epiphany
  - Dufwenberg, Sundaram, and Butler (2010)
  - Gneezy, Rustichini, and Vostroknutov (2010)
  - Easier problems – higher likelihood of epiphany

- Two types of epiphanies
  - *Pattern* epiphany (reflexive learning)
    - Does not transfer from game 1 to game 2
  - *Game* epiphany (mindful learning)
    - Transfers from game 1 to game 2

Our Questions / Hypotheses

How interim payments change …

- **WHETHER** people learn
  - Game performance best with on-path teasers
  - Game performance worst with off-path teasers
- **WHAT** people learn
  - If on-path payments lead to epiphanies about games
    - On-path payments lead to transferable learning
  - If reflexive learning crowds out mindful learning
    - On-path payments hinder transferable learning

Epiphanies: Crowding Out

- If
  - Easier games lead to more *pattern* epiphanies, and
  - *pattern* epiphanies crowd out *game* epiphanies
- Then
  - Transferable and non-transferable learning rates are negatively correlated

- Short-run (stable environment) success versus long-run (dynamic environment) success

A Nudge or a Crutch?

Results

Relative to no interim payments …

- On-path IPs help subjects "learn" the game
- Off-path IPs offer no significant hindrance

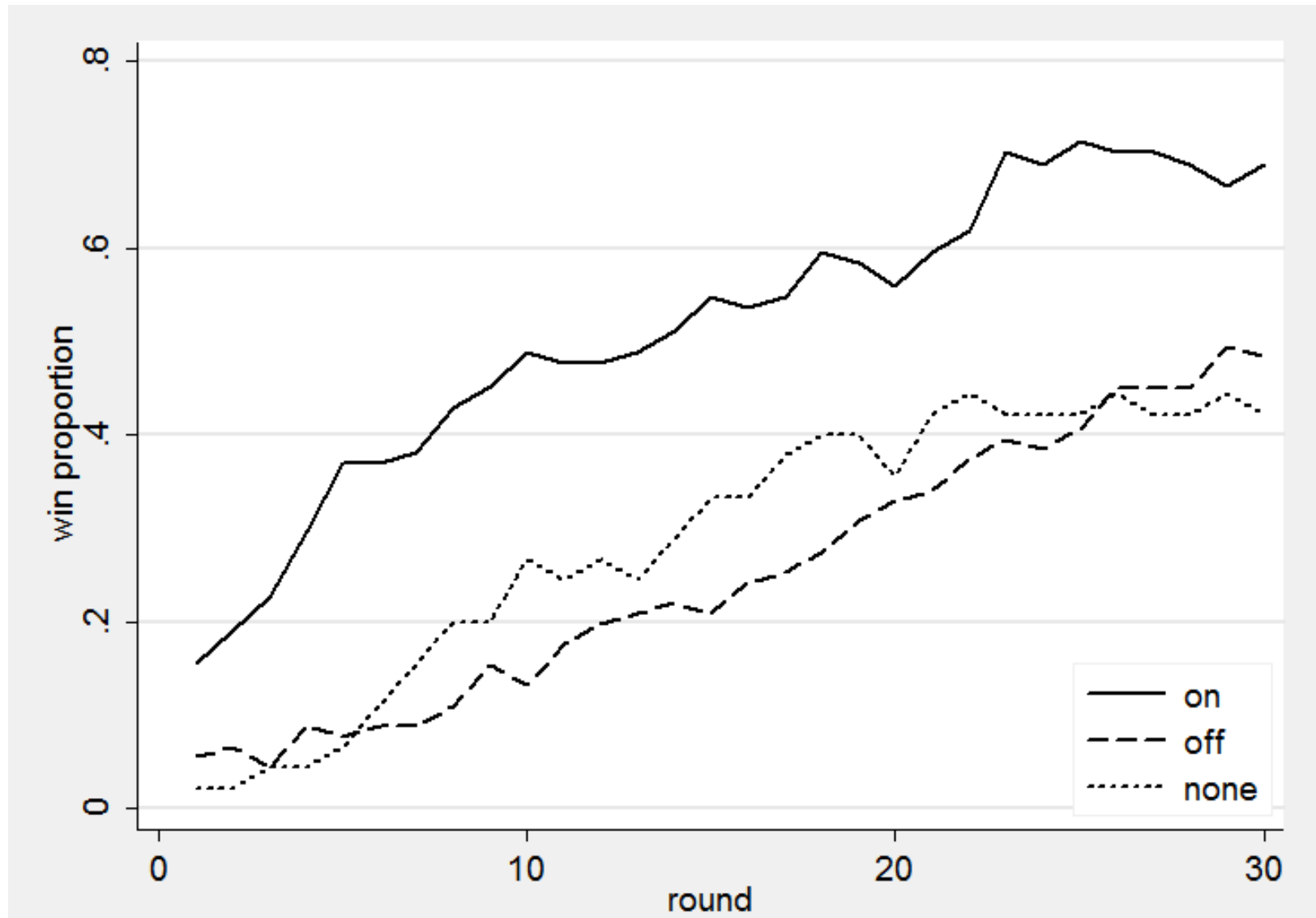| Game 1 Win Percentage	
On-path interim payments	52%
No interim payments	29%
Off-path interim payments	25%

Results

Relative to no interim payments …

- On-path IPs help subjects "learn" the game
- Off-path IPs offer no significant hindrance

Game 1 Win Percentage		
	rounds 1-10	rounds 21-30
On-path interim payments	33%	68%
No interim payments	9%	42%
Off-path interim payments	11%	43%

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On-path interim payments	0.647***	
Off-path interim payments	- 0.130	
Action-space = 4	0.181	0.172
Round #	0.051***	0.052***
Constant	- 1.482***	- 1.494***

Robust standard errors, clustered by subject. *** is significant at 0.1%

A Nudge or a Crutch?

Results: Probit for Winning Game 1

On-path interim payments	0.647***	
Early (stone 5/6)		0.429
Late (stone 11/13)		0.866***
Off-path interim payments	- 0.130	
Early (stone 5/6)		0.120
Late (stone 11/13)		- 0.374
Action-space = 4	0.181	0.172
Round #	0.051***	0.052***
Constant	- 1.482***	- 1.494***

Robust standard errors, clustered by subject. *** is significant at 0.1%

Off-path interim payments

- Serve as a distraction, at least early on
  - Every subject takes the off-path interim payment at least once by round 5

- Serve as a consolation prize later?
  - Even in the last few rounds, 50% of subjects still taking off-path payment

Did subjects learn a pattern or the concept?

- Define:
  - *Learner*

    won at least 2 of last 3 rounds of game 1
  - *Transferable learner*

    won at least 2 of first 3 rounds of game 2

Results

Relative to no interim payments …

- Interim payments hinder transferable learning

	Non-learners	Non-Transferable Learners	Transferable Learners
On-path IPs	30%	57%	13%
No IPs	58%	2%	40%
Off-path IPs	53%	22%	25%

Results

On-path interim payments:

Increase "learning" from 42% to 70%

Decrease transferability from 40% to 13%

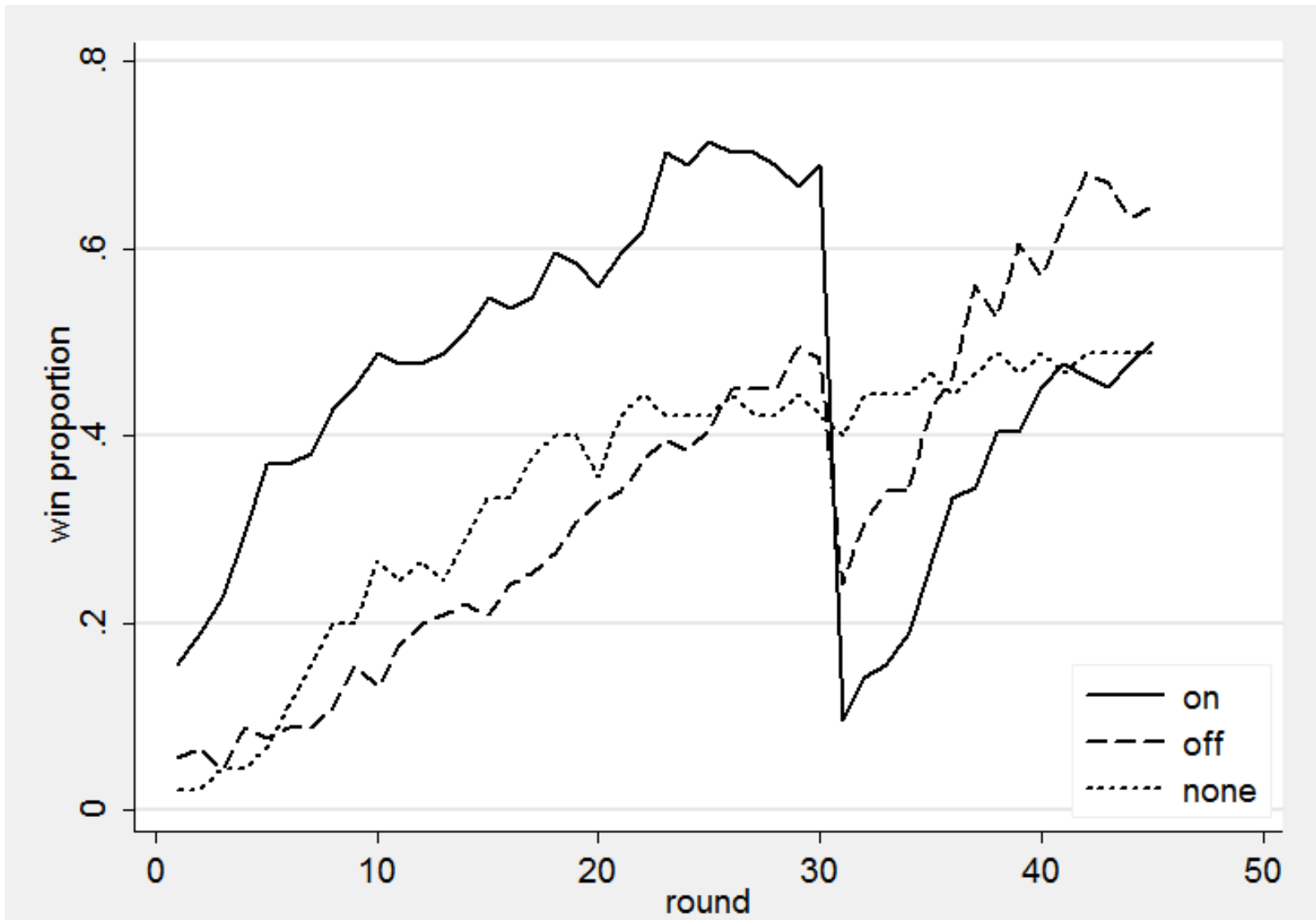|	Non-learners	Non-Transferable Learners	Transferable Learners
On-path IPs	30%	57%	13%
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Results

Off-path interim payments:

Insig. Increase "learning" from 42% to 47%

Decrease transferability from 40% to 25%

|	Non-learners	Non-Transferable Learners	Transferable Learners
On-path IPs	30%	57%	13%
No IPs	58%	2%	40%
Off-path IPs	53%	22%	25%

- A potential confound in the experiment:
  - "on-path" game 1 becomes "off-path" game 2
  - "off-path" game 1 becomes "on-path" game 2

- Could be confounding "learning" with innate game difficulty

- Experiment 2 (N=45):
  - Game 1: on-path, off-path, action space = 4
  - Game 2: no interim payment, action space 3
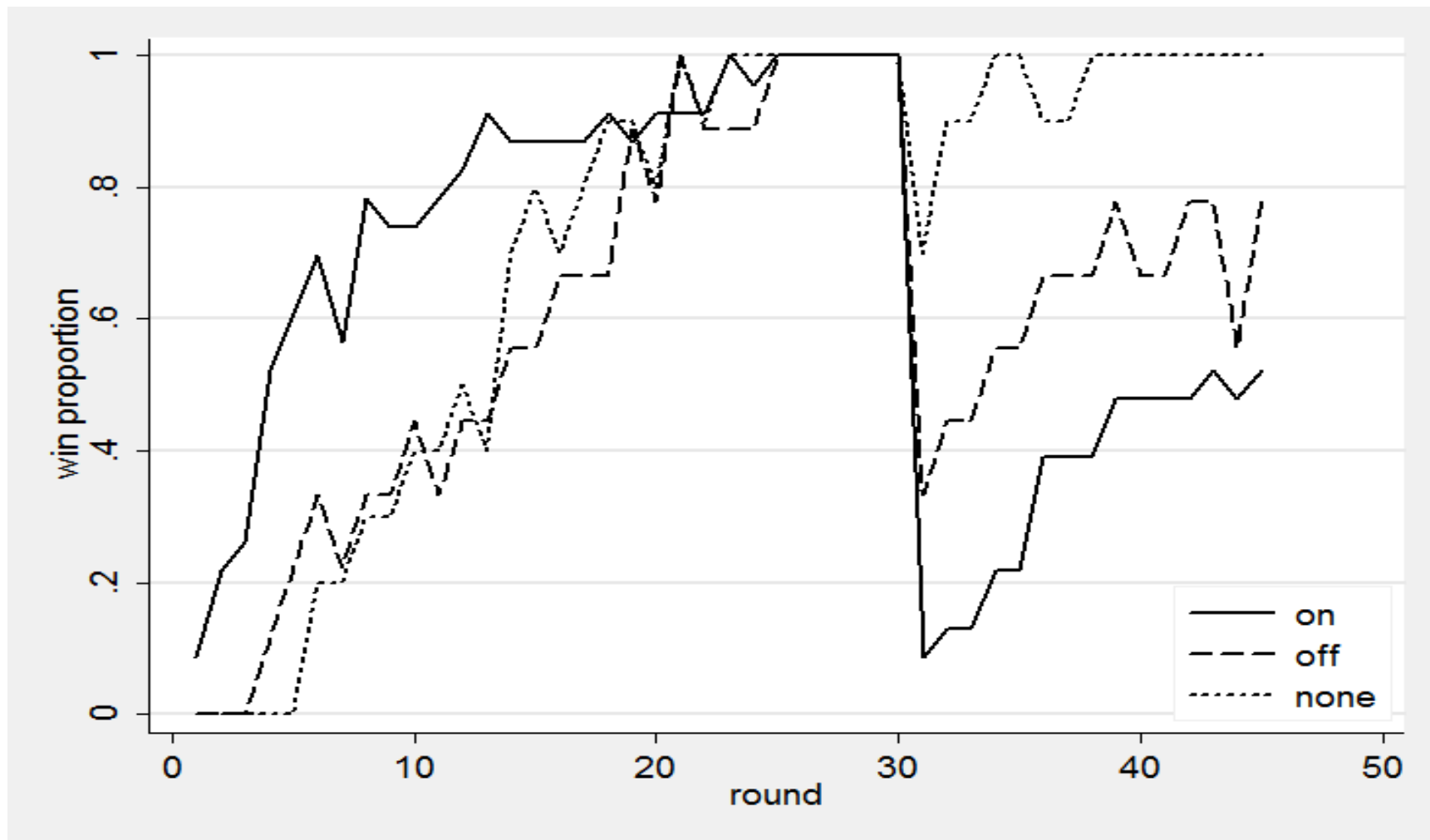 - Pool with no IPs from experiment 1

Results

Subjects who never learn game 1

A Nudge or a Crutch?
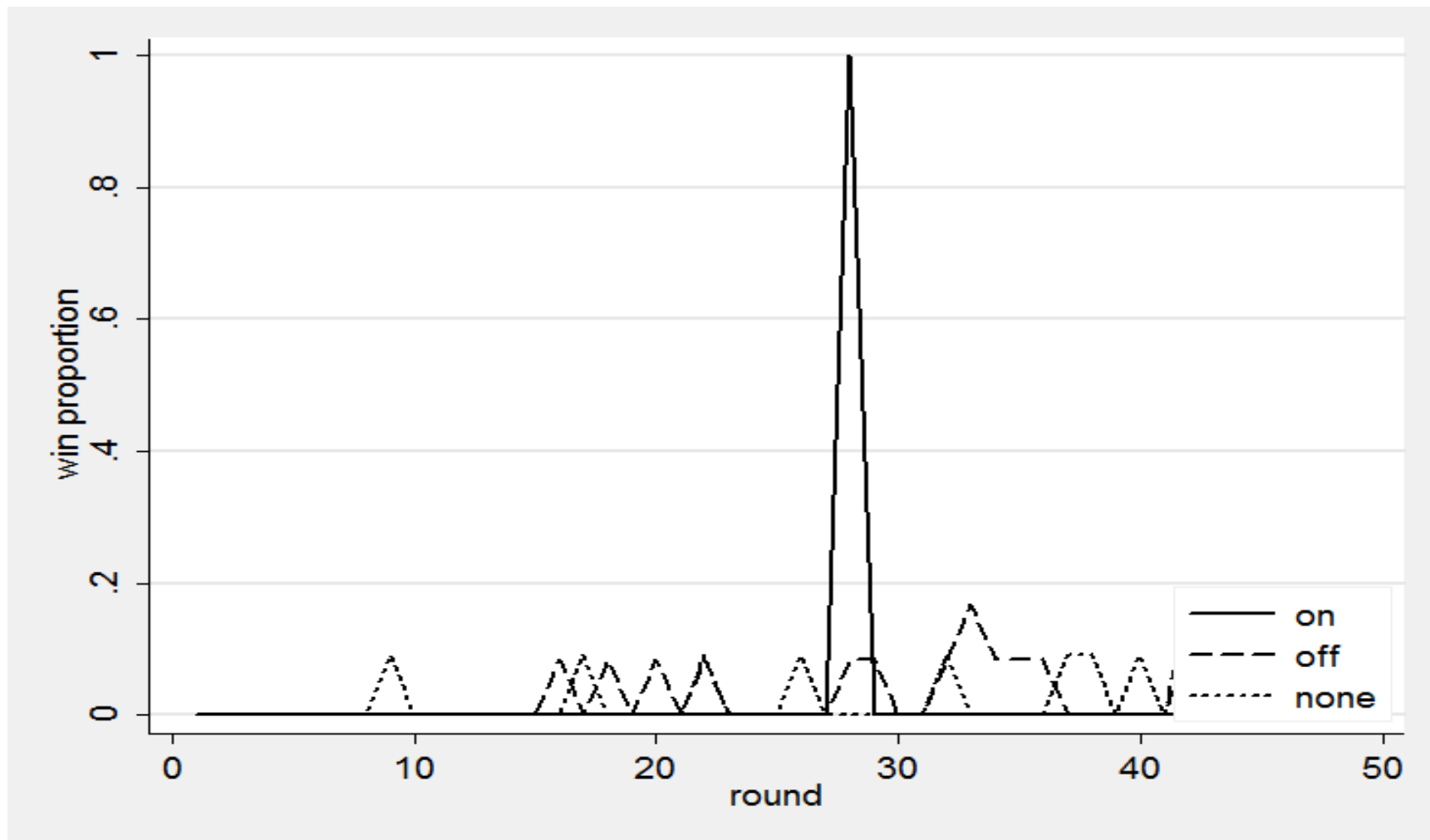
Results

Subjects who "learn" game 1

Results

- So far, we have lumped treatments into three. But, we have 10 in total (2 action spaces, 2 teaser locations), and 2 experiments (N=265).

- Crowding out hypothesis:

  - Easier games lead to less *transferable* learning

  - Challenge: how to measure "game ease"

Crowding Out

- Dependent Variable: Game 2 win percentage
  - Game 1 ease:
    - Average win rate of *other* subjects in game 1
  - Game 2 ease:
    - Average win rate in that game *as game 1*
  - Own game 1 win percentage
    - Also, own game 1 win *rank*

- Crowding out hypothesis:
  - Game 1 ease has a negative coefficient

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Crowding Out

Game 2 win percentage (OLS)		
Game 1 own win %	0.870 (0.053)	**
Game 2 ease	0.525 (0.130)	**
Game 1 ease	-0.833 (0.116)	***
Constant	0.210 (0.080)	***

N=264. ***,**,* = 0.1%, 1%, 5%

R^2=0.523, F=95.53

Crowding Out

Game 2 win percentage (OLS)		
Game 1 own rank	0.826 (0.047)	***
Game 2 ease	0.490 (0.126)	**
Game 1 ease	-0.234 (0.104)	*
Constant	-0.050 (0.080)	

N=264. ***,**,* = 0.1%, 1%, 5%

R^2=0.523, F=95.02

Implications

- Interim incentives potentially have conflicting effects in the short term and the long term
  - can help short-term learning
  - but hinder transferability of learning
- Need broader definition of intervention "success"
  - "Nudges" can be harmful
- _Conditional on learning a game_, transferability of learning is increasing in difficulty of game
- Overall judgment requires decisions about relative importance of current versus future world.

Implications

- Efforts to guide good behavior by rewarding …
    - students for reading
    - adults for exercising
    - people for saving

increase the desired activity in the short term,

but may hinder natural process of learning about

    - good study habits
    - good lifestyle habits
    - good financial habits

in general