

Virtual Teams in a Gig Economy: Field Experiments at a Ride-sharing Platform

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Motivation

Background: Experiment 1. Ai, Chen, Mei, Ye and Zhang

Experiment 2: Design

Hypotheses

Results

Summary

The Gig Economy and Its Problems

- ▶ Workers in traditional sectors
 - ▶ identity from work
 - ▶ bonds with co-workers
 - ▶ career trajectory

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 - ▶ identity from work
 - ▶ bonds with co-workers
 - ▶ career trajectory
- ▶ Gig workers
 - ▶ autonomy and flexibility
 - ▶ lack of work identity and bonds
 - ▶ Those who rely on the gig economy to make a living often find that “**these are jobs that don’t lead to anything.**”
 - a tasker for TaskRabbit, *The New Yorker* (05/2017)
 - ▶ Attrition and lack of engagement (Ravenelle 2019)

Ride-sharing platforms

- ▶ DiDi
 - ▶ the largest ride-sharing platform in the world
 - ▶ 31 million drivers globally, 25 million rides per day (12/2019)
 - ▶ DiDi drivers
 - ▶ migrant workers
 - ▶ the unemployed and under-employed
 - ▶ commuters
 - ▶ “I have no interaction or relationship with other colleagues.”
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– a DiDi driver, *The Curiosity Daily* (2019)
- ▶ Uber:
 - ▶ 3.9 million drivers, 14 million rides per day (12/2019)
- ▶ Lyft:
 - ▶ 1.4 million drivers, 1 million rides per day (12/2019)

An Identity-based Solution

- ▶ Objectives

- ▶ Create driver organization (team) identity
- ▶ Increase driver engagement and productivity

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- ▶ Social identity theory (Tajfel & Turner 79, 86)
- ▶ Identity economics (Akerlof & Kranton 00, 10)
- ▶ Contest theory (Konrad 10, Moldovanu et al. 07)

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▶ Experiments and empirical

- ▶ Lab (Eckel & Grossman 05, etc.)
- ▶ Field (Erev et al. 93, Ai et al. 16, etc.)
- ▶ **Surveys on group formation and contests**
 - ▶ Sheremeta (2017)
- ▶ **Surveys on identity and teams**
 - ▶ Charness & Chen (2020)
 - ▶ Shayo (2020)
 - ▶ Chowdhury (2021)

Research on the ride-sharing economy

- ▶ Labor market outcomes (Hall & Krueger 2018)
- ▶ Value of flexible work (Chevalier, Chen, Oehlsen & Rossi 2018)
- ▶ Consumer surplus (Cohen, Hahn, Hall, Levitt & Metcalfe 2019)
- ▶ Economics of apologies (Halperin, Ho, List & Muir 2019)
- ▶ Dynamic matching efficiency (Liu, Wan & Yang 2019)
- ▶ Our papers: putting organization and social relationships into the gig economy

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 - ▶ 2,100 drivers
 - ▶ team size: 7 drivers
 - ▶ 5 days
 - ▶ cash prize

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- ▶ **Team contest with pairwise battles** (Fu et al. 2015)
 - ▶ Individual prize
 - ▶ Team prize
 - ▶ Hybrid

Experiment 1: Main results

- ▶ **Team contest** increases driver revenue
 - ▶ Average treatment effect: 12%, 46 minutes longer per day
 - ▶ Driven by **responsive teams** (19%, 1.2 hours longer per day)
 - ▶ Importance of **communications**
 - ▶ Mechanisms: longer hours, same quality of service

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 - ▶ hometown similarity: most responsive
 - ▶ age similarity > random
- ▶ **Identity or cash prize?**
 - ▶ Treated drivers continue to be more productive two weeks after the contest (effect size larger for responsive teams)
 - ▶ Survey (25% response rate) and interview data: finding friends

Platform-wide Implementation

- ▶ **Shipped to production:** in 2018 alone
 - ▶ 1,548 team contests across 180 cities in China
 - ▶ 2 million drivers
- ▶ **Teams dismissed after contest:**
 - ▶ **Wasted opportunities:**
Team identity should have long-term effects
 - ▶ **Short-term contests costly**
Status contest without monetary rewards

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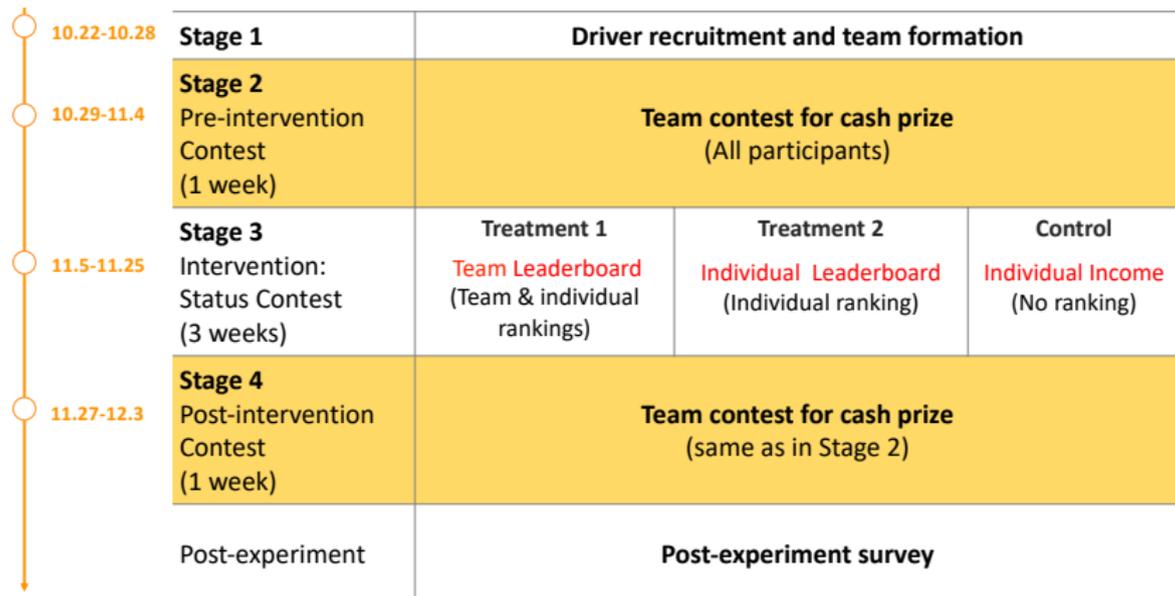
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Experimental Design



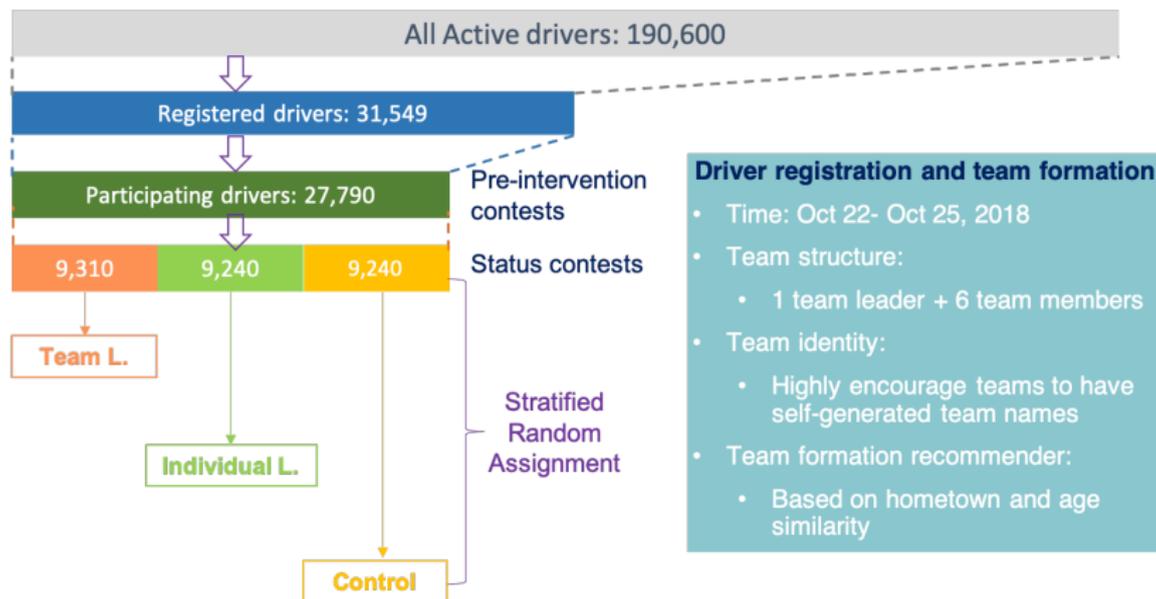
City Selection

Three cities:

- ▶ region, size
 - ▶ Beijing: 21 million
 - ▶ Taiyuan: 4 million
 - ▶ Kunming: 6 million
- ▶ order response rates
 - ▶ Beijing: 90%
 - ▶ Taiyuan: 90%
 - ▶ Kunming: 98%
- ▶ # historical team contests
 - ▶ Beijing: 17
 - ▶ Taiyuan: 14
 - ▶ Kunming: 4



Stage 1. Team Formation



- ▶ Drivers can volunteer to be team captains
- ▶ Each captain can organize a team of 7: complete (36%)
- ▶ Algorithms recommend members to incomplete teams (64%)

Stage 2. A Pre-intervention Contest

- ▶ Time: Oct 29– Nov 4, 2018
- ▶ Size of competing groups (leaderboard): 5 teams
- ▶ Contest mechanism: **Best of five** (Total revenue)
- ▶ Reward amount:
 - ▶ Keep the same *reward/city-specific income per hour rate*
 - ▶ E.g., each winning team in Beijing can get 1,000 RMB
- ▶ Performance calculation:
 - ▶ Total revenue of the top 6 drivers in a 7-driver team
- ▶ Similar to Experiment 1: enhance team identity

Stage 3. The Intervention: A Status Contest (Nov. 5–25)

Team leaderboard treatment

Ranking Within Competition Group		
#	Name	Revenue
1	Team 1	24851.4
2	Team 2	23723.2
3	Team 3	23120.9
4	Team 4	19626.6
5	Team 5	12412.8

Team 1		
#	Name	Revenue
1	Tang **	4643.2
2	Zhao *	4003.6
3	Chen **	3616.2
4	Li **	3241.6
5	Han **	2895.7
6	Mei **	2791.0
7	Wang **	1030.8

Individual leaderboard treatment

Team 1		
#	Name	Revenue
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4	Li **	3241.6
5	Han **	2895.7
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7	Wang **	1030.8

Control: Individual performance

Name	Revenue
Tang **	4643.2

Stage 3: Three Experimental Conditions

- ▶ **Team Leaderboard** Treatment: team ranking and individual ranking within a team
- ▶ **Individual Leaderboard** Treatment: individual ranking within a team
- ▶ **Control**: individual income, no ranking

Stage 4. A Post-intervention Contest

- ▶ Goal: to evaluate the spillover effects
- ▶ Time: Nov 27– Dec 3, 2018
- ▶ Who: all drivers in the sample
- ▶ Leaderboard: same as the pre-intervention contest
- ▶ Reward amount: same as the pre-intervention contest

Stage 5. Post-experiment survey

Key constructs include:

- ▶ Driver satisfaction
- ▶ Sense of team belonging
- ▶ Team bonding
- ▶ Attitude toward long-term team status
- ▶ Communication
 - ▶ Frequency
 - ▶ Media
- ▶ Participation motivation
- ▶ Perceived value of the contests

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Hypotheses (Pre-registered)

- ▶ H1 (**Average Treatment Effects**) Revenue ranking:
 - ▶ Treated drivers $>$ drivers in the control condition.
 - ▶ Team leaderboard $>$ Individual leaderboard
- ▶ H2 (**Treatment Persistence**): The same ranking holds in the post-intervention contest.
- ▶ H3 (**Retention**): Treated drivers are more likely to stay in DiDi than those in the control condition both during and post our experiment.
- ▶ H4 (**Leadership**): More productive and experienced drivers are more likely to volunteer to be team captains.

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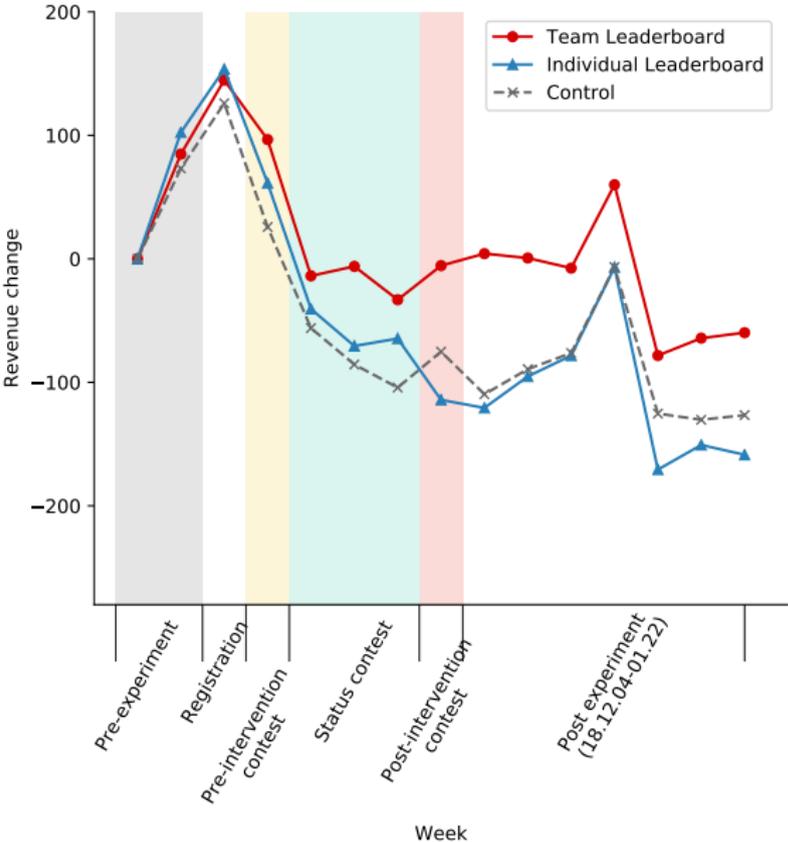
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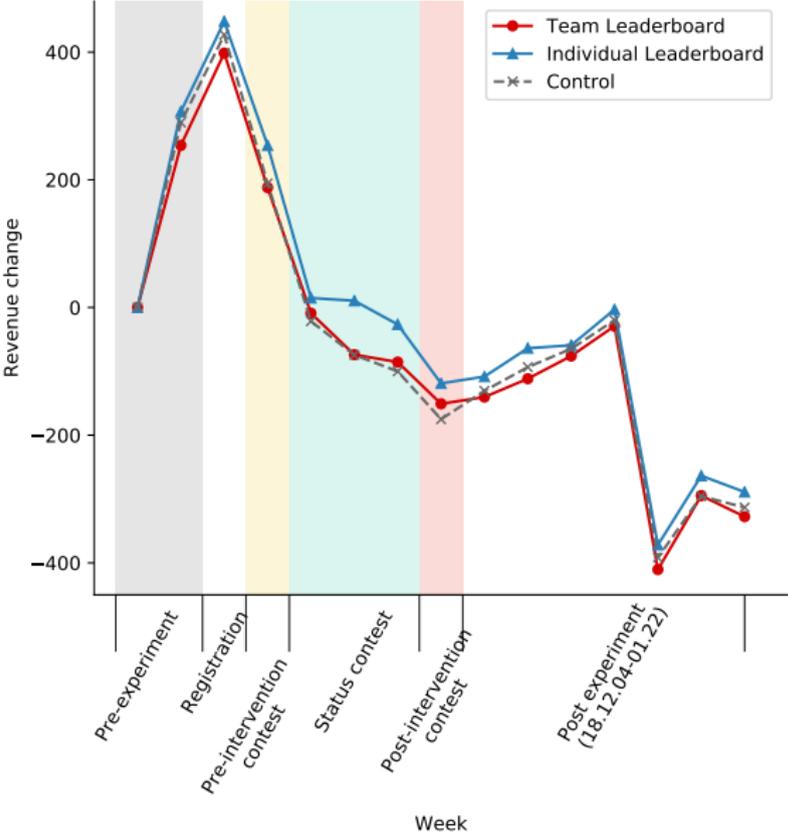
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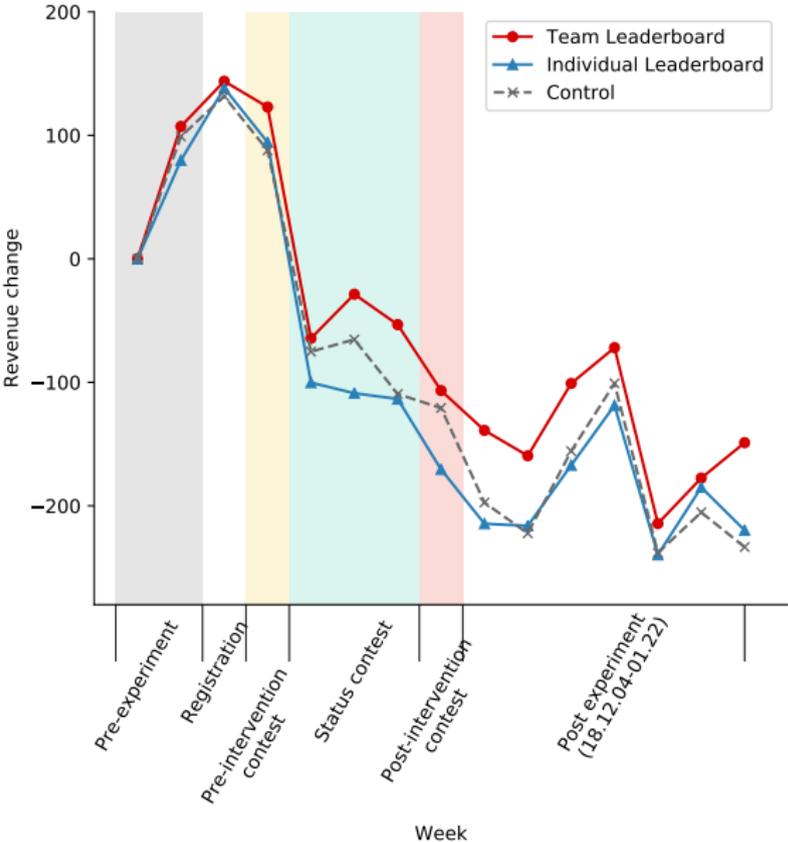
Effects of Status Contest on Revenue: Taiyuan



Effects of Status Contests on Revenue: Beijing



Effects of Status Contests on Revenue: Kunming



H1: Average Treatment Effects

H1 (ATE) Revenue ranking:

- (a) Treated drivers > drivers in the control condition.
- (b) Team leaderboard > Individual leaderboard

Difference-in-differences models:

$$\Delta Y_{i,t} = \beta_0 + \beta_1 \cdot \text{Treated} + \alpha_c + \epsilon_{i,t},$$

$$\Delta Y_{i,t} = \beta_0 + \beta_1 \cdot \text{Team Leaderboard} + \beta_2 \cdot \text{Individual Leaderboard} \\ + \alpha_c + \epsilon_{i,t},$$

- ▶ $\Delta Y_{i,t}$: outcome change in the t -th week in the current period compared to the corresponding pre-contest week
- ▶ α_c : city fixed effects

Status Contest: H1(a)

		Outcome variable: Δ of Weekly Revenue (CNY)							
		All	Beijing	Taiyuan	Kunming	All	Beijing	Taiyuan	Kunming
Treated		34.53**	41.67**	33.99	8.25	39.08**	45.82**	38.40	14.53
		(15.37)	(21.01)	(23.86)	(24.97)	(15.31)	(20.93)	(23.69)	(24.81)
		[0.03]	[0.17]	[0.18]	[0.33]	[0.01]	[0.09]	[0.12]	[0.23]
Age					6.98***	7.47***	1.90	8.39***	
					(0.83)	(1.17)	(1.37)	(1.27)	
DiDi age					32.16***	40.85***	3.64	3.43	
					(7.47)	(9.59)	(11.53)	(13.39)	
Hometown distance					-0.02	-0.01	-0.12**	-0.03	
					(0.02)	(0.02)	(0.05)	(0.02)	
Self-formed team					-45.25***	-60.09***	-24.18	-4.10	
					(16.09)	(21.59)	(27.49)	(26.90)	
City FE	yes	-	-	-	yes	-	-	-	
# of clusters	11,890	8,100	1,625	2,165	11,890	8,100	1,625	2,165	
# of drivers	27,790	18,900	3,815	5,075	27,790	18,900	3,815	5,075	

Standard errors are clustered at the team (individual) level for treatment (control) conditions. FDR q -values are in square brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Status Contest: H1(b)

Outcome variable: Δ of Weekly Revenue (CNY)								
	All	Beijing	Taiyuan	Kunming	All	Beijing	Taiyuan	Kunming
Team LB	32.12*	27.03	58.49**	30.54	36.70**	32.40	62.31**	33.81
(β_1)	(17.97)	(24.61)	(26.60)	(29.91)	(17.90)	(24.50)	(26.57)	(29.69)
	[0.08]	[0.44]	[0.09]	[0.44]	[0.04]	[0.33]	[0.06]	[0.34]
Individual LB	36.96**	56.32**	8.81	-14.50	41.47**	59.24**	13.68	-5.18
(β_2)	(17.90)	(24.49)	(28.76)	(28.03)	(17.82)	(24.37)	(28.43)	(27.86)
	[0.08]	[0.09]	[0.86]	[0.86]	[0.04]	[0.06]	[0.61]	[0.62]
Age					6.98***	7.47***	1.91	8.35***
					(0.83)	(1.17)	(1.37)	(1.28)
DiDi age					32.15***	40.77***	3.57	3.29
					(7.46)	(9.59)	(11.57)	(13.39)
Hometown distance					-0.02	-0.01	-0.12**	-0.03
					(0.02)	(0.02)	(0.05)	(0.02)
Self-formed team					-45.22***	-59.76***	-23.62	-3.96
					(16.10)	(21.59)	(27.40)	(26.91)
City FE	yes	-	-	-	yes	-	-	-
$H_0: \beta_1 = \beta_2$	0.7933	0.2487	0.0782*	0.1274	0.7954	0.2877	0.0828*	0.1832

Status Contest Results

Result 1 (Virtual teams and productivity). During the status contest intervention,

- ▶ treated drivers generate **1.7%** higher revenue than those in the control condition;
- ▶ drivers under team leaderboard generate **1.8%** higher revenue than those in the control condition;
- ▶ drivers under individual leaderboard generate **2%** higher revenue than those in the control condition;
- ▶ at the city level
 - ▶ **Taiyuan**: team leaderboard leads to a **5.3%** increase in driver revenue;
 - ▶ **Beijing**: individual leaderboard leads to a **2.3%** increase in revenue;
 - ▶ **Kunming**: neither treatment has a significant effect.

Result 2: Treatment Persistence (H2)

	Outcome: Δ of Weekly Revenue (CNY)			
	(1)	(2)	(3)	(4)
	All	Beijing	Taiyuan	Kunming
Team Leaderboard (β_1)	49.91** (23.80) [0.08]	59.89* (32.49) [0.32]	58.03 (37.50) [0.32]	6.05 (39.57) [0.56]
Individual Leaderboard (β_2)	11.75 (24.30) [0.46]	38.98 (33.12) [0.32]	-68.26* (39.25) [0.32]	-30.36 (39.52) [0.36]
$H_0: \beta_1 = \beta_2$	0.11	0.53	0.002***	0.33
# of clusters	3,970	2,700	545	725
# of drivers	27,790	18,900	3,815	5,075

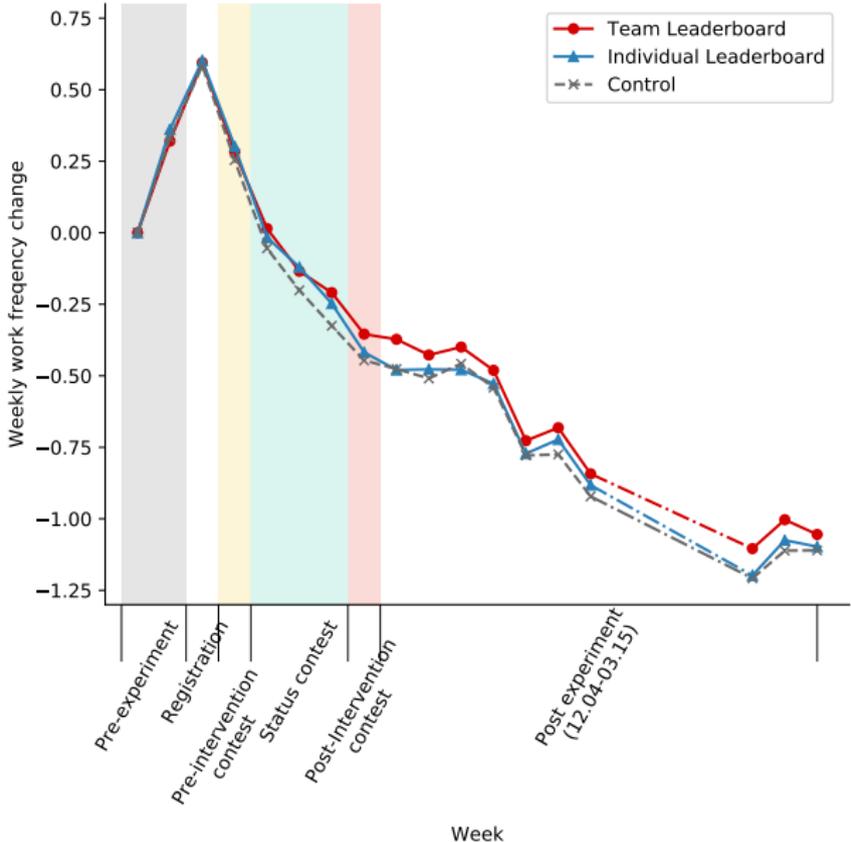
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Standard errors in parentheses are clustered at team level. False Discovery Rate adjusted q -values are reported in square bracket.

Result 2: Treatment Persistence

Result 2. During the one-week post-intervention contest, treated drivers in the team (individual) leaderboard condition continue to generate 2.49% more (the same) weekly revenue compared to those in the control condition.

Effects of Status Contests on Retention



Retention: One Week After Experiment

	Outcome: Δ of weekly # of work days			
	(1)	(2)	(3)	(4)
	All	Beijing	Taiyuan	Kunming
Team Leaderboard	0.11***	0.05	0.39***	0.14
	(0.04)	(0.05)	(0.11)	(0.09)
	[0.01]	[0.61]	[0.002]	[0.46]
Individual Leaderboard	-0.03	-0.01	-0.01	-0.12
	(0.04)	(0.05)	(0.11)	(0.09)
	[0.30]	[0.90]	[0.90]	[0.55]
$H_0: \beta_1 = \beta_2$	0.0004***	0.24	0.0002***	0.01
# of drivers	27,790	18,900	3,815	5,075

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Standard errors in parentheses are clustered at team level. False Discovery Rate adjusted q -values are reported in square bracket.

Retention: Three Months After Experiment

	Outcome variable: Δ of weekly # of work days					
	All	Beijing	Taiyuan	Kunming	All	Beijing
Team	0.10**	0.06	0.33***	0.05	0.11**	0.08
Leaderboard	(0.05)	(0.06)	(0.12)	(0.10)	(0.04)	(0.05)
	[0.06]	[1.00]	[0.03]	[1.00]	[0.02]	[0.50]
Individual	-0.01	-0.01	-0.02	0.01	0.01	-0.01
Leaderboard	(0.05)	(0.06)	(0.12)	(0.10)	(0.04)	(0.05)
	[0.70]	[1.00]	[1.00]	[1.00]	[0.77]	[1.00]
Age					0.03***	0.03*
					(0.00)	(0.00)
DiDi age					0.22***	0.24*
					(0.02)	(0.02)
Hometown distance					-0.00***	-0.00*
to contest city					(0.00)	(0.00)
Self-formed					-0.07*	-0.16*
Team					(0.04)	(0.05)
Team won in post-					0.66***	0.68*
intervention contest					(0.05)	(0.06)
City fixed effect	yes	-	-	-	yes	-
$H_0: \beta_1 = \beta_2$ (p -value)	0.0161**	0.1656	0.0026***	0.6569	0.0179**	0.122
# of drivers	27,790	18,900	3,815	5,075	27,790	18,900

False Discovery Rate adjusted q -values are reported in square brackets.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Result 3: Retention

Result 3. For up to **three months** after the experiment,

- ▶ Drivers in the **team leaderboard treatment** work an average of **one hour longer per week** than those in the control condition;
- ▶ Taiyuan drivers in the team leaderboard treatment work **three hours longer per week**;
- ▶ Treated drivers in Beijing and Kunming do not behave differently from those in the control condition.

Result 4: Who Wants to Be Team Captain?

	DV: Whether a driver volunteered to lead			
	(1) All	(2) Beijing	(3) Taiyuan	(4) Kunming
Pre-experiment revenue (in 1000 RMB)	0.0044*** (0.0007) [0.001]	0.0040*** (0.0008) [0.001]	0.0066** (0.0030) [0.012]	0.0084*** (0.0023) [0.001]
Served as captain before	0.2232*** (0.0039) [0.001]	0.2205*** (0.0041) [0.001]	0.2336*** (0.0168) [0.001]	0.2172*** (0.0111) [0.001]
Didi age (in years)	0.0137*** (0.0020) [0.001]	0.0205*** (0.0023) [0.001]	-0.0141** (0.0060) [0.009]	0.0011 (0.0052) [0.102]
# of drivers	27,790	18,900	3,815	5,075

Average marginal effect computed using the Delta Method; SE in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Robustness Checks

- ▶ Excluding captains: All results hold
- ▶ Above- versus below-median drivers

Post-Experiment Survey

- ▶ **Survey:** 15% response rate
 - ▶ captain (8 pp)
 - ▶ winning team in first short term contest (5 pp)
 - ▶ winning team in surprise short term contest (10 pp)
 - ▶ hometown distance (-), age, DiDi age

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- ▶ **Liked the contest:** 92%
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 - ▶ making friends (61%)
 - ▶ a sense of honor from winning (61%)

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- ▶ **Liked the contest:** 92%
 - ▶ team belonging (65%)
 - ▶ making friends (61%)
 - ▶ a sense of honor from winning (61%)
- ▶ **Communication**
 - ▶ WeChat (80%)
 - ▶ Phone (52%)
 - ▶ Text message (33%)
 - ▶ Face to face (25%)

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 - ▶ **Individual leaderboard**: significant effect in Beijing, and overall

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- ▶ **Retention**
 - ▶ **Team leaderboard**: significant effect overall and in Taiyuan
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- ▶ **Emotional well-being**
 - ▶ Being connected with other drivers
 - ▶ Learning from experience drivers
 - ▶ Finding friends