Effective Training Through a Mobile App

Evidence from a Randomized Field Experiment

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December 3, 2021

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Adoption of New Technology and Better Farming Practices Have Challenges

- Farmers in developing countries usually lack access to vital resources and services

- Agricultural extension services are important to overcome these deficiencies (including technical training)
  - Can reduce poverty by providing information and transferring knowledge to farmers (Anderson and Feder 2004, Nakasone et al. 2014)

- However, traditional extension services have high fixed and recurrent financial costs (Quizon et al. 2001, ICRAF 2018)
  - They limit their scalability and efficiency

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Rapid Expansion of ICTs Offers Great Potential

- ICT-based solutions may be an effective way of knowledge delivery rural setting
  - Radio, television, computer, mobile phones, etc.
  - May help increase farmers' awareness of improved practices

- Mobile phones are one of the fastest-growing and most widespread forms of ICT
  - 83% of adults in developing counties have a mobile phone (Gallup World Poll 2018)

- The roll-out of extension programs though ICTs is still in an early stage

- Little research is available regarding such programs' impacts (Nakasone et al. 2014)
  - Voice messages (Cole and Fernando 2021, Walter et al. 2021)
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Is Technical Training Through A Mobile App An Effective Method?

- We provide farmers technical training through an easy-to-use mobile application
  - Certain kinds of information may be too complicated to convey by text or voice (Fabregas et al., 2019)
  - Our mobile app addresses this issue by effectively communicate through videos
  - The app records what, when, and how long a farmer watched each video in our app

- We also provided aspirational videos via the same app
  - Aspiration videos may enhance farmers' psychological well-being (Ridley et al. 2020)
  - Could also facilitate learning among farmers (Fabregas et al., 2019)

- We do an experiment to examine whether the training improves farmers' knowledge and grape quality

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Study Setting

- Our study takes place in the city of Beizhen in Liaoning, China
  - China has the most mobile app downloads in the world
  - Cost of accessing the internet is low and 98% of rural villages have internet coverage

- We partner with the Beizhen government
  - Beizhen is a famous grape town and the largest grape fresh storage base in China
  - The Government is interested in improving the price small grape farmers receive
  - Commissioned Shenyang Agricultural University to find ways to improve the grape quality

- SAU developed training modules that would help farmers improve grape sweetness
  - But delivery is a challenge because of time and money cost
  - We developed a mobile-app to deliver the training distantly

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Mobile App Interface

Preview of Results

- Technical training through our mobile app
  - Improves farmers' knowledge
    - Technical test score ↑ 0.52 SDs
  - Farmers believe that their grapes are sweeter
    - Sweetness assessment ↑ 0.51 SDs
  - Helps them enhance the quality of their produce
    - Intent-to-treat (ITT): Grape sweetness ↑ 0.30 SDs
    - Treatment-on-the-treated (TOT): Grape sweetness ↑ 0.55 SDs

- Larger effects for higher percentage of videos watched
  - Would find puzzling results if we are not able to observe app usage

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- Technical videos only (T1)
  - A series of videos on grape farming techniques to increase grape quality
  - One to three minutes in length
  - Curated to be relevant to the farmers' particular needs at each stage of the grape-growing period

- Technical videos and aspiration videos (T2)
  - T1 plus aspirational videos promoting the practice of growing of high-quality grapes
  - Aspiration videos feature established farmers
  - Stories of their successful experience raising the quality of their grapes

- Placebo videos (C)
  - Nothing of T1 or T2
  - Featuring the local history of the grape industry and natural landscapes of the region
  - Released to all farmers at different points throughout the study period

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  - Stories of their successful experience raising the quality of their grapes

- Placebo videos (C)
  - Nothing of T1 or T2
  - Featuring the local history of the grape industry and natural landscapes of the region
  - Released to all farmers at different points throughout the study period

Intervention

- Technical videos only (T1)
  - A series of videos on grape farming techniques to increase grape quality
  - One to three minutes in length
  - Curated to be relevant to the farmers' particular needs at each stage of the grape-growing period

- Technical videos and aspiration videos (T2)
  - T1 plus aspirational videos promoting the practice of growing of high-quality grapes
  - Aspiration videos feature established farmers
  - Stories of their successful experience raising the quality of their grapes

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  - Nothing of T1 or T2
  - Featuring the local history of the grape industry and natural landscapes of the region
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Randomization

- Random treatment assignment happened before the grape planting season
- Unit of randomization is the zu (sub-village) of residence
- 1,026 farmers from 116 zus at the baseline
  - All have mobile phones with access to the internet
  - All have experience using mobile video app
- Randomly assigned into three groups
  - Technical videos only (T1): 39 clusters; N = 324
  - Technical videos and aspiration videos (T2): 39 clusters; N = 332
  - Placebo videos (C): 38 clusters; N = 370

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Estimation Strategy

$$y_{iz} = \beta_0 + \beta_1 T1_z + \beta_2 T2_z + X'_{iz}\delta + \varepsilon_{iz}$$

- y_{iz} is the outcome of interest measured at endline for farmer i in zu z
- $T1_z$ is technical training only arm
- $T2_z$ is technical training and aspiration arm
- X_{iz} includes baseline characteristics
- Cluster SEs by zu (level of treatment).

Treatment-on-the-treated (TOT)

First Stage:

$$k_{iz} = \alpha_0 + \alpha_1 D_z + X_{iz}^{'}\lambda + \nu_{iz}$$

Second Stage:

$$y_{iz} = \beta_0 + \beta_1 \hat{k}_{iz} + X_{iz}^{'}\delta + \varepsilon_{iz}$$

- k_{iz} is farmer i's score on knowledge test at endline
- $D_z \in \{T1_z, T2_z\}$ is an indicator for treatment status for the respective treatment group
- Estimation of TOT is restricted only to a treatment group and the control group

Motivation

Research Question

Study Design

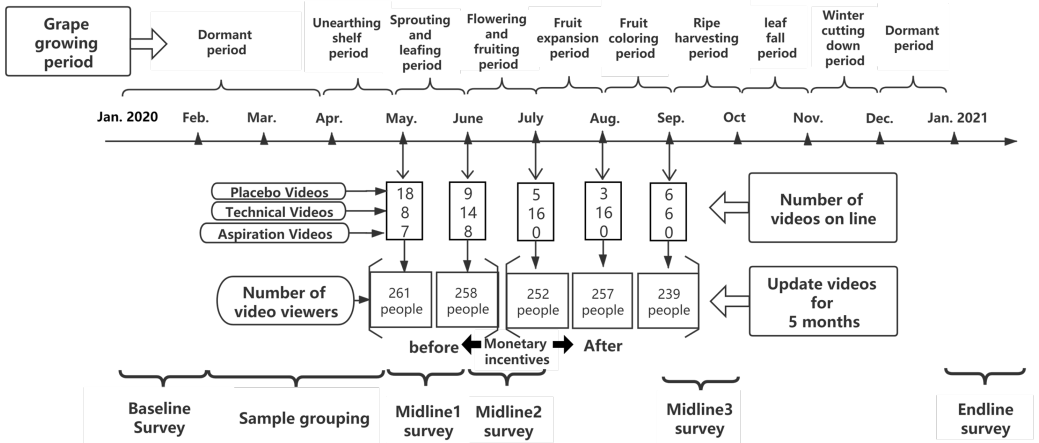
Empirical Framework

Data and Sample

Results

Take Away

Data Collection Timeline



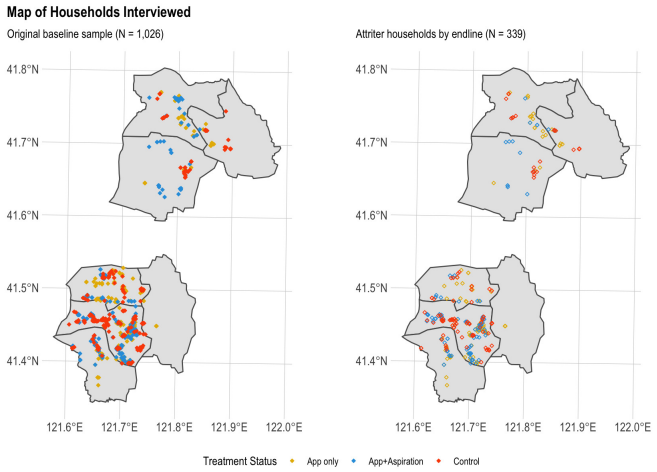
Baseline Sample Farmers Share Similar Characteristics...

	(1) C	(2) T1	(3) T2	(4) *p*-value from test of (1)=(2)=(3)
Panel A: Farmer Characteristics				
Male (=1)	0.67	0.72	0.70	0.532
Age (in years)	47.80	46.53	47.72	0.175
Completed middle school or above (=1)	0.62	0.67	0.58	0.069*
Has a good health (=1)	0.43	0.46	0.36	0.118
Household size	3.79	3.87	3.80	0.734
Has training experience (=1)	0.31	0.35	0.30	0.583
IHS(Total household income)	11.27	11.61	11.23	0.100*
Years of grape planting	21.50	21.45	21.48	0.999
Grape planting area (acre)	1.74	1.94	1.82	0.347
IHS(Grape yield)	10.92	11.00	11.09	0.617
IHS(Revenue from grape)	9.39	10.41	9.26	0.018**
IHS(Average grape sales price)	1.34	1.34	1.28	0.418
N	370	324	332	
Cluster	38	39	39	

...and Have Similar Outcomes

	(1) C	(2) T1	(3) T2	(4) *p*-value from test of (1)=(2)=(3)
Panel B: Outcomes Variables				
Test score (standardized)	0.00	-0.09	-0.11	0.523
Self assessed sweetness (standardized)	-0.00	0.07	0.11	0.595
Self assessed count (standardized)	-0.00	0.09	-0.01	0.552
Self assessed weight (standardized)	-0.00	0.23	-0.06	0.058*
IHS(Aspired income in 3 years)	11.37	11.78	11.91	0.119
Aspired sweetness in 3 years (standardized)	-0.00	-0.11	0.08	0.125
IHS(Aspired income in 5 years)	10.21	11.27	10.73	0.125
Aspired sweetness in 5 years (standardized)	-0.00	-0.06	0.08	0.322
N	370	324	332	
Cluster	38	39	39	
p-value from joint test of equality				
C=T1				0.007***
C=T2				0.148
T1=T2				0.016**

Study Households



Relatively Large Attrition, but Similar Across Arms

	(1) Missing at Midline	(2) Missing at Endline
T1	0.053	0.016
	(0.037)	(0.038)
T2	0.049	0.045
	(0.039)	(0.038)
Observations	1,026	1,026
Control-group mean	0.222	0.311
T1=T2 (*p*-value)	0.931	0.515

Measurement of Sweetness

Motivation

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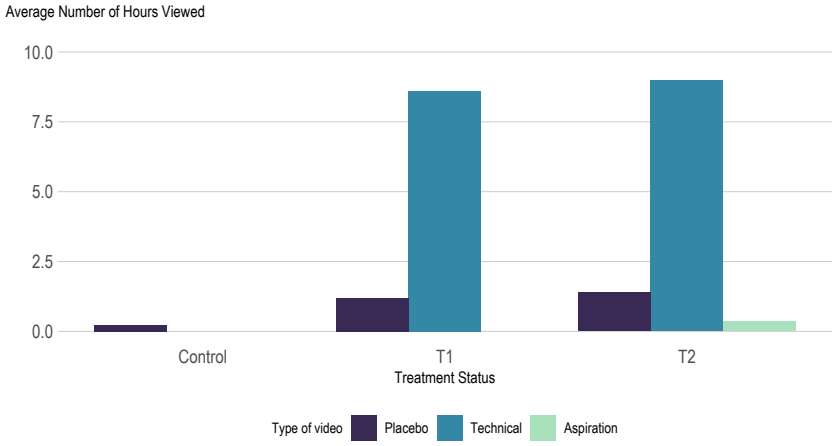
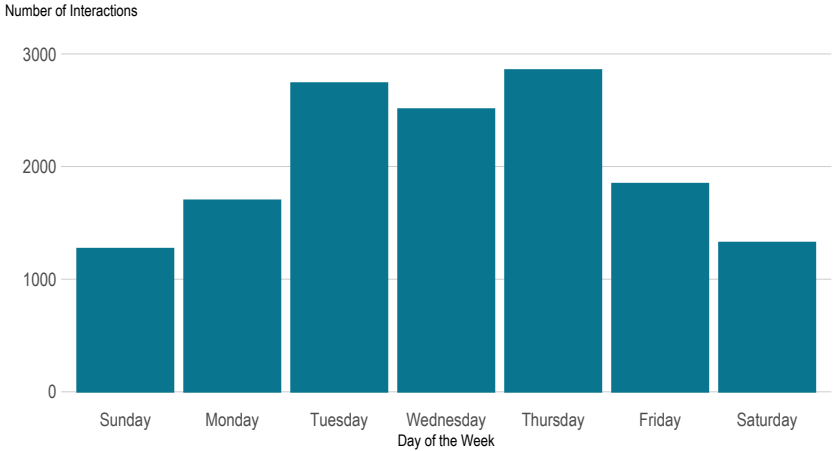
Treated Farmers Spent More Time on The App



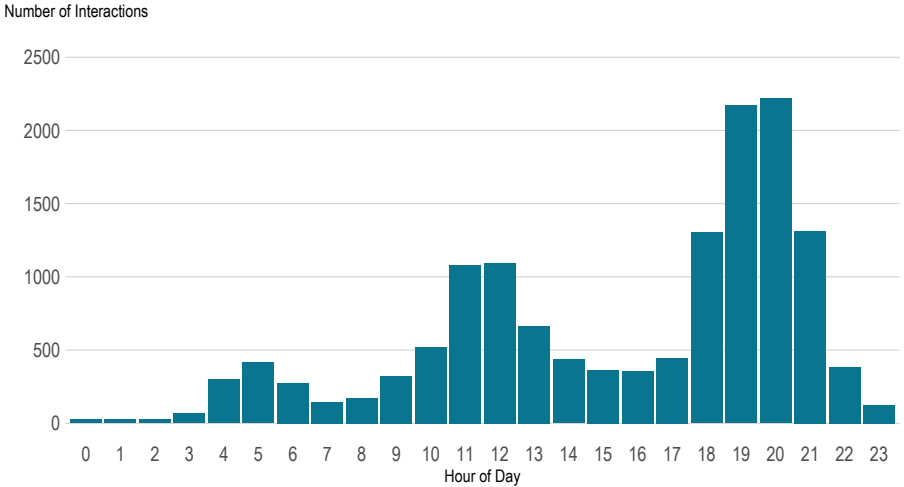
Note: Average hours viewed by all farmers. Each viewing instance is topcoded at twice the length of the video. Includes farmers surveyed at endline only.

Farmers Watched Videos During Weekdays



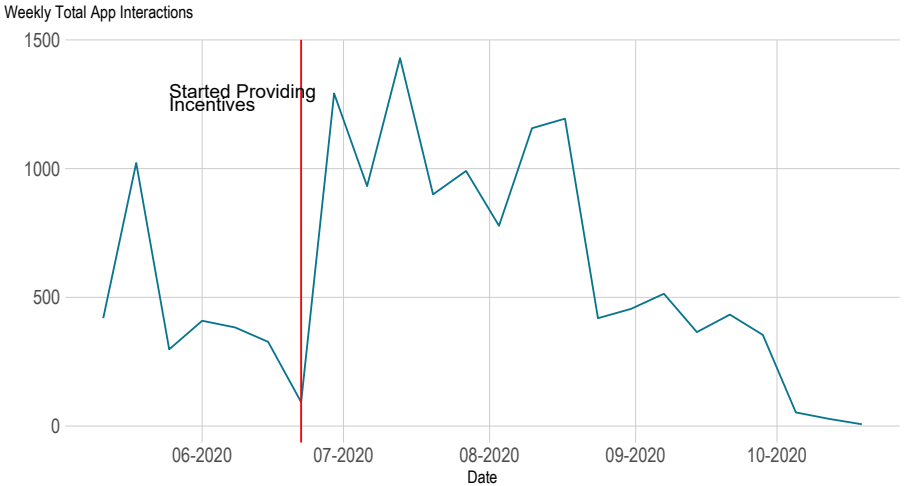
Note: Each interaction with the app is a video click by the user.

And After Work



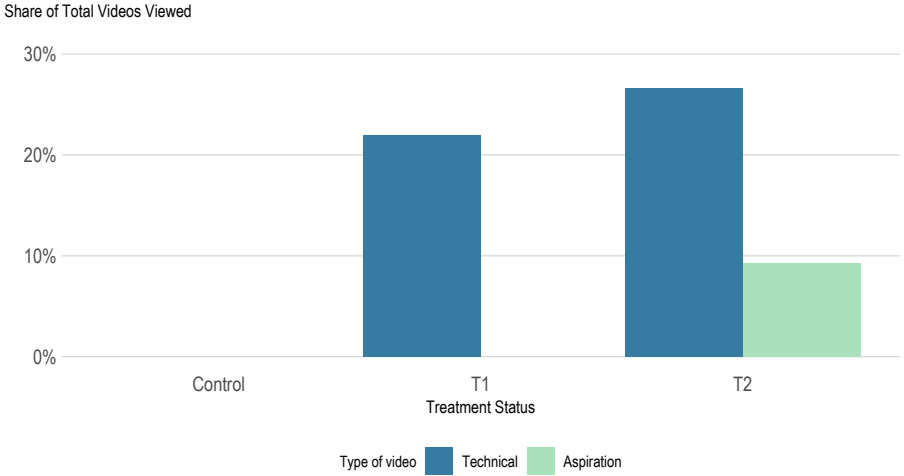
Note: Each interaction with the app is a video click by the user.

We Paid 2 RMB (0.3 USD) Per Videos to Increase Watching



Note: Each interaction is a video click by the user.

Still Relatively Low Share of Videos Watched



Note: Average share of videos viewed. Includes farmers surveyed at endline only.

Farmers Watched Videos Throughout the Study Period

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Technical Video				Aspirational Video		
	Overall	May	June	July	August	Overall	May	June
T1	0.222***	0.077***	0.172***	0.295***	0.253***	0.000***	0.000***	-0.000***
	(0.019)	(0.012)	(0.017)	(0.026)	(0.027)	(0.000)	(0.000)	(0.000)
T2	0.266***	0.090***	0.188***	0.356***	0.314***	0.093***	0.095***	0.091***
	(0.019)	(0.012)	(0.020)	(0.026)	(0.022)	(0.012)	(0.013)	(0.015)
Observations	687	687	687	687	687	687	687	687
Control-group mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
T1=T2 (p-value)	0.104	0.463	0.554	0.098	0.083	0.000	0.000	0.000

Both Interventions Increase Knowledge Test Scores

	(1) Standardized Test Score (All 10 questions)	(2) Standardized Test Score (Repeated 5 questions)
T1	0.520***	0.371***
	(0.097)	(0.095)
T2	0.451***	0.413***
	(0.102)	(0.083)
Observations	687	687
Control-group mean	0.000	0.000
T1=T2 (p-value)	0.492	0.572

Knowledge Increases More for Farmers Who Watch More Videos

	(1) Standardized Test Score (All 10 questions)	(2) Standardized Test Score (All 10 questions)	(3) Standardized Test Score (Repeated 5 questions)	(4) Standardized Test Score (Repeated 5 questions)
T1	1.133***	0.850***	0.488***	0.362***
	(0.083)	(0.103)	(0.088)	(0.104)
T2	1.052***	0.883***	0.527***	0.447***
	(0.093)	(0.096)	(0.064)	(0.072)
T1 x Demeaned Techinical Video Watched	0.056***	0.041***	0.016***	0.010**
	(0.003)	(0.005)	(0.003)	(0.004)
T2 x Demeaned Techinical Video Watched	0.054***	0.038***	0.015***	0.007*
	(0.003)	(0.005)	(0.003)	(0.004)
Observations	687	687	687	687
R-squared	0.090	0.199	0.080	0.128
Baseline Knowledge	Yes	Yes	Yes	Yes
Farmer Controls	No	Yes	No	Yes
Grape Controls	No	Yes	No	Yes
T1 + T1 x Techinical Video Watched %	0.000	0.000	0.000	0.000
T2 + T2 x Techinical Video Watched %	0.000	0.000	0.000	0.000

App ↑es sweetness, but not when bundled with aspiration

	(1) Sweetness	(2) Count	(3) Weight
T1	0.297**	0.138	-0.114
	(0.132)	(0.117)	(0.103)
T2	0.099	0.010	-0.154
	(0.109)	(0.121)	(0.116)
Observations	679	679	679
Control-group mean	0.000	0.000	0.000
T1=T2 (p-value)	0.150	0.364	0.720

Larger Increase of Sweetness of Those Whose Knowledge Increased

	(1) Sweetness (T1)	(2) Sweetness (T2)
Standardized Test Score	0.554* (0.294)	0.218 (0.241)
Observations	467	466
Control-group mean	0.000	0.000

Headline Findings Remain The Same When We Pick Controls Using ML

	(1) Standardized Test Score (All 10 questions)	(2) Standardized Test Score (Repeated 5 questions)	(3) Sweetness	(4) Count	(5) Weight
T1	0.477***	0.340***	0.301**	0.143	-0.060
	(0.094)	(0.097)	(0.131)	(0.119)	(0.119)
T2	0.489***	0.405***	0.098	0.008	-0.165
	(0.097)	(0.085)	(0.111)	(0.124)	(0.134)
Observations	687	687	679	679	679
Control-group mean	0.000	0.000	0.000	0.000	0.000
T1=T2 (p-value)	0.895	0.380	0.142	0.350	0.440

Why is Bundling Not Working?

- Not effective?
- Black box?

T2 Farmers Have A Slight Increase in 3-year Aspiration for Sweetness

	(1)	(2)	(3)	(4)
	3-year aspiration		5-year aspiration	
	IHS(Income)	Sweetness	IHS(Income)	Sweetness
T1	0.103	0.125	0.101	0.101
	(0.080)	(0.107)	(0.089)	(0.095)
T2	0.028	0.186*	0.034	0.095
	(0.094)	(0.107)	(0.094)	(0.096)
Observations	686	684	685	684
Control-group mean	12.215	0.000	12.392	0.000
T1=T2 (p-value)	0.404	0.562	0.475	0.946

Treated Farmers' Believe Their Grapes Are Sweeter

	(1) Sweetness	(2) Count	(3) Weight
T1	0.474***	0.173*	0.213**
	(0.092)	(0.103)	(0.105)
T2	0.510***	0.039	0.149
	(0.086)	(0.093)	(0.106)
Observations	687	687	687
Control-group mean	0.000	0.000	0.000
T1=T2 (p-value)	0.666	0.202	0.576

Actual Sweetness Increases for Farmers Who Watched Video

	(1) Sweetness	(2) Sweetness	(3) Sweetness	(4) Sweetness
T1	0.596***	0.303**	0.594***	0.621***
	(0.121)	(0.132)	(0.121)	(0.121)
T2	0.403***	0.236**	0.545***	0.527***
	(0.100)	(0.106)	(0.095)	(0.113)
T1 x Demeaned Techinical Video Watched %	0.024***		0.024***	0.024***
	(0.003)		(0.003)	(0.005)
T2 x Demeaned Techinical Video Watched %	0.023***		0.022***	0.022***
	(0.004)		(0.004)	(0.006)
T2 x Demeaned Aspirartional Video Watched %		0.057***	0.056***	0.052***
		(0.008)	(0.009)	(0.012)
Observations	679	679	679	679
R-squared	0.023	0.021	0.024	0.048
Baseline Knowledge	Yes	Yes	Yes	Yes
Baseline Aspirations	Yes	Yes	Yes	Yes
Farmer Controls	No	No	No	Yes
Grape Controls	No	No	No	Yes
T1 + T1 x Techinical Video Watched %	0.000		0.000	0.000
T2 + T2 x Techinical Video Watched %	0.000		0.000	0.000
T1 + T1 x Aspirartional Video Watched %		0.024	0.000	0.000
T2 + T2 x Aspirartional Video Watched %		0.005	0.000	0.000

Yield and Sales Revenue Also Increases for Treatment Farmers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	IHS(Yield)	IHS(Yield)	IHS(Yield)	IHS(Yield)	IHS(Yield)	IHS(Sales Revenue)	IHS(Sales Revenue)	IHS(Sales Revenue)	IHS(Sales Revenue)	IHS(Sales Revenue)
T1	0.070	0.414***	0.070	0.421***	0.189***	0.269	0.500***	0.270	0.512***	0.209
	(0.093)	(0.070)	(0.093)	(0.070)	(0.066)	(0.177)	(0.125)	(0.178)	(0.125)	(0.152)
T2	0.072	0.439***	0.093	0.452***	0.166**	-0.126	0.148	-0.038	0.198	-0.126
	(0.106)	(0.089)	(0.096)	(0.082)	(0.068)	(0.225)	(0.197)	(0.224)	(0.195)	(0.241)
T1 x Demeaned Techinical Video Watched %		0.025***		0.026***	0.014***		0.019***		0.019***	0.003
		(0.003)		(0.003)	(0.002)		(0.005)		(0.005)	(0.008)
T2 x Demeaned Techinical Video Watched %		0.023***		0.024***	0.014***		0.014*		0.023***	0.007
		(0.003)		(0.003)	(0.002)		(0.008)		(0.008)	(0.009)
T2 x Demeaned Aspirartional Video Watched %			-0.008	-0.007	-0.041***			-0.033	-0.040*	-0.070***
			(0.006)	(0.007)	(0.007)			(0.020)	(0.024)	(0.026)
Observations	687	687	687	687	687	687	687	687	687	687
R-squared	0.015	0.016	0.018	0.021	0.430	0.101	0.101	0.109	0.110	0.154
Baseline Knowledge	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Baseline Aspirations	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Farmer Controls	No	No	No	No	Yes	No	No	No	No	Yes
Grape Controls	No	No	No	No	Yes	No	No	No	No	Yes
T1 + T1 x Techinical Video Watched %		0.000		0.000	0.003		0.000		0.000	0.167
T2 + T2 x Techinical Video Watched %		0.000		0.000	0.010		0.401		0.252	0.621
T1 + T1 x Aspirartional Video Watched %			0.452	0.000	0.005			0.133	0.000	0.170
T2 + T2 x Aspirartional Video Watched %			0.359	0.000	0.072			0.735	0.395	0.426

Motivation

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Take Away

Providing Training Through Apps Is An Effective Delivery Mechanism

- Technical training through mobile app improves farmers' knowledge

- Also helps them enhance the quality of their produce
  - Can be an effective alternative to traditional extension service

- Cost of our whole experiment, including developing the app and watch bonuses
  - T1: $ 27.5 and T2: $ 31.7 per farmer
  - Average cost diminishes as the longer the farmers use the app

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Thank You!

Appendix

Sample Coverage