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Measuring Risk Aversion to Guide Policy: Naturalistic Tasks and Respondents

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Risk Attitudes and Risk Perceptions

- Congestion creates a risk of travel time delays
- Choices over how to travel depends on perceptions of and attitudes to risk:
  - Mode choice: public or private
  - Departure time choice: avoiding rush hours
  - Route choice: priced or non-priced routes
- To predict responses to congestion pricing it is important to have good measures of risk attitudes

Almost everyone is risk averse in common activities

- including route choices while driving

Predicting route choices while assuming drivers are risk neutral can lead to significant errors

How large can these errors be?

- If a safe (uncongested) route is valued at $2
  - The value of getting to the destination
  - Minus the cost of getting there
  - Including the time I use
  - And tolls I pay

How large can these errors be?

- If a safe (uncongested) route is valued at $2

> and a risky (congested) one has a uniform distribution between $0.25 and $6

How large can these errors be?

- If a safe (uncongested) route is valued at $2
- and a risk (congested) one has a uniform distribution between $0.25 and $6

> If we assume risk neutrality rather than risk aversion

- Using the estimated risk aversion from this study

How large can these errors be?

We would overestimate the propensity to use the congested route by 40%

How can we predict route choices?

- Instead of expensive and difficult observations in actual traffic
- We can measure risk attitudes of drivers in simpler laboratory settings
  - Once a person knows the extent of the risk, attitudes to risk are stable across many tasks

A Laboratory Study of Risk Attitudes

- Comparing risk attitudes in monetary lottery choices
- to risk attitudes in driving simulator route choices

- AND

- Comparing drivers recruited from the driving population in Atlanta and Orlando
- to students

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Eliciting risk attitudes from lotteries

Safer lottery: 0.9*$2 + 0.1*$3=$2.10

Prob of High Prize	Safe Low Prize	Safe High Prize	Risky Low Prize	Risky High Prize	Safe Expected Value	Risky Expected Value
0.1	$2	$3	$0.25	$5	$2.10	$0.725

Eliciting risk attitudes from lotteries

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Riskier lottery: 0.9*$0.25 + 0.1*$5=$0.725

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Risk Neutral person cares only about Expected Value:
chooses the option with the largest Expected Value

Eliciting risk attitudes from lotteries

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0.1	$2	$3	$0.25	$5	$2.10	$0.725
0.3	$2	$3	$0.25	$5	$2.30	$1.675

Eliciting risk attitudes from lotteries

Prob of High Prize	Safe Low Prize	Safe High Prize	Risky Low Prize	Risky High Prize	Safe Expected Value	Risky Expected Value
0.1	$2	$3	$0.25	$5	$2.10	$0.725
0.3	$2	$3	$0.25	$5	$2.30	$1.675
0.5	$2	$3	$0.25	$5	$2.50	$2.625

Choice pattern for risk neutral person

Prob of High Prize	Safe Low Prize	Safe High Prize	Risky Low Prize	Risky High Prize	Safe Expected Value	Risky Expected Value
0.1	$2	$3	$0.25	$5	$2.10	$0.725
0.3	$2	$3	$0.25	$5	$2.30	$1.675
0.5	$2	$3	$0.25	$5	$2.50	$2.625
0.7	$2	$3	$0.25	$5	$2.70	$3.575
0.9	$2	$3	$0.25	$5	$2.90	$4.525

A risk neutral person would always choose the highest expected value

Choice pattern for risk averse person

Prob of High Prize	Safe Low Prize	Safe High Prize	Risky Low Prize	Risky High Prize	Safe Expected Value	Risky Expected Value
0.1	$2	$3	$0.25	$5	$2.10	$0.725
0.3	$2	$3	$0.25	$5	$2.30	$1.675
0.5	$2	$3	$0.25	$5	$2.50	$2.625
0.7	$2	$3	$0.25	$5	$2.70	$3.575
0.9	$2	$3	$0.25	$5	$2.90	$4.525

A risk averse person may want to avoid the risk of getting only $0.25 by foregoing $0.125 in Expected Value

Choice pattern for risk averse person

Prob of High Prize	Safe Low Prize	Safe High Prize	Risky Low Prize	Risky High Prize	Safe Expected Value	Risky Expected Value
0.1	$2	$3	$0.25	$5	$2.10	$0.725
0.3	$2	$3	$0.25	$5	$2.30	$1.675
0.5	$2	$3	$0.25	$5	$2.50	$2.625
0.7	$2	$3	$0.25	$5	$2.70	$3.575
0.9	$2	$3	$0.25	$5	$2.90	$4.525

An extremely risk averse person may want to avoid the risk of getting only $0.25 by foregoing as much as $1.625 in Expected Value

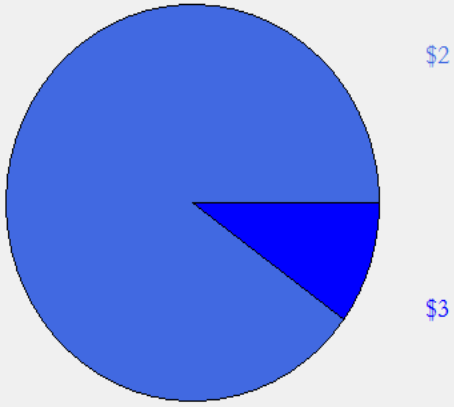
The pattern of choices reveals the risk attitude of the person

Visual presentation of lotteries

ID: test

Decision number 1

Option A

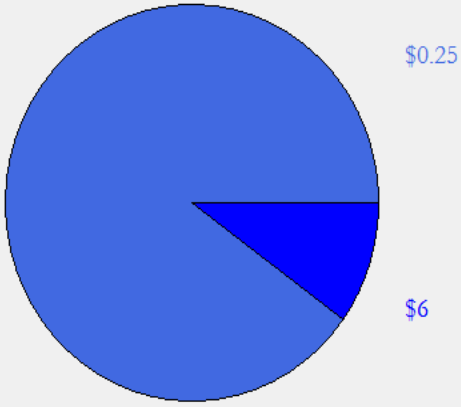


$2 if the die shows 2 to 10

$3 if the die shows 1

Choose A

Option B



$0.25 if the die shows 2 to 10

$6 if the die shows 1

Choose B

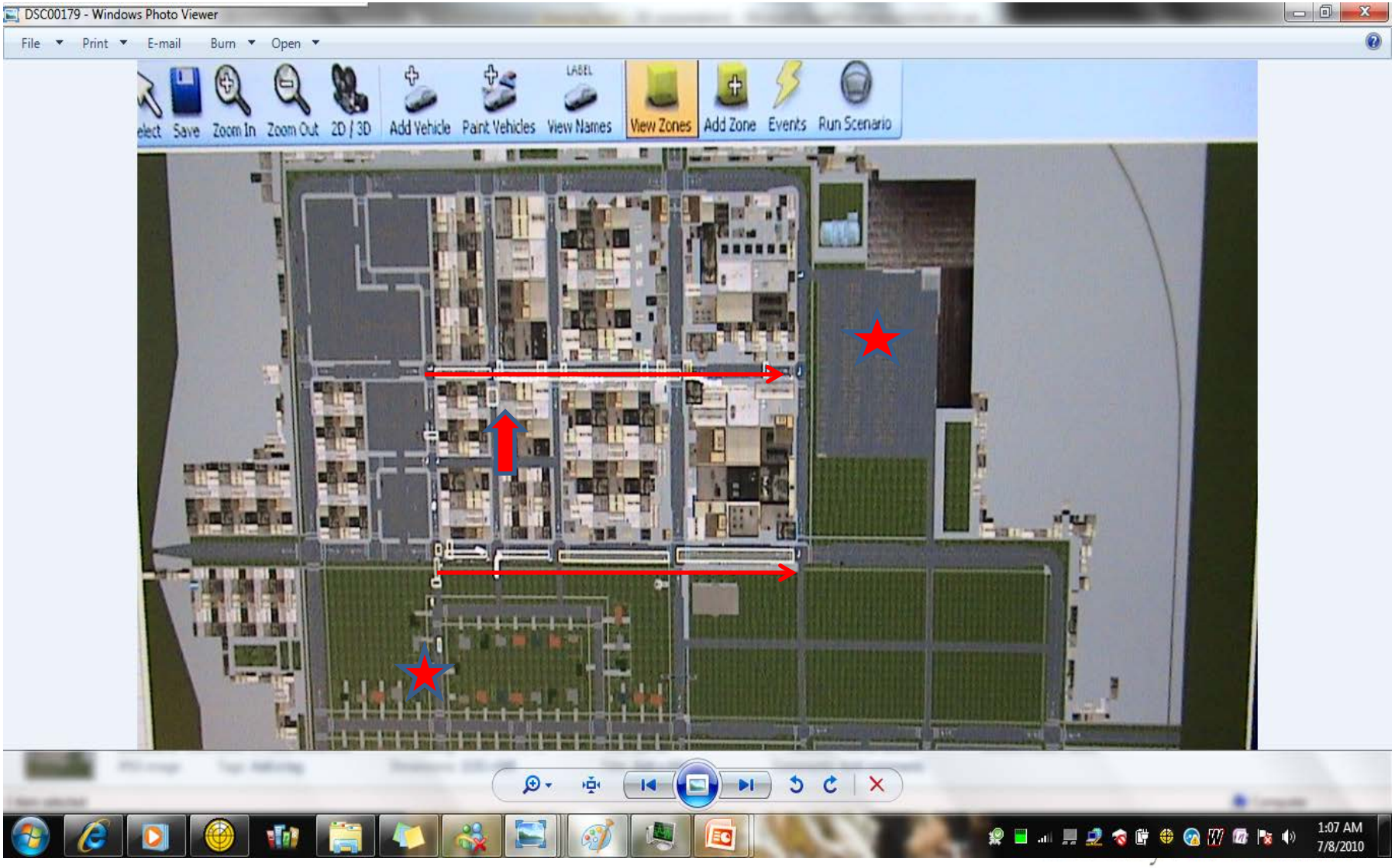
Continue

Presentation of lotteries using driving simulators

Driving task in simulator

- Safer lottery: Expressway with a toll charge
- Riskier lottery: Local road with risk of congestion
  - Value of trip as money
  - Cost of delay as a money cost
  - Congestion probability known to driver

Simulator routes

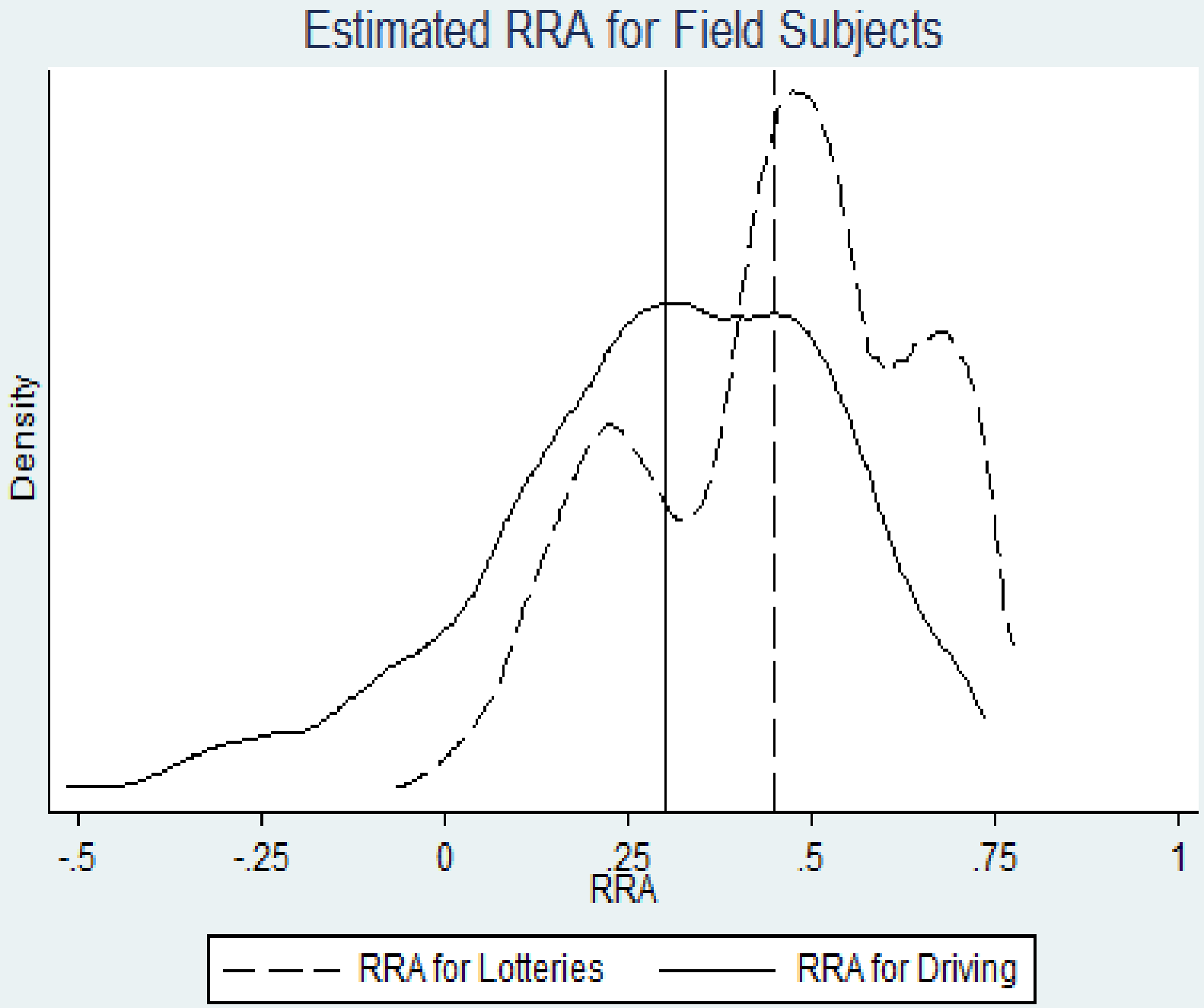


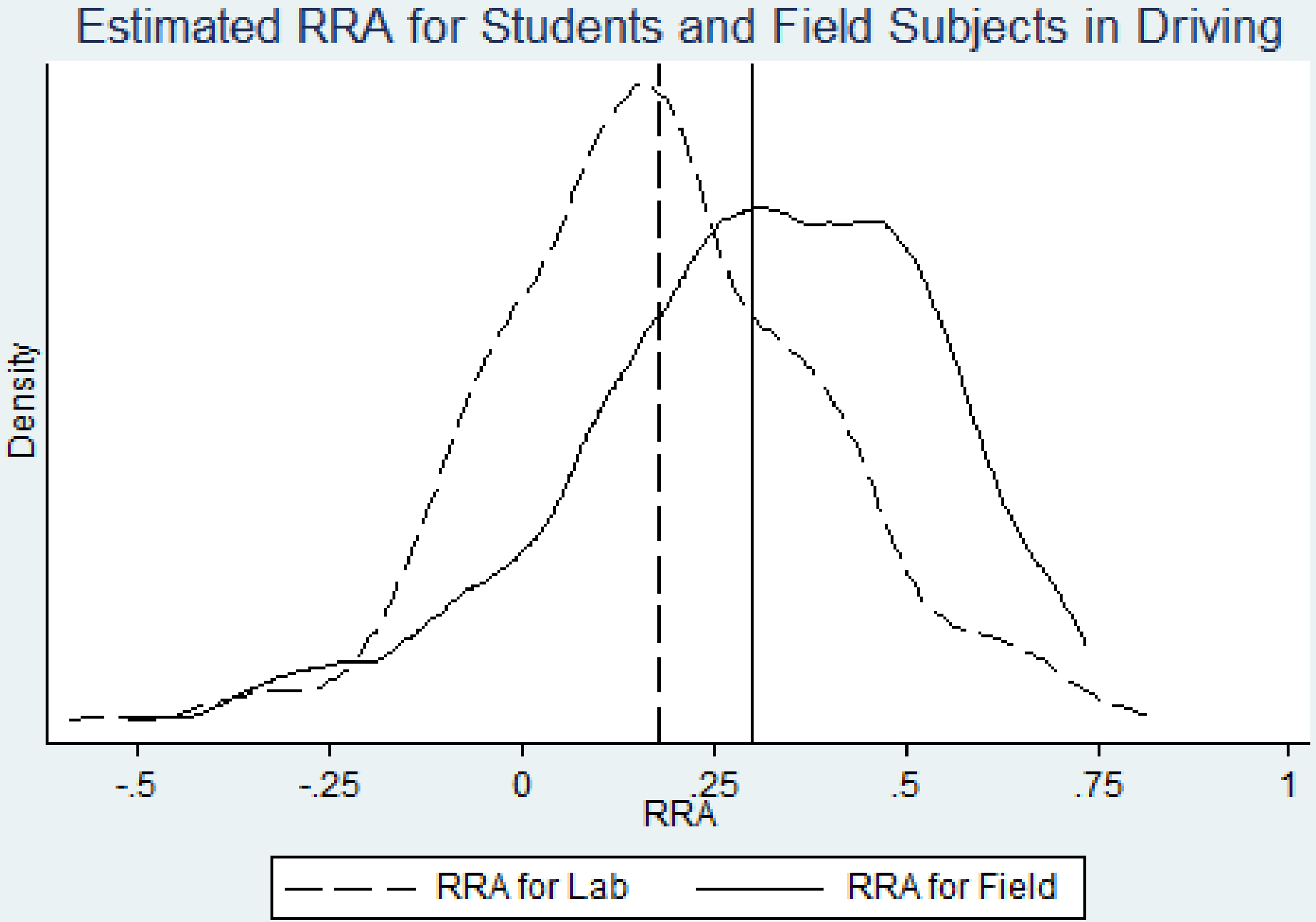
BASELINE SIMULATION.SCN
Car: Toyota Camry, blue, 2WD
SCN
PARK BRAKE
22 MPH
2167 RPM
D
GEAR
00:01:22 : 0.4 Miles
MDYM

CamStudio

The portable driving simulator

Findings


Estimated RRA for Field Subjects
Density
-.5
-.25
0
.25
.5
.75
1
RRA
RRA for Lotteries
RRA for Driving


Estimated RRA for Students and Field Subjects in Driving
Density
-.5
-.25
0
.25
.5
.75
1
RRA
RRA for Lab
RRA for Field

Drivers risk attitudes

	Field lottery	Student lottery	Field driving	Student driving
r				
Constant	.998 (.000)	.73 (.001)	.75 (.001)	.36 (.14)

Drivers vs. Students

	Field lottery	Student lottery	Field driving	Student driving
r				
Constant	.998 (.000)	.73 (.001)	.75 (.001)	.36 (.14)

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Repetition removes the differences in risk attitudes

Drivers in lotteries approach simulators

	Field lottery	Student lottery	Field driving	Student driving
r				
Constant	.998 (.000)	.73 (.001)	.75 (.001)	.36 (.14)
Task	-.31 (.004)	-.13 (.25)	.06 (.47)	.28 (.01)

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Students approach drivers

	Field lottery	Student lottery	Field driving	Student driving
r				
Constant	.998 (.000)	.73 (.001)	.75 (.001)	.36 (.14)
Task	-.31 (.004)	-.13 (.25)	.06 (.47)	.28 (.01)

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Conclusions

- If you give a person from the driving population an unfamiliar task like lotteries
- They will initially act excessively risk averse
- But minimal experience removes the excess risk aversion

Conclusions

- If you give a student a simulator task that is fun like a video game
- They will initially take on excessive risk
- But minimal experience removes the excess risk taking

The experience involves the visceral effect of getting money earnings

ADVICE

You can use simple lottery tasks to measure risk aversion in driving populations

Just give them some experience

ADVICE

You can learn a lot about general driving populations by studying students

Elisabet Rutström

Thank You

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