Economic Decision-Making Skill Predicts Income in Two Countries

Andrew Caplin, NYU and NBER
David J. Deming, Harvard and NBER
Soren Leth-Petersen, University of Copenhagen
Ben Weidmann, Harvard

July 2024

Most jobs require decision-making

- Workers valued not only for how much they can do, but for their ability to *decide what to do*

Most jobs require decision-making

- Workers valued not only for how much they can do, but for their ability to *decide what to do*
- Canonical human capital theory takes "what to do" as given - more HC $\Longleftrightarrow$ more output per hour (e.g. Mincer 1958, Becker 1962)

Most jobs require decision-making

- Workers valued not only for how much they can do, but for their ability to *decide what to do*
- Canonical human capital theory takes "what to do" as given - more HC $\Longleftrightarrow$ more output per hour (e.g. Mincer 1958, Becker 1962)
  - Perfect information rules out "allocative ability" (Welch 1970)

Most jobs require decision-making

- Workers valued not only for how much they can do, but for their ability to *decide what to do*
- Canonical human capital theory takes "what to do" as given - more HC $\iff$ more output per hour (e.g. Mincer 1958, Becker 1962)
  - Perfect information rules out "allocative ability" (Welch 1970)
- Yet firms invest in managerial talent, emphasize problem-solving as a desirable quality in new hires (NACE 2023)

What do we know about decision-making as a skill?

- Behavior lit - complexity aversion and heuristics (e.g. Kahneman and Frederick 2002, Oprea 2020)

What do we know about decision-making as a skill?

- Behavior lit - complexity aversion and heuristics (e.g. Kahneman and Frederick 2002, Oprea 2020)
  - Rules of thumb as a rational response to complexity (e.g. Lieder and Griffiths 2020)

What do we know about decision-making as a skill?

- Behavior lit - complexity aversion and heuristics (e.g. Kahneman and Frederick 2002, Oprea 2020)
  - Rules of thumb as a rational response to complexity (e.g. Lieder and Griffiths 2020)
- Some people less "behavioral" than others (e.g. Benjamin, Brown, and Shapiro 2013))

What do we know about decision-making as a skill?

- Behavior lit - complexity aversion and heuristics (e.g. Kahneman and Frederick 2002, Oprea 2020)
  - Rules of thumb as a rational response to complexity (e.g. Lieder and Griffiths 2020)
- Some people less "behavioral" than others (e.g. Benjamin, Brown, and Shapiro 2013))
  - Cognitive ability and mental resources available for "system 2" analysis

What do we know about decision-making as a skill?

- Behavior lit - complexity aversion and heuristics (e.g. Kahneman and Frederick 2002, Oprea 2020)
  - Rules of thumb as a rational response to complexity (e.g. Lieder and Griffiths 2020)
- Some people less "behavioral" than others (e.g. Benjamin, Brown, and Shapiro 2013))
  - Cognitive ability and mental resources available for "system 2" analysis
- Little systemic evidence of individual variation in decision quality

This paper

Develops a theory and measurement paradigm for assessing individual variation in decision quality

This paper

Develops a theory and measurement paradigm for assessing individual variation in decision quality

1. We call this *economic decision-making skill*

This paper

Develops a theory and measurement paradigm for assessing individual variation in decision quality

1. We call this *economic decision-making skill*

   1.1 Resource allocation, understanding of comparative advantage

This paper

Develops a theory and measurement paradigm for assessing individual variation in decision quality

1. We call this *economic decision-making skill*
   - 1.1 Resource allocation, understanding of comparative advantage
   - 1.2 *Not* complex counterfactuals (what should I do with my life, strategic direction of company, etc.)

This paper

Develops a theory and measurement paradigm for assessing individual variation in decision quality

1. We call this *economic decision-making skill*
   - 1.1 Resource allocation, understanding of comparative advantage
   - 1.2 *Not* complex counterfactuals (what should I do with my life, strategic direction of company, etc.)
2. DM assigns factors of production to different roles to maximize total output

This paper

Develops a theory and measurement paradigm for assessing individual variation in decision quality

1. We call this *economic decision-making skill*
   - 1.1 Resource allocation, understanding of comparative advantage
   - 1.2 *Not* complex counterfactuals (what should I do with my life, strategic direction of company, etc.)
2. DM assigns factors of production to different roles to maximize total output
   - 2.1 A manager assigning workers to jobs, or workers allocating effort to tasks

A model of economic decision-making

Adapts a generalized rational inattention framework to explain variation in labor productivity

A model of economic decision-making

Adapts a generalized rational inattention framework to explain variation in labor productivity

1. DM acquires costly information about heterogeneous factor productivity (Sims 2003, Mackowiak et al 2023)

A model of economic decision-making

Adapts a generalized rational inattention framework to explain variation in labor productivity

1. DM acquires costly information about heterogeneous factor productivity (Sims 2003, Mackowiak et al 2023)
   1.1 Individual-specific attention costs - analogy to input costs in production theory

A model of economic decision-making

Adapts a generalized rational inattention framework to explain variation in labor productivity

1. DM acquires costly information about heterogeneous factor productivity (Sims 2003, Mackowiak et al 2023)
   - 1.1 Individual-specific attention costs - analogy to input costs in production theory
   - 1.2 $\Uparrow$ ED skill $\Rightarrow$ more efficient assignments, holding time/complexity/priors constant

A model of economic decision-making

Adapts a generalized rational inattention framework to explain variation in labor productivity

1. DM acquires costly information about heterogeneous factor productivity (Sims 2003, Mackowiak et al 2023)
   - 1.1 Individual-specific attention costs - analogy to input costs in production theory
   - 1.2 $\Uparrow$ ED skill $\Rightarrow$ more efficient assignments, holding time/complexity/priors constant
2. Economic decision-making skill is the *marginal product of attention*

How do we measure ED skill?

- **The Assignment Game**

How do we measure ED skill?

- **The Assignment Game**
- Participants are managers assigning fictional workers to jobs to maximize output

How do we measure ED skill?

- **The Assignment Game**
- Participants are managers assigning fictional workers to jobs to maximize output
  - Observe draws from workers' productivity schedules over tasks, choose an assignment

How do we measure ED skill?

- **The Assignment Game**
- Participants are managers assigning fictional workers to jobs to maximize output
  - Observe draws from workers' productivity schedules over tasks, choose an assignment
  - Paid for performance

How do we measure ED skill?

- **The Assignment Game**
- Participants are managers assigning fictional workers to jobs to maximize output
  - Observe draws from workers' productivity schedules over tasks, choose an assignment
  - Paid for performance
- Measure allocative efficiency over multiple decision problems

How do we measure ED skill?

- **The Assignment Game**
- Participants are managers assigning fictional workers to jobs to maximize output
  - Observe draws from workers' productivity schedules over tasks, choose an assignment
  - Paid for performance
- Measure allocative efficiency over multiple decision problems
  - Design minimizes the importance of working memory

Does ED skill matter in the US labor market?

- We administer the Assignment game to a survey of ~1,000 U.S. FT workers ages 25-55

Does ED skill matter in the US labor market?

- We administer the Assignment game to a survey of ~1,000 U.S. FT workers ages 25-55
  - Paid for performance on AG + other cognitive tests

Does ED skill matter in the US labor market?

- We administer the Assignment game to a survey of ~1,000 U.S. FT workers ages 25-55
  - Paid for performance on AG + other cognitive tests
  - Income, occupation, demographics

Does ED skill matter in the US labor market?

- We administer the Assignment game to a survey of ~1,000 U.S. FT workers ages 25-55
  - Paid for performance on AG + other cognitive tests
  - Income, occupation, demographics
- ED skill is strongly associated with income, conditional on IQ, numeracy, education

Does ED skill matter in the US labor market?

- We administer the Assignment game to a survey of ~1,000 U.S. FT workers ages 25-55
  - Paid for performance on AG + other cognitive tests
  - Income, occupation, demographics
- ED skill is strongly associated with income, conditional on IQ, numeracy, education
  - 1 SD higher AG = 7% higher income; more than twice as large as IQ

Does ED skill matter in the US labor market?

- We administer the Assignment game to a survey of ~1,000 U.S. FT workers ages 25-55
  - Paid for performance on AG + other cognitive tests
  - Income, occupation, demographics
- ED skill is strongly associated with income, conditional on IQ, numeracy, education
  - 1 SD higher AG = 7% higher income; more than twice as large as IQ
- Association between AG score and income greater in decision-intensive jobs

Does ED skill matter in the Danish labor market?

- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry

Does ED skill matter in the Danish labor market?

- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry
  - Admin data from Statistics Denmark; income/occ/demogs; pop weights

Does ED skill matter in the Danish labor market?

- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry
  - Admin data from Statistics Denmark; income/occ/demogs; pop weights
- First draft of the paper was only U.S. results - constrained ourselves to the same analysis across samples

Does ED skill matter in the Danish labor market?

- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry
  - Admin data from Statistics Denmark; income/occ/demogs; pop weights
- First draft of the paper was only U.S. results - constrained ourselves to the same analysis across samples
- ED skill is strongly associated with labor income in Denmark, conditional on education and demographics

Does ED skill matter in the Danish labor market?

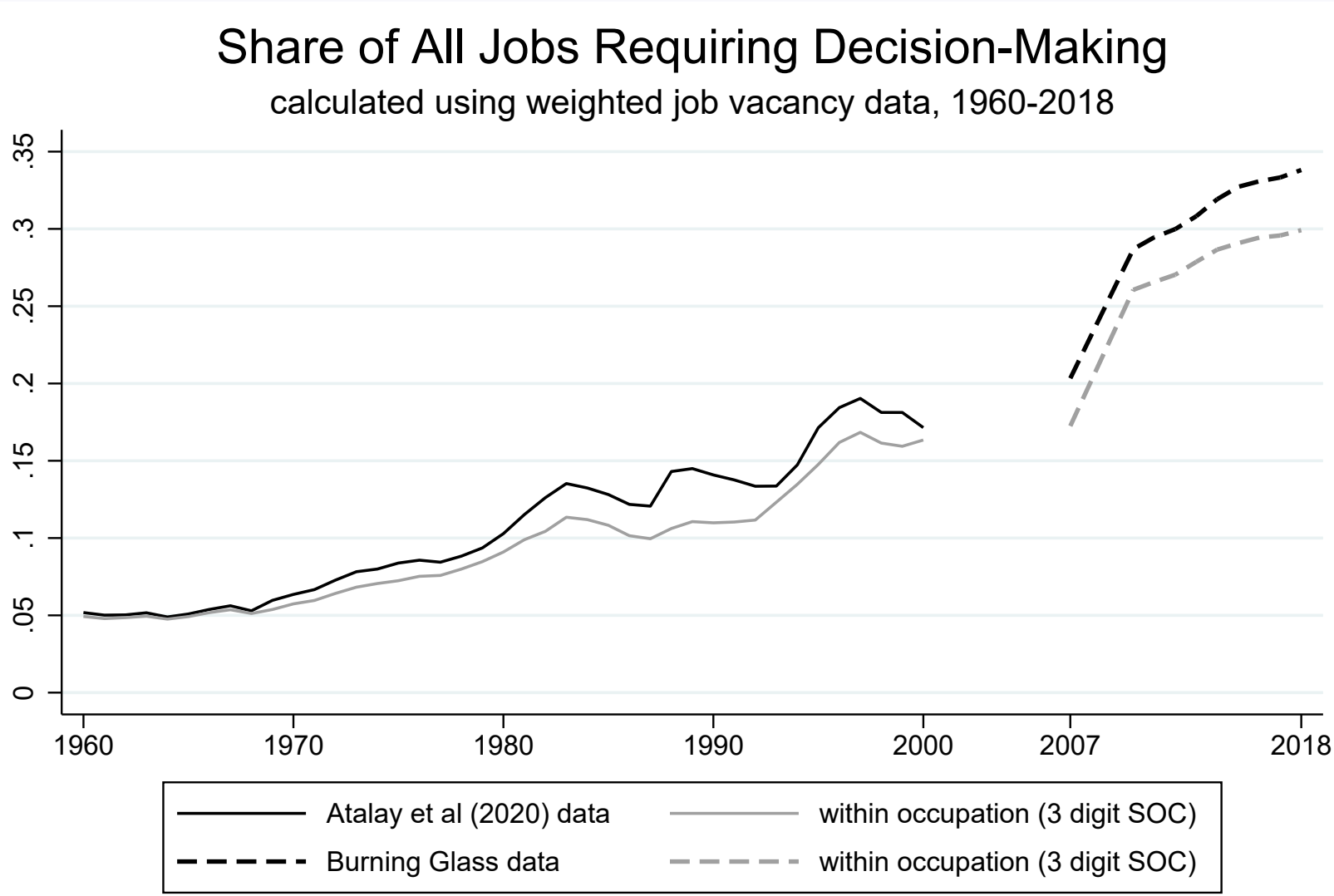
- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry
  - Admin data from Statistics Denmark; income/occ/demogs; pop weights
- First draft of the paper was only U.S. results - constrained ourselves to the same analysis across samples
- ED skill is strongly associated with labor income in Denmark, conditional on education and demographics
  - 1 SD higher AG = 9-11% higher income

Does ED skill matter in the Danish labor market?

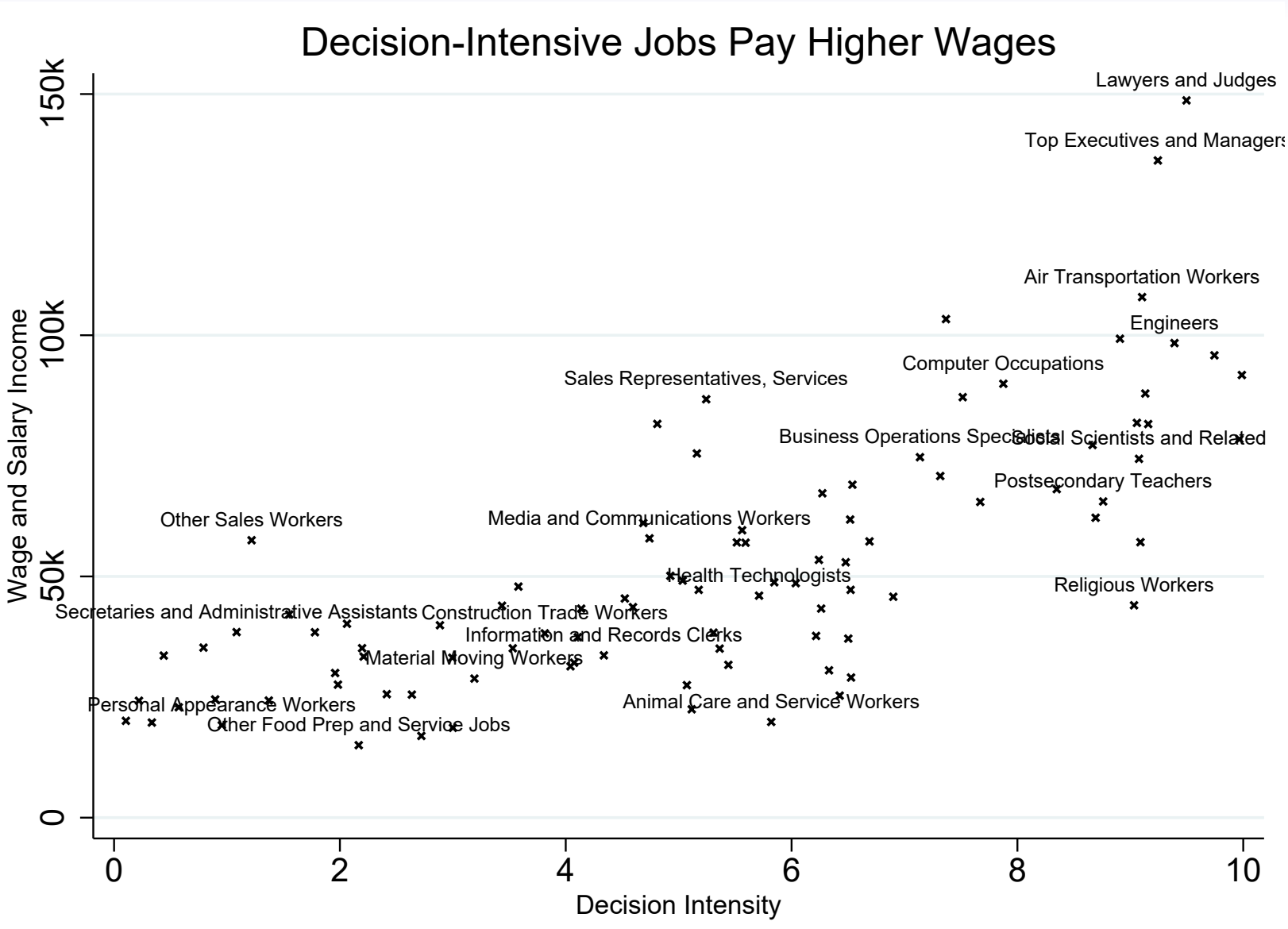
- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry
  - Admin data from Statistics Denmark; income/occ/demogs; pop weights
- First draft of the paper was only U.S. results - constrained ourselves to the same analysis across samples
- ED skill is strongly associated with labor income in Denmark, conditional on education and demographics
  - 1 SD higher AG = 9-11% higher income
- Association between AG score and income greater in decision-intensive jobs

Does ED skill matter in the Danish labor market?

- We also administer the AG to ~2,300 people ages 25-55 in the Danish population registry
  - Admin data from Statistics Denmark; income/occ/demogs; pop weights
- First draft of the paper was only U.S. results - constrained ourselves to the same analysis across samples
- ED skill is strongly associated with labor income in Denmark, conditional on education and demographics
  - 1 SD higher AG = 9-11% higher income
- Association between AG score and income greater in decision-intensive jobs
  - Magnitudes strikingly similar in the two samples



Share of job vacancies requiring decisions and related keywords. Weighted to match occupation distribution in 1960-2018 Census/ACS. Smoothed using a five-year moving average. See text for details on data definitions and weighting.


Decision-Intensive Jobs Pay Higher Wages
Wage and Salary Income
150k
100k
50k
0
0
2
4
6
8
10
Decision Intensity
Lawyers and Judges
Top Executives and Managers
Air Transportation Workers
Engineers
Computer Occupations
Sales Representatives, Services
Business Operations Specialists
Social Scientists and Related
Postsecondary Teachers
Other Sales Workers
Media and Communications Workers
Health Technologists
Religious Workers
Secretaries and Administrative Assistants
Construction Trade Workers
Information and Records Clerks
Material Moving Workers
Personal Appearance Workers
Animal Care and Service Workers
Other Food Prep and Service Jobs

Model Setup

A risk neutral DM assigns a set of M factors (workers) to M tasks. Assume 1:1 for simplicity.

Workers have a finite set of possible productivity schedules $\omega(m) = (\omega_1(m), ..., \omega_M(m)) \in \Omega^M$, where $\omega_n(m)$ is worker m's productivity type in task n.

Model Setup

A production function $\mathcal{F}$ maps task levels into output. The agent's expected output for any assignment $a : \{1, ..., M\} \to \{1, ..., M\}$, in any state ω is:

$$f(a, \omega) \equiv \mathcal{F}\left(\omega_1\left(a^{-1}(1), ...\omega_M\left(a^{-1}(M)\right)\right)\right)$$

If worker productivity schedules are perfectly observed, the optimal assignment solves the linear programming problem of Koopmans and Beckmann (1957).

Contribution

- If information is costly to observe, DMs weigh expected output from $\mathcal{F}$ against expected cost of acquiring information about ω

Contribution

- If information is costly to observe, DMs weigh expected output from $\mathcal{F}$ against expected cost of acquiring information about ω
  - The ability to learn about factor productivity has economic value (e.g. Nelson and Phelps 1966, Jovanovic and Nyarko 1996)

Contribution

- If information is costly to observe, DMs weigh expected output from $\mathcal{F}$ against expected cost of acquiring information about ω
  - The ability to learn about factor productivity has economic value (e.g. Nelson and Phelps 1966, Jovanovic and Nyarko 1996)
- Fundamental source of allocative inefficiency is *costly attention*

Contribution

- If information is costly to observe, DMs weigh expected output from $\mathcal{F}$ against expected cost of acquiring information about ω
  - The ability to learn about factor productivity has economic value (e.g. Nelson and Phelps 1966, Jovanovic and Nyarko 1996)
- Fundamental source of allocative inefficiency is *costly attention*
  - In perfectly competitive markets, "allocative ability" can never be the source of return to a factor (Welch 1970)

Contribution

- If information is costly to observe, DMs weigh expected output from $\mathcal{F}$ against expected cost of acquiring information about ω
  - The ability to learn about factor productivity has economic value (e.g. Nelson and Phelps 1966, Jovanovic and Nyarko 1996)
- Fundamental source of allocative inefficiency is *costly attention*
  - In perfectly competitive markets, "allocative ability" can never be the source of return to a factor (Welch 1970)
- "Waste is an error within the framework of modern economic analysis, and it will not become a useful concept until we have a theory of error (Leibenstein 1966, Stigler 1976)

Model Setup

- DM begin with prior beliefs $\mu(\omega)$ about productivity types, develops an *attention strategy* that optimally refines beliefs

Model Setup

- DM begin with prior beliefs $\mu(\omega)$ about productivity types, develops an *attention strategy* that optimally refines beliefs
  - Acquire costly signals - which workers to monitor and for how long, what questions to ask etc.

Model Setup

- DM begin with prior beliefs $\mu(\omega)$ about productivity types, develops an *attention strategy* that optimally refines beliefs
  - Acquire costly signals - which workers to monitor and for how long, what questions to ask etc.
- After receiving signals, they form a posterior $\gamma(\omega)$ and choose an assignment a that maximizes expected output

Model Setup

- DM begin with prior beliefs $\mu(\omega)$ about productivity types, develops an *attention strategy* that optimally refines beliefs
  - Acquire costly signals - which workers to monitor and for how long, what questions to ask etc.
- After receiving signals, they form a posterior $\gamma(\omega)$ and choose an assignment a that maximizes expected output
- Next characterize agents' attention costs, e.g. their signal extraction efficiency.

Beliefs

Define an *attention strategy* function Q, where $Q(\gamma)$ is the unconditional probability of posterior belief γ.

Define the optimal value of a posterior belief as $\hat{f}(\gamma) = \max_a \sum_\omega f(a, w)\gamma(\omega)$.

Thus the optimal value of an attention strategy is a probability-weighted posterior belief function:

$$\hat{f}(Q) = \sum_\gamma Q(\gamma)\hat{f}(\gamma).$$

Attention as a Production Input

Just as production theory requires functional form assumptions to deliver smooth comparative statics, we consider attention cost functions $K(Q)$ that can be scaled by some multiple $c > 0$, e.g.:

$$V(c, Q) = \hat{f}(Q) - cK(Q)$$

A production function with attention as the input, rather than labor and capital.

Attention Production Possibility Set

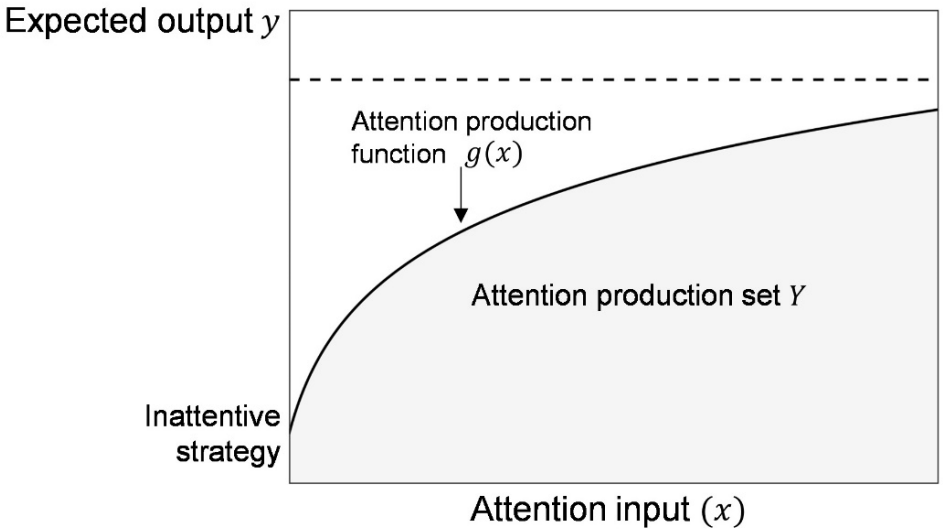
$$\mathcal{Y}=\left\{(x,y)\in\mathbb{R}^2|\exists Q\in Q(\mu)\, s.t.\hat{f}(Q)\geq y, K(Q)\leq x\right\}$$

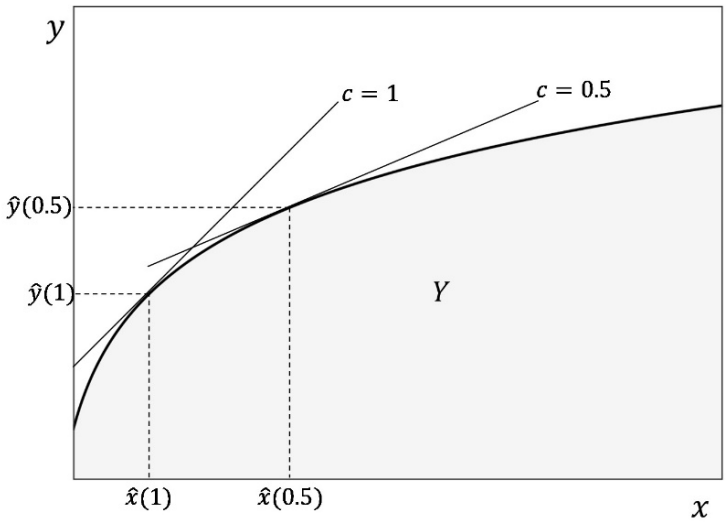
where y is the output level, x is an attention input, and $K(Q)$ is an attention cost function that depends on beliefs.

The *attention production function* $g(x)$ - supremum of $\mathcal{Y}$ for attention inputs of x or below.

With two add'l assumptions about $K(Q)$, Y is convex, $g(x)$ is concave, and optimal strategies for all $c>0$.

See the paper for a proof.


Expected output y
Attention production function $g(x)$
Attention production set Y
Inattentive strategy
Attention input (x)


y
$c = 1$
$c = 0.5$
$\hat{y}(0.5)$
$\hat{y}(1)$
Y
$\hat{x}(1)$
$\hat{x}(0.5)$
x

Identifying ED Skill

Recall that $V(c, Q) = \hat{f}(Q) - cK(Q)$. Now rewrite beliefs as assignment probabilities $P(a \mid \omega)$:

$$V_j(a, \omega) = \max_{P_j} \sum_a \sum_\omega y_j(a, \omega) P_j(a \mid \omega) \mu_j(\omega) - c_j K(P_j)$$

where $c_j > 0$ is the agent's marginal cost of attention, and *economic decision-making skill* is $\alpha_j = \frac{1}{c_j}$.

Empirical challenge - isolate α_j from other individual differences (utility, available actions, prior beliefs....).

The Assignment Game

- Participants are managers assigning fictional workers 1:1 to jobs

The Assignment Game

- Participants are managers assigning fictional workers 1:1 to jobs
  - Observe multiple "days" of each worker's productivity schedule

The Assignment Game

- Participants are managers assigning fictional workers 1:1 to jobs
  - Observe multiple "days" of each worker's productivity schedule
  - "Workers have good days and bad days"; figure out "how good workers are at different tasks ON AVERAGE"

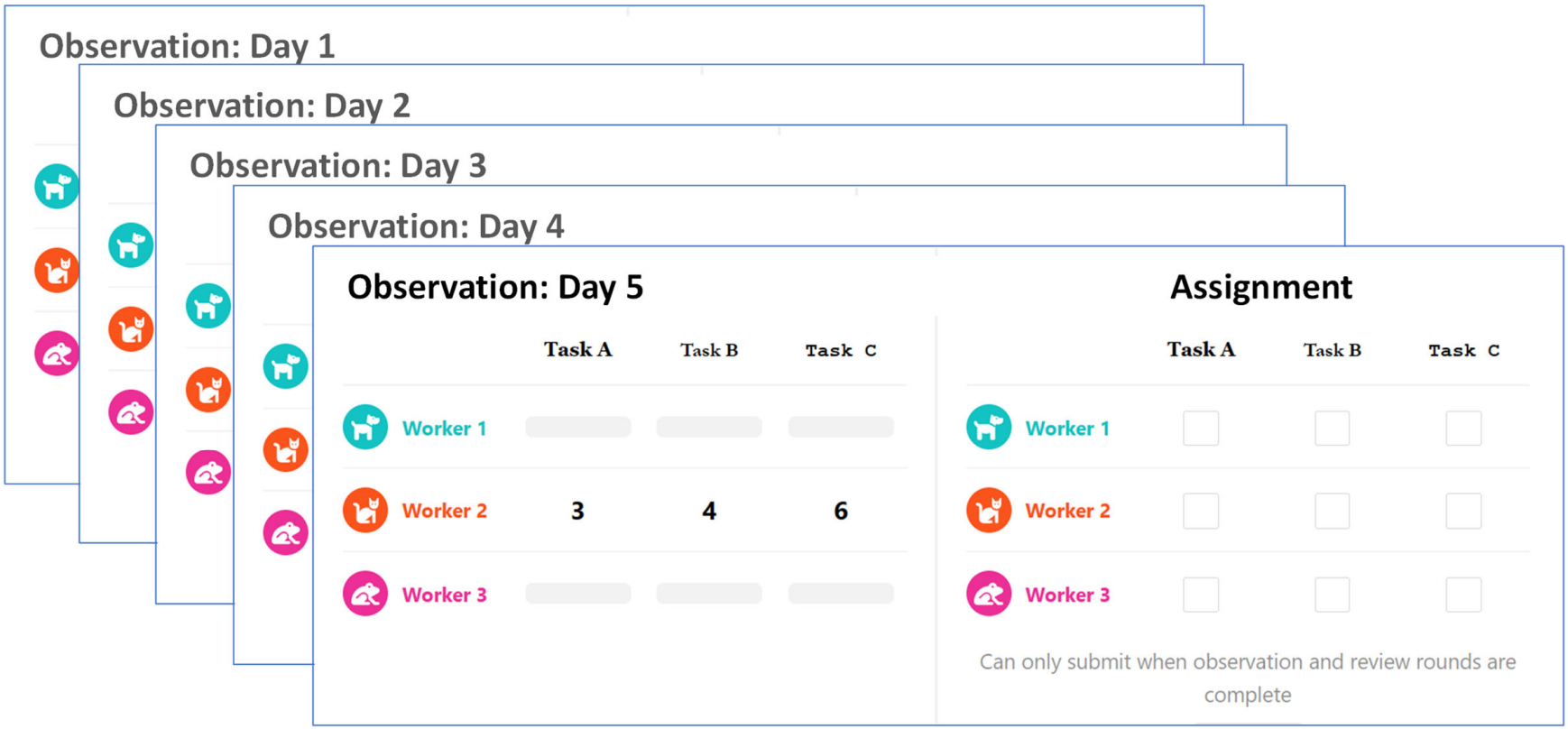
The Assignment Game

- Participants are managers assigning fictional workers 1:1 to jobs
  - Observe multiple "days" of each worker's productivity schedule
  - "Workers have good days and bad days"; figure out "how good workers are at different tasks ON AVERAGE"
- After seeing separately, they see the full matrix again for each day

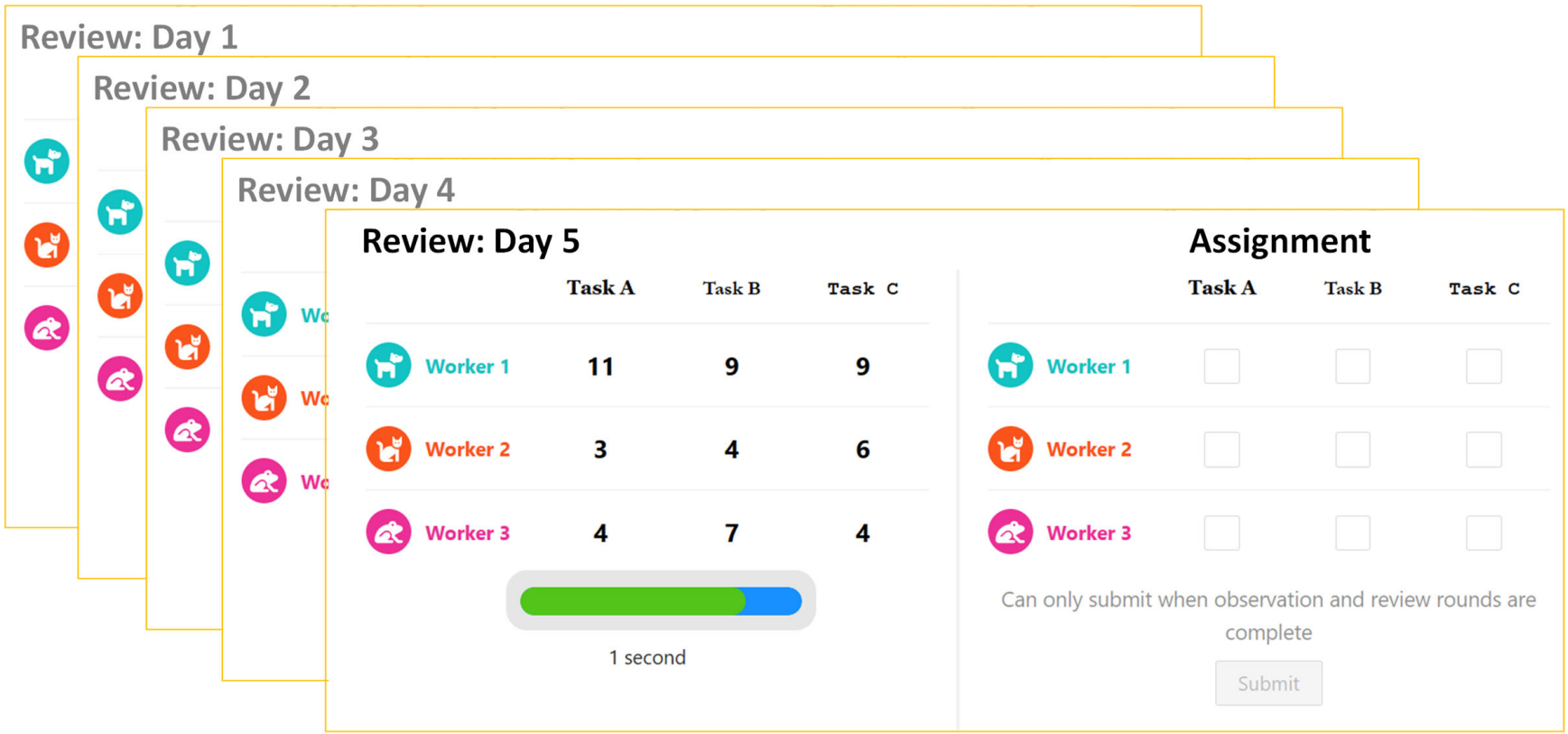
The Assignment Game

- Participants are managers assigning fictional workers 1:1 to jobs
  - Observe multiple "days" of each worker's productivity schedule
  - "Workers have good days and bad days"; figure out "how good workers are at different tasks ON AVERAGE"
- After seeing separately, they see the full matrix again for each day
- Can make/change assignments at any time

Participants first see worker productivity sequentially
(This example shows worker 2, and output is visible for the 5th day)



Participants then see review all workers' productivity together
(This example shows all 3 workers' output on day 5)



Scoring

- Scores are based on average productivity of each worker in the assigned task

Scoring

- Scores are based on average productivity of each worker in the assigned task
  - Payment depends on performance relative to random guessing

Scoring

- Scores are based on average productivity of each worker in the assigned task
  - Payment depends on performance relative to random guessing
- 16 items - 8 each of 3x3 and 4x4

Scoring

- Scores are based on average productivity of each worker in the assigned task
  - Payment depends on performance relative to random guessing
- 16 items - 8 each of 3x3 and 4x4
  - 7 participants achieved the max score of 84; mean = 68, SD = 9.4

Other Assessments

- Ravens Matrices (nonverbal IQ)

Other Assessments

- Ravens Matrices (nonverbal IQ)
- Revised version of the Cognitive Reflection Test (Frederick 2005, Toplak et al 2014)

Other Assessments

- Ravens Matrices (nonverbal IQ)
- Revised version of the Cognitive Reflection Test (Frederick 2005, Toplak et al 2014)
- Berlin Numeracy Test (Cokely et al 2012, 2018)

Other Assessments

- Ravens Matrices (nonverbal IQ)
- Revised version of the Cognitive Reflection Test (Frederick 2005, Toplak et al 2014)
- Berlin Numeracy Test (Cokely et al 2012, 2018)
- Split-sample reliabilities (n=5,000)

Other Assessments

- Ravens Matrices (nonverbal IQ)
- Revised version of the Cognitive Reflection Test (Frederick 2005, Toplak et al 2014)
- Berlin Numeracy Test (Cokely et al 2012, 2018)
- Split-sample reliabilities (n=5,000)
  - Assignment Game = 0.75

Other Assessments

- Ravens Matrices (nonverbal IQ)
- Revised version of the Cognitive Reflection Test (Frederick 2005, Toplak et al 2014)
- Berlin Numeracy Test (Cokely et al 2012, 2018)
- Split-sample reliabilities (n=5,000)
  - Assignment Game = 0.75
  - IQ = 0.72; CRT = 0.76; BNT = 0.65

U.S. Survey Sample

- Recruited from the online research website Prolific

U.S. Survey Sample

- Recruited from the online research website Prolific
  - Full-time employed U.S. residents ages 25-55 who speak fluent English

U.S. Survey Sample

- Recruited from the online research website Prolific
  - Full-time employed U.S. residents ages 25-55 who speak fluent English
- 1,008 respondents with complete data

U.S. Survey Sample

- Recruited from the online research website Prolific
  - Full-time employed U.S. residents ages 25-55 who speak fluent English
- 1,008 respondents with complete data
- Participants paid $12 for their time + up to $14 in bonuses (mean was $4.50)

U.S. Survey Sample

- Recruited from the online research website Prolific
  - Full-time employed U.S. residents ages 25-55 who speak fluent English
- 1,008 respondents with complete data
- Participants paid $12 for their time + up to $14 in bonuses (mean was $4.50)
- Sample is more educated than average, but otherwise representative

Danish Registry Sample

- AG given through survey invitation sent from gov't official email account (e-bok)

Danish Registry Sample

- AG given through survey invitation sent from gov't official email account (e-bok)
  - response rate ~6.5% - comparable to many other studies in this population

Danish Registry Sample

- AG given through survey invitation sent from gov't official email account (e-bok)
  - response rate ~6.5% - comparable to many other studies in this population
- Sample slightly older and more education, but otherwise representative

Danish Registry Sample

- AG given through survey invitation sent from gov't official email account (e-bok)
  - response rate ~6.5% - comparable to many other studies in this population
- Sample slightly older and more education, but otherwise representative
  - Population weights

Table 3 - Economic Decision-Making Skill Predicts Higher Wage and Salary Income

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	6,006	4,480	5,881		5,012	5,227
	[1,423]	[1,312]	[1,520]		[1,516]	[1,538]
Nonverbal IQ (Ravens)				3,099	1,601	1,811
				[1,588]	[1,611]	[1,653]
Cognitive Reflection Test						978
						[1,916]
Berlin Numeracy Test						-2,183
						[1,756]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.018	0.182	0.193	0.186	0.195	0.197
Sample Size	1,008	1,008	1,008	1,008	1,008	1,008
Panel B - Danish Registry Sample						
ED Skill (AG Score)	3,694	4,050	3,243			
	[709]	[665]	[676]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.010	0.252	0.262			
Sample Size	2,297	2,297	2,297			

Table 3 - Economic Decision-Making Skill Predicts Higher Wage and Salary Income

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	6,006	4,480	5,881		5,012	5,227
	[1,423]	[1,312]	[1,520]		[1,516]	[1,538]
Nonverbal IQ (Ravens)				3,099	1,601	1,811
				[1,588]	[1,611]	[1,653]
Cognitive Reflection Test						978
						[1,916]
Berlin Numeracy Test						-2,183
						[1,756]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.018	0.182	0.193	0.186	0.195	0.197
Sample Size	1,008	1,008	1,008	1,008	1,008	1,008
Panel B - Danish Registry Sample						
ED Skill (AG Score)	3,694	4,050	3,243			
	[709]	[665]	[676]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.010	0.252	0.262			
Sample Size	2,297	2,297	2,297			

Table 3 - Economic Decision-Making Skill Predicts Higher Wage and Salary Income

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	6,006	4,480	5,881		5,012	5,227
	[1,423]	[1,312]	[1,520]		[1,516]	[1,538]
Nonverbal IQ (Ravens)				3,099	1,601	1,811
				[1,588]	[1,611]	[1,653]
Cognitive Reflection Test						978
						[1,916]
Berlin Numeracy Test						-2,183
						[1,756]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.018	0.182	0.193	0.186	0.195	0.197
Sample Size	1,008	1,008	1,008	1,008	1,008	1,008
Panel B - Danish Registry Sample						
ED Skill (AG Score)	3,694	4,050	3,243			
	[709]	[665]	[676]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.010	0.252	0.262			
Sample Size	2,297	2,297	2,297			

Table 3 - Economic Decision-Making Skill Predicts Higher Wage and Salary Income

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	6,006	4,480	5,881		5,012	5,227
	[1,423]	[1,312]	[1,520]		[1,516]	[1,538]
Nonverbal IQ (Ravens)				3,099	1,601	1,811
				[1,588]	[1,611]	[1,653]
Cognitive Reflection Test						978
						[1,916]
Berlin Numeracy Test						-2,183
						[1,756]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.018	0.182	0.193	0.186	0.195	0.197
Sample Size	1,008	1,008	1,008	1,008	1,008	1,008
Panel B - Danish Registry Sample						
ED Skill (AG Score)	3,694	4,050	3,243			
	[709]	[665]	[676]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.010	0.252	0.262			
Sample Size	2,297	2,297	2,297			

Table 3 - Economic Decision-Making Skill Predicts Higher Wage and Salary Income

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	6,006	4,480	5,881		5,012	5,227
	[1,423]	[1,312]	[1,520]		[1,516]	[1,538]
Nonverbal IQ (Ravens)				3,099	1,601	1,811
				[1,588]	[1,611]	[1,653]
Cognitive Reflection Test						978
						[1,916]
Berlin Numeracy Test						-2,183
						[1,756]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.018	0.182	0.193	0.186	0.195	0.197
Sample Size	1,008	1,008	1,008	1,008	1,008	1,008
Panel B - Danish Registry Sample						
ED Skill (AG Score)	3,694	4,050	3,243			
	[709]	[665]	[676]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.010	0.252	0.262			
Sample Size	2,297	2,297	2,297			

Direct evidence of attention constraints

- Is AG just a working memory test?

Direct evidence of attention constraints

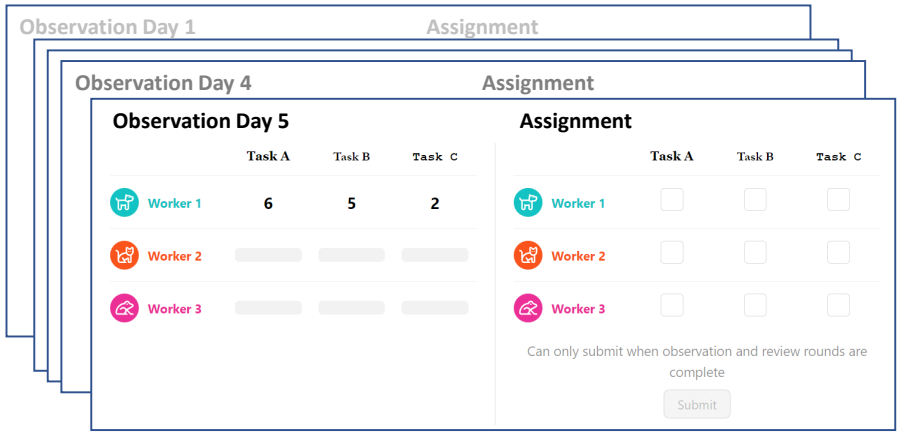
- Is AG just a working memory test?
  - Do errors look random, or strategic?

Direct evidence of attention constraints

- Is AG just a working memory test?
  - Do errors look random, or strategic?
- Participants with high attention costs will look for cognitive shortcuts

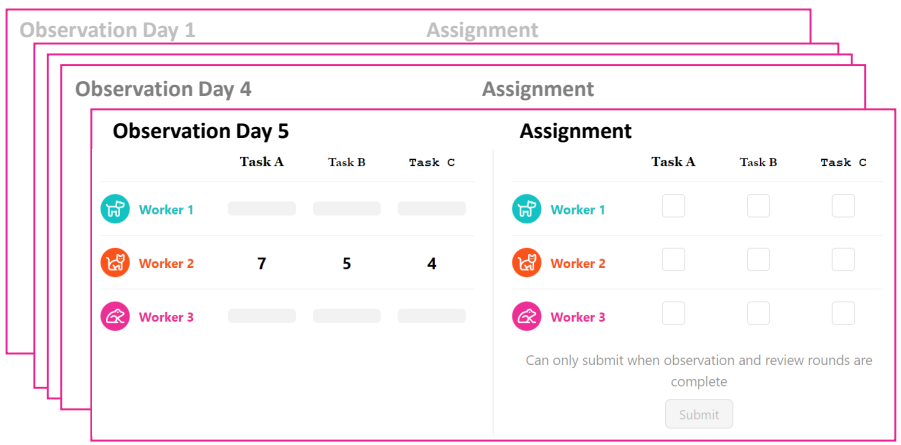
Direct evidence of attention constraints

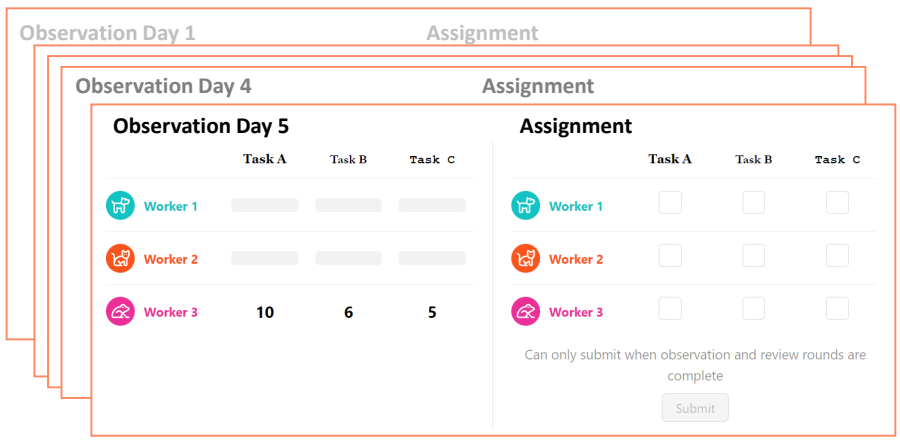
- Is AG just a working memory test?
  - Do errors look random, or strategic?
- Participants with high attention costs will look for cognitive shortcuts
  - Recall that they first see all days of each worker, then after that, the full matrix



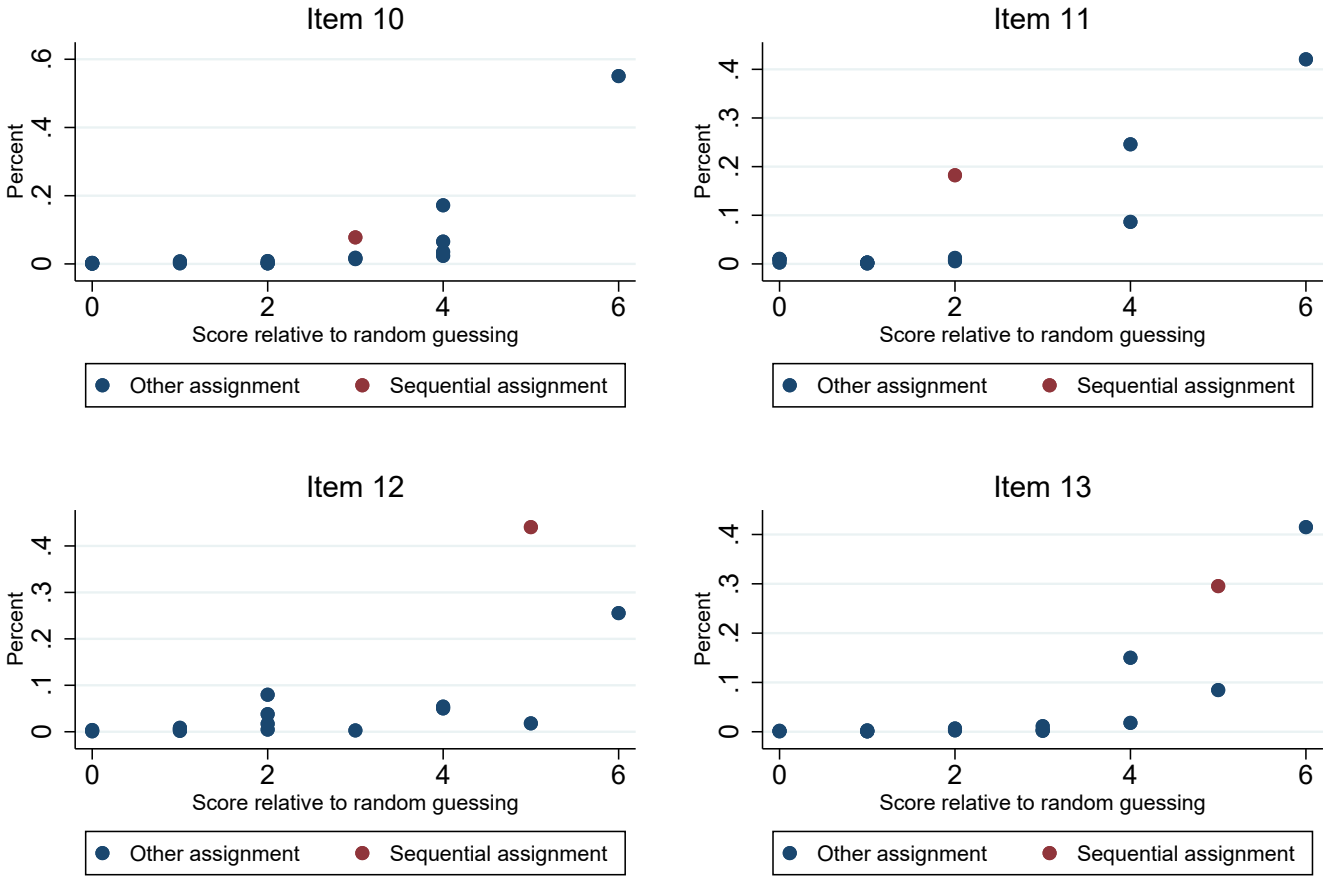
Full productivity schedule

	A	B	C
W1	6	5	2
W2	7	5	4
W3	10	6	5





Item-level analysis of pr(sequential assignment)



Sequential strategy and attention costs

- DMs deploying the sequential strategy have lower α_j, conditional on their score

Sequential strategy and attention costs

- DMs deploying the sequential strategy have lower α_j, conditional on their score
  - Sometimes they just get lucky

Sequential strategy and attention costs

- DMs deploying the sequential strategy have lower α_j, conditional on their score
  - Sometimes they just get lucky
- Test this by interacting AG score with the number of times each participant gave the sequential answer (mean = 1.9)

Table 6 - AG Score is Less Predictive of Income when Answers are Heuristic

	(1)	(2)	(3)	(4)	(6)
ED Skill (AG Score)	10,457	10,109	9,617	9,387	9,450
	[2,420]	[2,460]	[2,445]	[2,427]	[2,663]
AG * # Sequential	**-1,944**	**-2,205**	-2,177	-2,060	-2,008
	[804]	**[809]**	[806]	[825]	[886]
# of Sequential Answers	-242	-826	-790	-779	-908
	[1,098]	[997]	[995]	[997]	[995]
Nonverbal IQ (Ravens)			1,438	1,997	2,158
			[1,594]	[2,614]	[2,687]
IQ * # Sequential				-314	-261
				[955]	[975]
Cognitive Reflection Test					955
					[3,253]
CRT * # Sequential					32
					[1137]
Berlin Numeracy Test					-1,643
					[2,969]
BNT * # Sequential					-512
					[1,155]
Demographic Controls		X	X	X	X
Population Weights		X	X	X	X
R-Squared	0.024	0.202	0.203	0.203	0.205
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 6 - AG Score is Less Predictive of Income when Answers are Heuristic

	(1)	(2)	(3)	(4)	(6)
ED Skill (AG Score)	10,457	10,109	9,617	9,387	9,450
	[2,420]	[2,460]	[2,445]	[2,427]	[2,663]
AG * # Sequential	**-1,944**	**-2,205**	**-2,177**	-2,060	-2,008
	[804]	**[809]**	**[806]**	[825]	[886]
# of Sequential Answers	-242	-826	-790	-779	-908
	[1,098]	[997]	[995]	[997]	[995]
Nonverbal IQ (Ravens)			**1,438**	1,997	2,158
			[1,594]	[2,614]	[2,687]
IQ * # Sequential				-314	-261
				[955]	[975]
Cognitive Reflection Test					955
					[3,253]
CRT * # Sequential					32
					[1137]
Berlin Numeracy Test					-1,643
					[2,969]
BNT * # Sequential					-512
					[1,155]
Demographic Controls		X	X	X	X
Population Weights		X	X	X	X
R-Squared	0.024	0.202	0.203	0.203	0.205
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 6 - AG Score is Less Predictive of Income when Answers are Heuristic

	(1)	(2)	(3)	(4)	(6)
ED Skill (AG Score)	10,457	10,109	9,617	9,387	9,450
	[2,420]	[2,460]	[2,445]	[2,427]	[2,663]
AG * # Sequential	-1,944	**-2,205**	**-2,177**	**-2,060**	-2,008
	[804]	**[809]**	**[806]**	**[825]**	[886]
# of Sequential Answers	-242	-826	-790	-779	-908
	[1,098]	[997]	[995]	[997]	[995]
Nonverbal IQ (Ravens)			1,438	1,997	2,158
			[1,594]	[2,614]	[2,687]
IQ * # Sequential				**-314**	-261
				[955]	[975]
Cognitive Reflection Test					955
					[3,253]
CRT * # Sequential					32
					[1137]
Berlin Numeracy Test					-1,643
					[2,969]
BNT * # Sequential					-512
					[1,155]
Demographic Controls		X	X	X	X
Population Weights		X	X	X	X
R-Squared	0.024	0.202	0.203	0.203	0.205
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 6 - AG Score is Less Predictive of Income when Answers are Heuristic

	(1)	(2)	(3)	(4)	(6)
ED Skill (AG Score)	10,457	10,109	9,617	9,387	9,450
	[2,420]	[2,460]	[2,445]	[2,427]	[2,663]
AG * # Sequential	**-1,944**	-2,205	-2,177	-2,060	**-2,008**
	[804]	[809]	[806]	[825]	**[886]**
# of Sequential Answers	-242	-826	-790	-779	-908
	[1,098]	[997]	[995]	[997]	[995]
Nonverbal IQ (Ravens)			1,438	1,997	2,158
			[1,594]	[2,614]	[2,687]
IQ * # Sequential				-314	**-261**
				[955]	**[975]**
Cognitive Reflection Test					955
					[3,253]
CRT * # Sequential					**32**
					[1137]
Berlin Numeracy Test					-1,643
					[2,969]
BNT * # Sequential					**-512**
					[1,155]
Demographic Controls		X	X	X	X
Population Weights		X	X	X	X
R-Squared	0.024	0.202	0.203	0.203	0.205
Sample Size	1,003	1,003	1,003	1,003	1,003

Occupational Sorting

- Regress decision intensity of occupation on AG + controls

Occupational Sorting

- Regress decision intensity of occupation on AG + controls
- Prediction unclear - depends on equilibrium sorting, relative returns to other skills

Occupational Sorting

- Regress decision intensity of occupation on AG + controls
- Prediction unclear - depends on equilibrium sorting, relative returns to other skills
  - e.g. strong technical skills

Table 4 - Occupational Sorting on Economic Decision-Making Skill

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	0.311	0.220	0.258		0.209	0.157
	[0.077]	[0.076]	[0.096]		[0.102]	[0.105]
Nonverbal IQ (Ravens)				0.218	0.155	0.079
				[0.086]	[0.092]	[0.098]
Cognitive Reflection Test						0.016
						[0.122]
Berlin Numeracy Test						0.286
						[0.114]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.015	0.136	0.149	0.147	0.152	0.163
Sample Size	1,033	1,033	1,033	1,033	1,033	1,033
Panel B - Danish Registry Sample						
ED Skill (AG Score)	0.343	0.211	0.275			
	[0.051]	[0.046]	[0.051]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.019	0.253	0.232			
Sample Size	2,297	2,297	2,297			

Table 4 - Occupational Sorting on Economic Decision-Making Skill

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)
ED Skill (AG Score)	0.311	0.220	0.258		0.209	0.157
	[0.077]	[0.076]	[0.096]		[0.102]	[0.105]
Nonverbal IQ (Ravens)				0.218	0.155	0.079
				[0.086]	[0.092]	[0.098]
Cognitive Reflection Test						0.016
						[0.122]
Berlin Numeracy Test						0.286
						[0.114]
Demographic Controls		X	X	X	X	X
Population Weights			X	X	X	X
R-Squared	0.015	0.136	0.149	0.147	0.152	0.163
Sample Size	1,033	1,033	1,033	1,033	1,033	1,033
Panel B - Danish Registry Sample						
ED Skill (AG Score)	0.343	0.211	0.275			
	[0.051]	[0.046]	[0.051]			
Demographic Controls		X	X			
Population Weights			X			
R-Squared	0.019	0.253	0.232			
Sample Size	2,297	2,297	2,297			

ED skill and decision intensity

- Interact AG score with occupation decision intensity (0-10 percentile scale)

ED skill and decision intensity

- Interact AG score with occupation decision intensity (0-10 percentile scale)
  - compare to interactions with other cognitive assessments

ED skill and decision intensity

- Interact AG score with occupation decision intensity (0-10 percentile scale)
  - compare to interactions with other cognitive assessments
- Robust to other categorizations

Table 5A - Allocative Skill Predicts Income More in Decision-Intensive Occupations

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)
ED Skill (AG Score)	4,200	3,758	4,701		5,059
	[1,381]	[1,318]	[1,536]		[1,622]
* Decision Intensity	**1,115**	1,177	1,064		1,126
	[497]	[467]	[506]		[507]
Decision Intensity (O*NET)	5,793	4,031	3,907	3,963	3,984
	[468]	[456]	[474]	[477]	[483]
Nonverbal IQ (Ravens)				2,215	1,760
				[1,540]	[1,610]
* Decision Intensity				602	416
				[579]	[593]
Cognitive Reflection Test					927
					[1,999]
* Decision Intensity					631
					[624]
Berlin Numeracy Test					-3,921
					[1,825]
* Decision Intensity					-1,015
					[558]
Demographic Controls		X	X	X	X
Population Weights			X	X	X
R-Squared	0.121	0.229	0.240	0.231	0.248
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 5A - Allocative Skill Predicts Income More in Decision-Intensive Occupations

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)
ED Skill (AG Score)	4,200	3,758	4,701		5,059
	[1,381]	[1,318]	[1,536]		[1,622]
* Decision Intensity	**1,115**	**1,177**	**1,064**		1,126
	[497]	**[467]**	**[506]**		[507]
Decision Intensity (O*NET)	5,793	4,031	3,907	3,963	3,984
	[468]	[456]	[474]	[477]	[483]
Nonverbal IQ (Ravens)				2,215	1,760
				[1,540]	[1,610]
* Decision Intensity				602	416
				[579]	[593]
Cognitive Reflection Test					927
					[1,999]
* Decision Intensity					631
					[624]
Berlin Numeracy Test					-3,921
					[1,825]
* Decision Intensity					-1,015
					[558]
Demographic Controls		X	X	X	X
Population Weights			X	X	X
R-Squared	0.121	0.229	0.240	0.231	0.248
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 5A - Allocative Skill Predicts Income More in Decision-Intensive Occupations

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)
ED Skill (AG Score)	4,200	3,758	4,701		5,059
	[1,381]	[1,318]	[1,536]		[1,622]
* Decision Intensity	1,115	1,177	**1,064**		1,126
	[497]	[467]	**[506]**		[507]
Decision Intensity (O*NET)	5,793	4,031	3,907	3,963	3,984
	[468]	[456]	[474]	[477]	[483]
Nonverbal IQ (Ravens)				2,215	1,760
				[1,540]	[1,610]
* Decision Intensity				**602**	416
				[579]	[593]
Cognitive Reflection Test					927
					[1,999]
* Decision Intensity					631
					[624]
Berlin Numeracy Test					-3,921
					[1,825]
* Decision Intensity					-1,015
					[558]
Demographic Controls		X	X	X	X
Population Weights			X	X	X
R-Squared	0.121	0.229	0.240	0.231	0.248
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 5A - Allocative Skill Predicts Income More in Decision-Intensive Occupations

Panel A - U.S. Survey Sample

	(1)	(2)	(3)	(4)	(5)
ED Skill (AG Score)	4,200	3,758	4,701		5,059
	[1,381]	[1,318]	[1,536]		[1,622]
* Decision Intensity	1,115	1,177	**1,064**		**1,126**
	[497]	[467]	**[506]**		**[507]**
Decision Intensity (O*NET)	5,793	4,031	3,907	3,963	3,984
	[468]	[456]	[474]	[477]	[483]
Nonverbal IQ (Ravens)				2,215	1,760
				[1,540]	[1,610]
* Decision Intensity				**602**	**416**
				[579]	**[593]**
Cognitive Reflection Test					927
					[1,999]
* Decision Intensity					**631**
					[624]
Berlin Numeracy Test					-3,921
					[1,825]
* Decision Intensity					**-1,015**
					[558]
Demographic Controls		X	X	X	X
Population Weights			X	X	X
R-Squared	0.121	0.229	0.240	0.231	0.248
Sample Size	1,003	1,003	1,003	1,003	1,003

Table 5B - Allocative Skill Predicts Income More in Decision-Intensive Occupations

Panel B - Danish Registry Sample

	(1)	(2)	(3)
ED Skill (AG Score)	2,144	3,387	2,558
	[682]	[658]	[611]
* Decision Intensity	**679**	**563**	**630**
	[272]	**[245]**	**[253]**
Decision Intensity (O*NET)	4,879	3,706	3,826
	[278]	[298]	[314]
Demographic Controls		X	X
Population Weights			X
R-Squared	0.131	0.306	0.321
Sample Size	2,297	2,297	2,297

ED Skill Predicts Income in Two Countries

- Theory and measurement paradigm for assessing individual differences in quality of economic decision-making

ED Skill Predicts Income in Two Countries

- Theory and measurement paradigm for assessing individual differences in quality of economic decision-making
- DMs assign heterogeneous factors to tasks, information is costly to acquire

ED Skill Predicts Income in Two Countries

- Theory and measurement paradigm for assessing individual differences in quality of economic decision-making
- DMs assign heterogeneous factors to tasks, information is costly to acquire
    - Performance diffs measure DM's *marginal product of attention*

ED Skill Predicts Income in Two Countries

- Theory and measurement paradigm for assessing individual differences in quality of economic decision-making
- DMs assign heterogeneous factors to tasks, information is costly to acquire
  - Performance diffs measure DM's *marginal product of attention*
- The Assignment Game, a novel decision-making task that predicts income conditional on IQ, education

ED Skill Predicts Income in Two Countries

- Theory and measurement paradigm for assessing individual differences in quality of economic decision-making
- DMs assign heterogeneous factors to tasks, information is costly to acquire
  - Performance diffs measure DM's *marginal product of attention*
- The Assignment Game, a novel decision-making task that predicts income conditional on IQ, education
  - Very similar results in US and Danish registry samples

ED Skill Predicts Income in Two Countries

- Theory and measurement paradigm for assessing individual differences in quality of economic decision-making
- DMs assign heterogeneous factors to tasks, information is costly to acquire
  - Performance diffs measure DM's *marginal product of attention*
- The Assignment Game, a novel decision-making task that predicts income conditional on IQ, education
  - Very similar results in US and Danish registry samples
- Decision-making skills, attention, and labor productivity

Thanks!

david_deming@harvard.edu