# Misguided Effort

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# Motivation

# A basic inference problem

- You submitted to a top journal
- You think highly about the quality of your work
- You receive a rejection

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- You submitted to a top journal
- You think highly about the quality of your work
- You receive a rejection
  - What do you learn about the quality of your work and the fairness of the review process?
  - How do these inferences affect your future effort?

# A basic inference problem

- Psychology literature: people attribute their achievements to their own merits but their failures to external fundamentals (see Mezulis et al., 2004, for a review).
  - Rejection: "the review process is unfair"
  - Acceptance: "my work is great"

# Misguided inference

- Heidhues et al. (2018) and Hestermann and Le Yaouanq (2021) model attribution bias as an inference problem.
  - Individuals observe an outcome, but cannot identify the effect of one's ability (e.g., scholarship quality) and the external fundamental (e.g., fairness of review process).
  - Individuals with miscalibrated priors about their ability draw misguided inferences about the external fundamental.
  - Misguided inference leads to suboptimal decision making.

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  - Individuals observe an outcome, but cannot identify the effect of one's ability (e.g., scholarship quality) and the external fundamental (e.g., fairness of review process).
  - Individuals with miscalibrated priors about their ability draw misguided inferences about the external fundamental.
  - Misguided inference leads to suboptimal decision making.
- Experiments confirm misguided inference (Goette and Kozakiewicz, 2022; Marray et al., 2020) but they do not study the causal impact on decision making.

# Research question

Biased beliefs about one's ability

$\rightarrow$ Misguided inferences about environment

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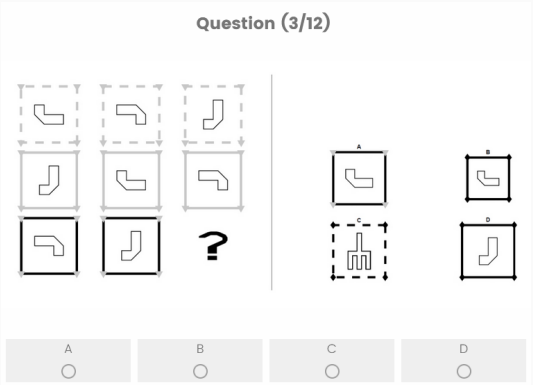
**Labor Market Setup:**

- Work on an ability-based task
- Hold biased beliefs about how skilled they are
- Receive feedback
- Can make inferences about the returns to effort from feedback
- Work on a subsequent effort-task

# Experimental Design

# Work on an ability-based task

- Logic quiz with 12 questions (Civelli et al., 2018)
- EASY and DIFFICULT quiz versions (Moore and Healy, 2008).
  - Questions 1-7 are common.
  - Questions 8-12 vary across EASY and DIFFICULT quiz versions.



## Form beliefs about their relative performance

- Beliefs about likelihood of scoring in the top half among a group of 4.
- Performance prior: $\gamma \in (0, 1)$
- Incentivized with the Binarized Scoring Rule (Prize of 1$).

# Receive payoff feedback

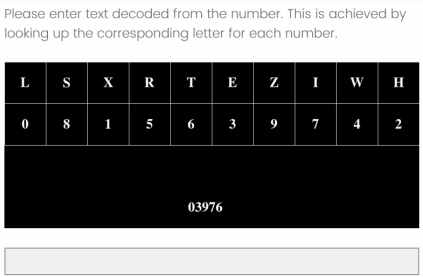
- Participants receive payments from two different evaluators (evaluator 1 and evaluator 2):
  - Performance Evaluator: $2 if they score in the top half, and $0 otherwise
  - Random Evaluator: $2 if a coin toss lands on heads, and $0 otherwise
- We randomly assign these roles to evaluator 1 and evaluator 2.

# Receive payoff feedback

- Payoff feedback is based on logic quiz performance, the outcome of the coin toss and the randomly assigned evaluator roles:
  - BOTH HIGH (Evaluator 1: \$2, Evaluator 2: \$2) $\rightarrow$ high ability type.
  - BOTH LOW (Evaluator 1: \$0, Evaluator 2: \$0) $\rightarrow$ low ability type.
  - MIXED 1 (Evaluator 1: \$2, Evaluator 2: \$0)
  - MIXED 2 (Evaluator 1: \$0, Evaluator 2: \$2)
- MIXED 1 and MIXED 2 groups do not learn their ability type and proceed to period 2.

# Work on a real effort-task

- Choose how much to work (1–25 decoding tasks).
- Payment is based on evaluator 1 type from period 1:
  - If evaluator 1 is chance based, no payment (zero returns to effort).
  - If evaluator 1 is performance based, 10 cents per task (positive returns to effort).



# Form beliefs about the evaluator 1 type (returns to effort)

- Beliefs about likelihood that evaluator 1 is the performance based evaluator (returns to effort beliefs).
- Returns to effort beliefs: $\theta \in (0, 1)$

# Theoretical Predictions

# No learning about ability ($\gamma$)

- MIXED 1 and MIXED 2 payoff feedback provides no information about participants' relative performance in the logic quiz.

$$Pr(H|s_i = H, s_{-i} = L) = \frac{Pr(H)Pr(s_i = H, s_{-i} = L|H)}{Pr(s_i = H, s_{-i} = L)} = \gamma \quad (1)$$

## Learning about the returns to effort ($\theta$)

- MIXED 1 and MIXED 2 payoff feedback flips the direction of learning about the returns to effort.
- MIXED 1:

$$Pr(P|s_1 = H, s_2 = L) = \frac{Pr(P)Pr(s_1 = H, s_2 = L|P)}{Pr(s_1 = H, s_2 = L)} = \gamma \tag{2}$$

- MIXED 2:

$$Pr(P|s_1 = L, s_2 = H) = \frac{Pr(P)Pr(s_1 = L, s_2 = H|P)}{Pr(s_1 = L, s_2 = H)} = 1 - \gamma \tag{3}$$

# Misguided inference

- Definitions:
  - Prior Bias: $\Delta\gamma \stackrel{\text{def}}{=\!=} \gamma - \gamma^*$; Overconfidence: $\Delta\gamma > 0$; Underconfidence $\Delta\gamma < 0$
  - Misguided inference: $\Delta\theta \stackrel{\text{def}}{=\!=} \theta - \theta^*$
- Bayesian misguided inference:
  - Mixed 1: $\Delta\theta = \theta - \theta^* = \gamma - \gamma^* = \Delta\gamma$
  - Mixed 2: $\Delta\theta = \theta - \theta^* = 1 - \gamma - (1 - \gamma^*) = \gamma^* - \gamma = -\Delta\gamma$

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- Bayesian misguided inference:
  - MIXED 1: $\Delta\theta = \theta - \theta^* = \gamma - \gamma^* = \Delta\gamma$
  - MIXED 2: $\Delta\theta = \theta - \theta^* = 1 - \gamma - (1 - \gamma^*) = \gamma^* - \gamma = -\Delta\gamma$
- **Hypothesis 1:** *Overconfident individuals will be positively misguided in* MIXED 1 *and negatively misguided in* MIXED 2*. Underconfident individuals will be negatively misguided in* MIXED 1 *and positively misguided in* MIXED 2*. More generally, the difference in misguided inference between* MIXED 1 *and* MIXED 2 *increases monotonically in prior bias.*

# Effort provision

- Assume that the expected utility from exerting effort $e$ depends on expected returns to effort provision, $\theta\omega e$, and convex costs of effort, $c(e)$:
  $u(e, \theta) = \theta\omega e - c(e)$

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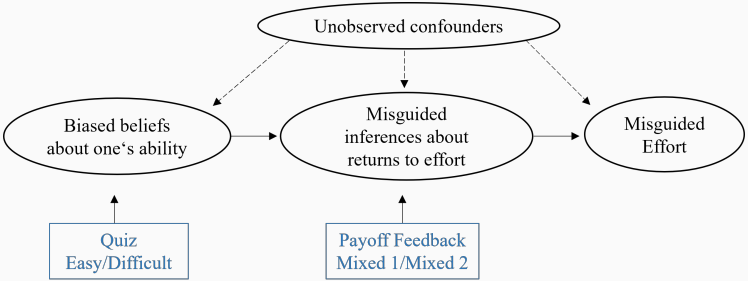
  $u(e, \theta) = \theta\omega e - c(e)$
- **Hypothesis 2:** *The expected utility-maximizing effort is monotonically increasing in returns to effort beliefs $\theta$ and consequently monotonically increasing in the degree of misguided inference $\Delta\theta$.*

# Causal inference




- Our design orthogonally manipulates
  - Extent of prior bias, by quiz difficulty assignment
  - Direction of misguided inference, by evaluator type assignment
- Without confounding effort provision
  - No learning about ability
  - No motivational effects through payoff differences

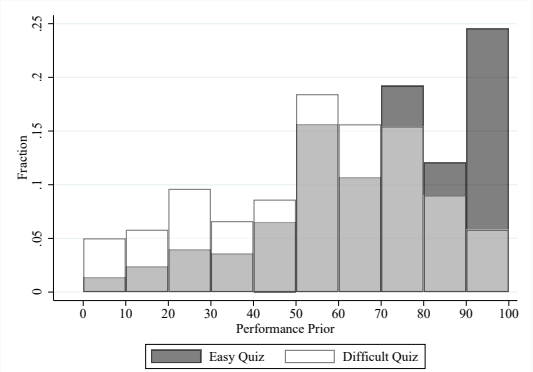
# Results

# Procedures

- N=2,011, US sample on *Prolific*, half of them women.
- N=1,004 received mixed payoff feedback in period 1 and proceed to period 2
- Completion fee: $2; average bonus payments: $1.7.
- Treatments are balanced by observable characteristics.

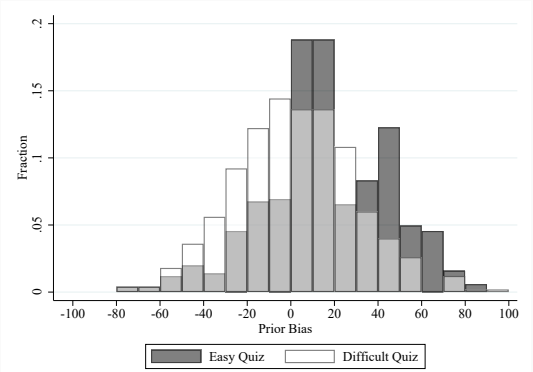
# Performance priors ($\gamma$)

- Higher confidence in EASY compared to DIFFICULT ($p < 0.001$).
- Average performance priors in EASY: 66.7%.
- Average performance priors in DIFFICULT: 51.4%.



# Prior bias ($\Delta\gamma = \gamma - \gamma^*$)

- Higher overconfidence in EASY compared to DIFFICULT ($p < 0.001$).
- Average prior bias in EASY: 15.4%.
- Average prior bias in DIFFICULT: 1.7%.

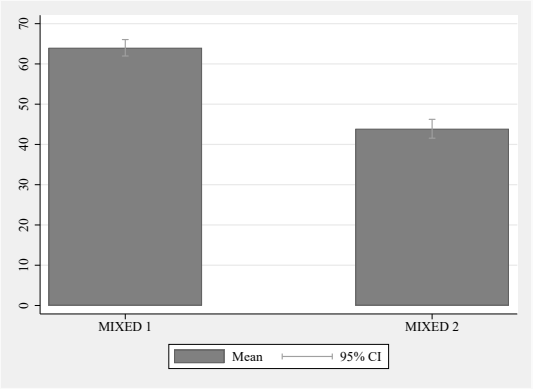


## How do individuals make inferences about the returns to effort in period 2?

- With aggregate overconfidence, hypothesis 1 predicts higher returns to effort beliefs in MIXED 1 compared to MIXED 2.
- Why? Overconfident individuals infer that evaluator 1 is more likely performance based when they receive a high payoff from evaluator 1 (MIXED 1).

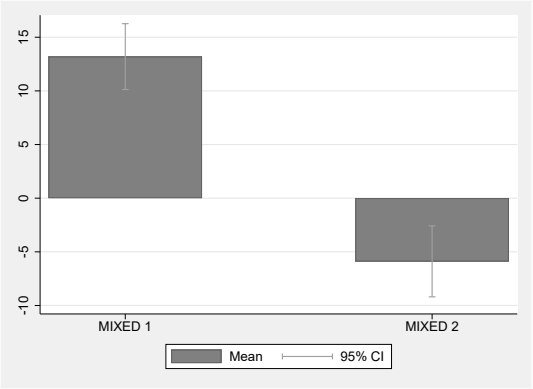
# Returns to effort beliefs ($\theta$)

- Higher returns to effort beliefs in MIXED 1 compared to MIXED 2 ($p < 0.001$).
- Average returns to effort belief in MIXED 1: 64.0%.
- Average returns to effort belief in MIXED 2: 43.9%.

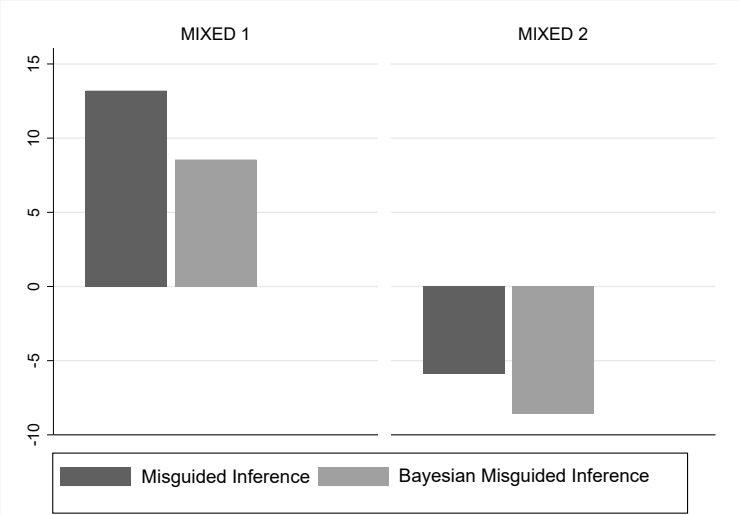


# Misguided inference ($\Delta\theta = \theta - \theta^*$)

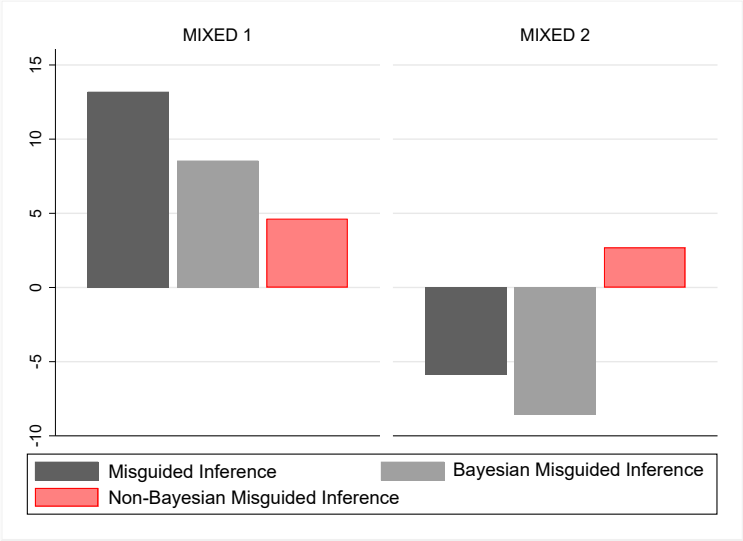
- Higher misguided inference in MIXED 1 compared to MIXED 2 ($p < 0.001$).
- Average misguided inference in MIXED 1: 13.2%.
- Average misguided inference in MIXED 2: -5.9%.



# Are subjects perfect Bayesians?

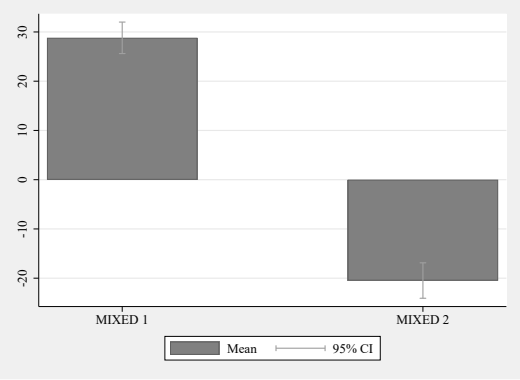


# Decomposition of misguided inference

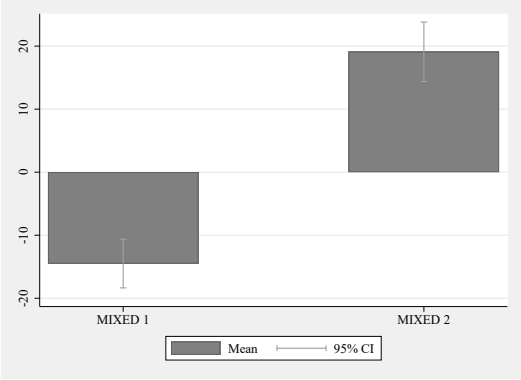


# Misguided inference as a function of prior bias

Panel A: Overconfident Individuals




Panel B: Underconfident Individuals

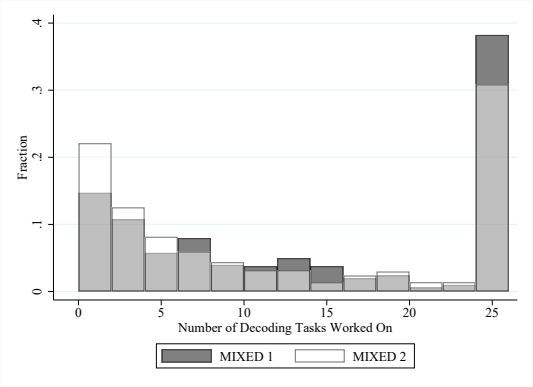


# Misguided inference $\Delta\theta$ as a function of prior bias $\Delta\gamma$

| Dependent Variable: | Misguided Inference | |
|---|---|---|
| | (1) | (2) |
| Mixed 1 | 19.088*** | 19.091*** |
| | (1.704) | (1.896) |
| Prior Bias | -0.759*** | -0.228 |
| | (0.043) | (0.226) |
| Mixed 1*Prior Bias | 1.655*** | 0.771*** |
| | (0.053) | (0.279) |
| Constant | -5.876*** | -5.885 |
| | (1.352) | (1.521) |
| Observations | 1,004 | 1,004 |
| Instrumental Variables | No | Yes |

# Do misguided inferences about the returns to effort causally affect effort provision in period 2?

- Distribution is bi-modal: most people either quit after working on one task or work on all 25 tasks.
- MIXED 1 group is more likely to solve maximum ($p = 0.011$), and MIXED 2 group is more likely to solve minimum ($p = 0.003$).
- Average decoding tasks solved are different ($p < 0.001$):
  - MIXED 1: 13.8
  - MIXED 2: 11.8



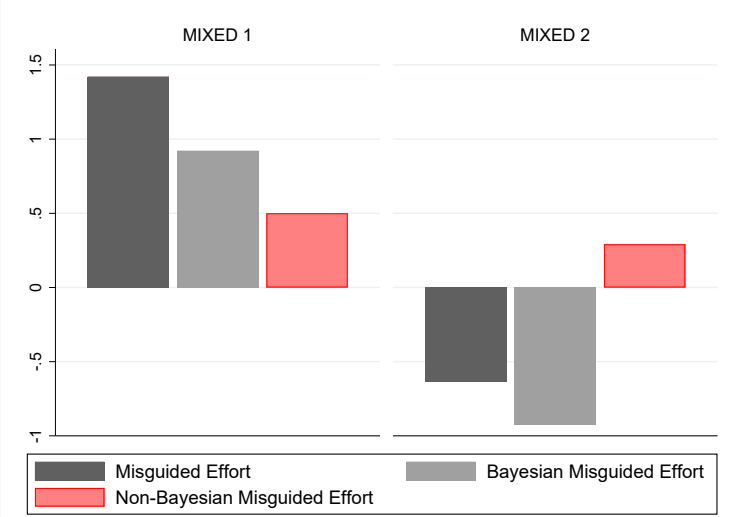
# Causal impact of misguided inference on effort provision (tasks solved)

| Dependent Variable: | Tasks Solved | |
|---|---|---|
| | (1) | (2) |
| Misguided Inference | 0.023*** | 0.108*** |
| | (0.008) | (0.033) |
| Constant | 12.716*** | 12.405*** |
| | (0.318) | (0.345) |
| Observations | 1004 | 1004 |
| Instrumental Variables | No | Yes |

# Misguided effort: What if priors were accurate?

- We predict the level of effort provision with and without misguided returns to effort beliefs.
- We denote the difference between these predictions *misguided effort*.

# Misguided effort



# Conclusion

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- We show that overconfident individuals attribute poor initial labor market outcomes to low returns to effort in the economic environment, and therefore, put less effort into a subsequent real-effort task.
- Underconfident individuals also learn in a misguided manner and adjust their efforts accordingly, but in the opposite direction.
- With misguided learning, it is hard for meritocracy to work. Initial prior biases and initial feedback may have long-lasting consequences on who succeeds.

# Thank you!

- Questions?
- Contact: christoph.drobner@tum.de