### "Hot" and "Cold" Punishment in Public Goods Provision

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#### Punishment in Public Goods Game

- Public goods game:
  - Widely used to study cooperation and fundraising
  - Each group member allocates own endowment between their private accounts and a common group project;
  - All group members receive <u>equal returns</u> from each unit of the group project (MPCR<1);</li>
  - Theory prediction: no one contributes to the group project;
  - Lab findings: average group contribution is positive, falls over time. (Fehr & Gachter, 2000, 2002)
- Costly punishment opportunity in public goods game:
  - Reduce other's earnings at a personal cost;
  - Costly punishment significantly increases contributions (Fehr & Gachter, 2000, 2002)
  - Second order public good.

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#### Mechanisms: How Does Punishment Work?

#### • Strategic mechanism:

- Punish to increase future giving
- Contribute more: just to avoid the loss from being punished.
- Emotional mechanism:
  - Punishing: <u>Anger</u> is an important motivation for punishment (Fehr & Gachter, 2002; Cubitt et al., 2011; Dickinson & Masclet, 2014);
  - Being punished: <u>Shame and guilt</u> lead to subsequent cooperation (Hopfensitz&Reuben, 2009).
- Emotions play an important role in donations:
  - Measure of emotion: <u>self-reported</u> emotional responses;
  - Some evidence that measuring emotion can interferer with main effect
  - Limited direct evidence of emotions as the mechanism behind the effectiveness of punishment. (Fiala and Noussair El 2017; Homer 2021)

#### **Biometrics in Emotional Studies**

• Involuntary responses to stimulus.



- Pupil dilation:
  - Larger pupil diameter indicates higher emotional arousal (Wang et al., 2010) or larger cognitive load (Sirois & Brisson, 2014)
- Skin conductance response (SCR):
  - When internally or externally aroused, skin momentarily becomes a better conductor of electricity. (Not covered today)
  - Joffily et al. (2014) used skin conductance response in public goods game:
    - Punishing behaviors are involved with higher psychological arousal.
    - Negative emotions when being punished predict higher subsequent contribution.

#### Research Question and Contribution

- What we did:
  - Exogenously vary emotional arousal by varying the **timing of punishment**:
    - Post-punishment rule: 'Hot' punishment
    - Pre-punishment rule. 'Cold' punishment
  - Directly measure the psychological process using **pupil dilation**;
- Research question:
  - Would "post" vs. "pre" punishment work differently in increasing cooperation?
  - Does emotion play a role in these two types of punishment?
- Contribution:
  - Develop a new punishment rule that does not rely on emotional arousal;
  - Provide direct evidence of the emotional mechanism of the effectiveness of punishment.

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#### Experimental Design: Public Goods Game

• Fehr & Gachter (2000) setting

Each member's endowment: 20 tokens



- Fixed group matching
- Round 1~10: without punishment;
- Round 11~20: with punishment.

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#### Punishment Rules: Post-Punishment (Hot)

- Post-punishment (Similar to Fehr & Gachter (2000)):
  - Punishment decisions after contribution feedback;
  - 1 token  $\rightarrow$  reduce other's income by 3 tokens
  - Subjects know group members' contributions when making punishment decisions.

#### Punishment Rules: Pre-Punishment (Cold)

- Pre-punishment:
  - Punishment decisions before contribution feedback;
  - Each subject sets a cutoff (not observable by others);
    - They also set the maximum number of group member to be punished.
  - After contribution decisions, whoever contributes <u>below</u> the cutoff automatically triggers punishment;
    - 1 token → reduce other's income by 3 tokens;
  - Subjects do NOT know group members' contributions when making punishment decisions;

#### $\rightarrow$ Less emotional arousal.

#### Game Procedures (with Punishment)



#### Measures of Emotion: Eye Tracker

- Model: Tobii eye tracker X2-60 and Pro Spectrum
- Pupil diameters sampled at 60Hz;



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#### **Experimental Procedure**

- Human Behavior Lab, Texas A&M University.
- Undergraduate participants.
- Between-subject design.

- Post-punishment: 52 participants
  - 36 with pupil dilation data (equipment failure, calibration failure)
- Pre-punishment: 56 participants
  - 36 with pupil dilation data

# Punishment and total contributions

#### **Result:** Average Contribution

 Punishment opportunities increase contributions. (replicating Fehr and Gaechter AER 2000)



Average Contribution

#### Note: Error bars represent standard errors.

Note:

- 1. No significant differences in contribution for subjects with and without eye trackers.
- 2. No significant differences in contribution for round 11~15 between two punishment rules.

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#### Panel Regression of Contribution: Comparison of Two Punishment Rules

• No differences in impact on contributions.

DV: Contribution	(1)	(2)	(3)
w/ punishment	7.650***	8.434***	7.556***
	(1.225)	(1.239)	(0.842)
Pre $\times$ w/ punishment			0.962
			(0.907)
Round	-0.363***	-0.345***	-0.353***
	(0.121)	(0.0941)	(0.0752)
Constant	22.97**	-3.437	3.798
	(10.34)	(10.17)	(6.518)
Individual Controls	Yes	Yes	Yes
Total Observations	940	1060	2000
Individuals	47	53	100

Robust standard errors in parentheses; \* p < .1, \*\* p < .05, \*\*\* p < .01; Individual controls includes: group fixed effect; SVO angle measure; ethnicity; gender; age; whether from Texas; whether economic major. <u>Welfare</u> <u>Comparison</u>

- Part 1: Punishment decisions
  - Does <u>contributing above group average</u> lead to stronger emotional arousal?
  - Does emotional arousal predict more punishment?
- Part 2: Experiences of being punished
  - Does <u>being punished</u> lead to stronger emotional arousal?
  - Does emotional arousal predict higher subsequent contributions?

### **Construction of Pupil Dilation Measures**

- Change in biometric measures from baseline (Sirois & Brisson, 2014)
  - Baseline: average pupil diameters across 0.5 second before a scene



• Measure:

 $BioMeasure_t = RawBioMeasure_t - Baseline$ 

• Take average of  $BioMeasure_t$  across a scene.

### Punishment

• *Hypothesis 1:* If others are free riding (contributing less), it triggers negative emotion (anger).

- *Hypothesis 2*: Negative emotion towards low contributors motivate individuals to punish.
- *H2a*: This mechanism is stronger under the post-punishment treatment.

#### Pupil Dilation When Viewing Contribution

Above average contributors have higher arousal



Note. This figure pools round 11-round 20 together.

Regression

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### Post Punishment: (Hot) Panel Regression of Punishment

• With Post-Punishment rule: high contributor's pupil dilation predicts more punishment.

DV: Punishment Point Assigned to Others	(1)	(2)
Pupil Dilation	-0.188	-0.238
	(0.200)	(0.204)
Above Group Average	0.412***	0.334***
	(0.090)	(0.089)
Above Group Average $ imes$ Pupil Dilation	0.481*	0.621**
	(0.287)	(0.289)
Individual Controls	No	Yes
Total Observations	298	279
Individuals	37	34

9/14/2023 Robust standard errors in parentheses: \* p < .1, \*\* p < .05, \*\*\* p < .01WZB – Recent Advances in the Economics of Philanthropy

### Pre Punishment: (Cold) Panel Regression of Punishment

• With Pre-Punishment rule: high-contributors' pupil dilation **does NOT** predict increase of cutoffs.

DV: Punishment Point Assigned to Others	(1)	(2)
Pupil Dilation <sub>t-1</sub>	0.235	0.198
	(0.164)	(0.172)
Above Group Average <sub>t–1</sub>	0.098	0.087
	(0.065)	(0.064)
Pupil Dilation <sub>t-1</sub> × Above Group Average <sub>t-1</sub>	0.040	0.060
	(0.226)	(0.230)
Individual Controls	No	Yes
Total Observations	581	562
Individuals	36	35

Robust standard errors in parentheses; \* p < .1, \*\* p < .05, \*\*\* p < .01

#### Key Findings on Punishing Decisions

- 1. Under both Hot and Cold (Post- and Pre-Punishment) rules, above-average contributors have higher pupil dilation.
- 2. Under *Post-Punishment* rule, high contributors' pupil dilation predicts more punishment. Arousal predicts "hot" punishment.
- 3. Under *Pre-Punishment* rule, high contributors' pupil dilation does NOT predict more punishment. Arousal does NOT predict "cold" punishment.

### Response to punishment

• *Hypothesis 3:* Being punished triggers negative emotion (shame or guilt).

- *Hypothesis 4:* Negative emotion triggered by being punished motivate individuals to contribute more.
- *H4a:* This mechanism is stronger under the post-punishment treatment.

#### Pupil Dilation When Viewing Punishment Feedback

• Stronger arousal when being punished.



Note. This figure pools round 11 - round 20 together.

**Regression** 

Waitpage



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#### Panel Regression of Contribution Change

#### Pupil dilation does not affect the impact of punishment on contributions, in either treatment

DV: $Contribution_t - Contribution_{t-1}$	(1)	(2)
	Post-Punishment Rule	Pre-Punishment Rule
Punish Pts $Received_{t-1}$	0.936***	1.201***
	(0.207)	(0.212)
Pupil Dilation <sub>t-1</sub>	1.483	0.224
	(2.042)	(2.781)
Punish Pts Received <sub>t-1</sub> × Pupil Dilation <sub>t-1</sub>	-0.213	0.955
	(1.278)	(0.809)
Individual Controls	Yes	Yes
Total Observations	265	255
Individuals	34	35

Standard errors in parentheses; \* p < .1, \*\* p < .05, \*\*\* p < .01 9/14/2023 WZB – Recent Advances in the Economics of Philanthropy

1. Under both the Pre- and the Post-Punishment rules, being punished *increases* pupil dilation.

- 2. However, the pupil dilation does NOT predict subsequent contributions.
  - Subjects increase contributions after being punished, but NOT through pupil dilation.

#### Summary of Findings

- 1. The Post-and the Pre-Punishment rules significantly increase the average group contribution equally well;
  - No differences in welfare effects.
- 2. Although there is emotional arousal triggered by free riders under both punishment rules, this negative emotion predicts more punishment *only* under <u>Post-Punishment rule</u>;
- 3. Although being punished triggers emotional arousal, this arousal does not lead to higher contribution in neither of the punishment rules.
  - In other words, free riders increase their contributions anyways, which does not depend on negative emotion.

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#### Conclusion

 The impact of negative emotion on punishing decisions depends on whether there is a "direct target" of the punishment;

2. For punishment receivers, their increased cooperation is more likely to be a strategic avoidance of future loss, rather than an avoidance of shameful feeling;

3. Pre-commitment to penalty before cooperation is an effective mechanism that relies less on negative emotion.

### Thank you!

#### Please send comments ceckel@tamu.edu

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### **Comparison of Welfare Increase**

- Both punishment opportunities significantly increase welfare;
- There is no differences in the welfare increase between Pre- and Post-Punishment rules.

DV: Individual Payoff	(1)	(2)	(3)
	Post	Pre	Pooled
w/ punishment	$2.185^{**}$	3.035***	2.469***
	(0.927)	(0.835)	(0.631)
Pre $\times$ w/ punishment			0.314
			(0.685)
Individual Controls	Yes	Yes	Yes
Total Observations	940	1060	2000
Individuals	47	53	100

Standard errors in parentheses; \* p < .1, \*\* p < .05, \*\*\* p < .01



## Panel Regression of Pupil Dilation When Viewing Contribution Feedback

#### • Being above group average increases pupil dilation.

DV: Pupil Dilation	(1)	(2)
Pre-Punishment	0.0172	0.0410
	(0.0344)	(0.0430)
Above Group Average	0.0591*	0.0652**
	(0.0303)	(0.0315)
Pre-Punishment # Above Group Average	-0.0511	-0.0626
	(0.0400)	(0.0445)
Contribution Gap	-0.00612	-0.00469
	(0.00581)	(0.00613)
Pre-Punishment # Contribution Gap	-0.00161	-0.00259
	(0.00772)	(0.00795)
Above Group Average # Contribution Gap	0.00992	0.00736
	(0.00800)	(0.00919)
Pre-Punishment # Above Group Average # Contribution Gap	0.0111	0.0117
	(0.0108)	(0.0124)
Individual Controls	No	Yes
Total Observations	578	549
Individuals	72	68

Standard errors in parentheses; \* p < .1, \*\* p < .05,  $B^{\pm}$  peger Advances in the Economics of Philanthropy



### Panel Regression of Pupil Dilation When Viewing Punishment Feedback

#### Being punished triggers higher pupil dilation.

	(1)	(2)
Punishment Points Received	$0.006^{*}$	0.010***
	(0.00312)	(0.00333)
Pre-Punishment	$0.076^{***}$	$0.099^{***}$
	(0.0192)	(0.0325)
Pre-Punishment × Punishment Points Received	-0.006	-0.009**
	(0.00419)	(0.00453)
Individual Controls	No	Yes
Total Observations	600	569
Individuals	73	69

Standard errors in parentheses; \* p < .1, \*\* p < .05, \*\*\* p < .01



### **Screenshot: Waiting Page**



(Round 1 of 10) will start in 3 seconds.



### **Screenshot: Contribution Page**

#### Contribution Stage (Round 1 of 10)

How much will you contribute to the project (from 0 to 20)?

#### Next



#### **Screenshot: Belief Elicitation Page**

#### Belief Stage (Round 1 of 10)

What do you think will be the average contribution from your group members (from 0 to 20)?

#### Next



### **Screenshot: Cutoff Page**

#### Punishment Rule Stage (Round 3 of 10)

Group member whose contribution is below your cutoff will automatically receive a deduction of **3 tokens**. You will pay **1 token** per deduction on one member.

Please choose your cutoff:

Please choose the maximum number of group members you are willing to punish:

Next



### **Screenshot: View Contribution Page**

#### **Other's contribution**

This page will automatically expire in **10 seconds**. Contribution of other group members are displayed in **random order**.

You contributed:	
	10
Other group members contributed:	
	2
	14
	20

### **Screenshot: Punishment Decision Page**

#### Reduction Stage (Round 2 of 10)

By transferring 1 token from your endowment you decrease the income of another participant by 3 tokens.

Other player's contribution:	Send Deduction to this player	
18	⊖ Yes	No
0	Yes	O No
10	⊖ Yes	No
Next		

### **Screenshot: View Punishment Page**

#### *Post-Punishment:*

Reduction Stage	
This page will automatically expire in <b>7 seconds</b> .	
The number of group members who reduced your income:	1
Total deductions you received in this round:	-3

#### **Pre-Punishment:**

<b>Reduction Stage</b>		
This page will automatically expire in <b>10 second</b>	ds.	
Your contribution is below other member's cu	toff:	1 times
Total deductions you received in this round:		-3 Tokens
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### **Screenshot: View Results Page**

#### Results (Round 1 of 10)

Your endowment:		20
You contributed:	-	10
Your earnings from the project:	+	4.0
Deductions you sent cost:	-	2
Deductions you received:	-	0
Your payoff in this round:	=	12.0
Next		



### Distribution of punishment by contribution level

• These two punishment rules are equally "harsh" in punishment, and mostly targeting at low contributors.





#### Distribution of Cutoffs under Pre-Punishment



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#### Trend of Cutoffs under Pre-Punishment



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