Emotions and Punishments in Public Good Experiments: A Biometric Investigation

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Introduction: Punishment in Public Goods Game

- Public goods game:
  - Widely used to study cooperation;
  - Each group member allocates own endowment between their private accounts and a common group project;
  - All group members equally share the return from the group project;
  - Theory prediction: no one contribute to the group project;
  - Lab findings: average group contribution converges to zero (Fehr & Gachter, 2000, 2002)

- Costly punishment opportunity in public goods game:
  - Reduce other's earnings at own costs;
  - Costly punishment significantly increases contributions (Fehr & Gachter, 2000, 2002)

Mechanisms: How Does Punishment Work?

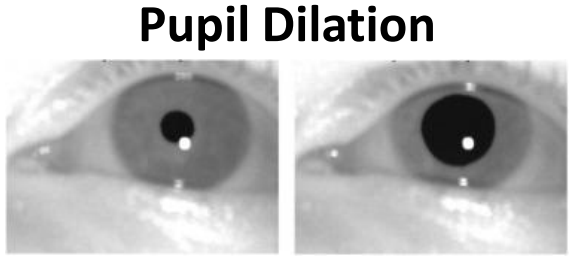
- Strategic mechanism: Avoid the loss from being punished.

- **Emotional mechanism**:
  - Punishing: **Anger** is an important motivation (Fehr & Gachter, 2002; Cubitt et al., 2011; Dickinson & Masclet, 2014);
  - Being punished: **Shame and guilt** lead to subsequent cooperation (Hopfensitz&Reuben, 2009).
  - Measure of emotion: self-reported emotional responses;

- Sparse direct evidence of emotions as the mechanism behind the effectiveness of punishment.

Biometrics in Emotional Studies

- Involuntary responses to arousals.



- Pupil dilation:
  - Larger pupil diameter indicates larger cognitive load (Sirois & Brisson, 2014) / higher emotional arousals (Wang et al., 2010)
- Skin conductance response (SCR):
  - When internally or externally aroused, skin momentarily becomes a better conductor of electricity.
- Joffily et al. (2014) used skin conductance response in public goods game:
  - Punishing behaviors are involved with higher psychological arousals.
  - Negative emotions when being punished predict higher subsequent contribution.

Research Question and Contribution

- What we did:
  - Exogenously vary the emotional arousals by varying the punishment rules;
    - Post-punishment rule;
    - Pre-punishment rule.
  - Directly measure the psychological process of participants using pupil dilation and skin conductance response;

- Research question:
  - How would “post” vs. “pre” punishment work differently in increasing cooperation?
  - How does emotion play a role in these two types of punishment?

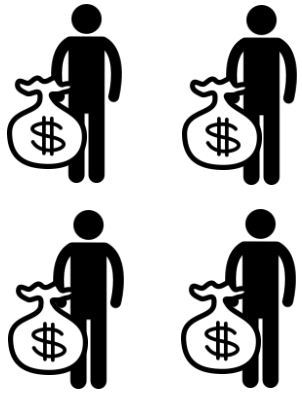
- Contribution:
  - Develop a new punishment rule that involves less emotional arousals compared with the classical punishment rule in Fehr & Gachter (2000);
  - Provide direct evidence of the emotional mechanism of the effectiveness of punishment.

Experimental Design: Public Goods Game

- Fehr&Gachter (2000) setting

Each member's endowment:

20 tokens



Contribute using own endowment

Public Goods Project

Everyone **equally** share returns.

Total return = total contribution*1.6

- Fixed group matching
- Round 1~10: Public goods game without punishment;
- Round 11~20: With Punishment.

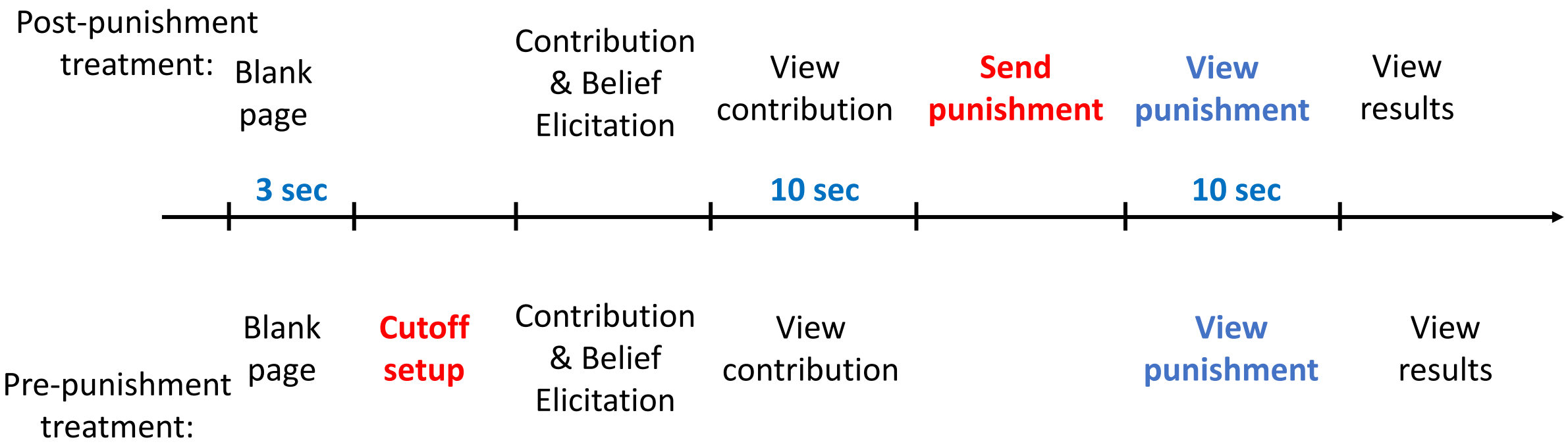
Punishment Rules

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

- Pre-punishment:
  - Punishment decisions before contribution decisions;
  - Each participant sets a **cutoff** (not observable by others);
  - After contribution decisions, whoever contributes below the cutoff automatically triggers punishment;
  - They do NOT know group members' contributions when making punishment decisions;

    → **Less emotional arousals.**

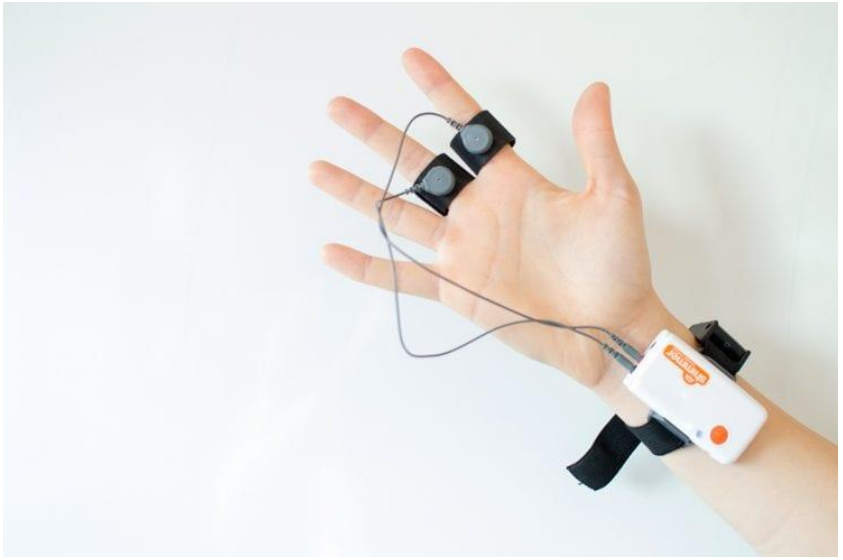
Game Procedures (with Punishment)



Measures of Emotions

Eye Tracker

GSR Device



Hypotheses

- Hypothesis 1 (Punishing others): Negative emotions (anger) towards low contributors motivate individuals to punish.
  - H1a: This mechanism is stronger under the post-punishment treatment.

- Hypothesis 2 (Being punished): Negative emotions (shame and guilt) when being punished motivate individuals to contribute more.
  - H2a: This mechanism is stronger under the post-punishment treatment.

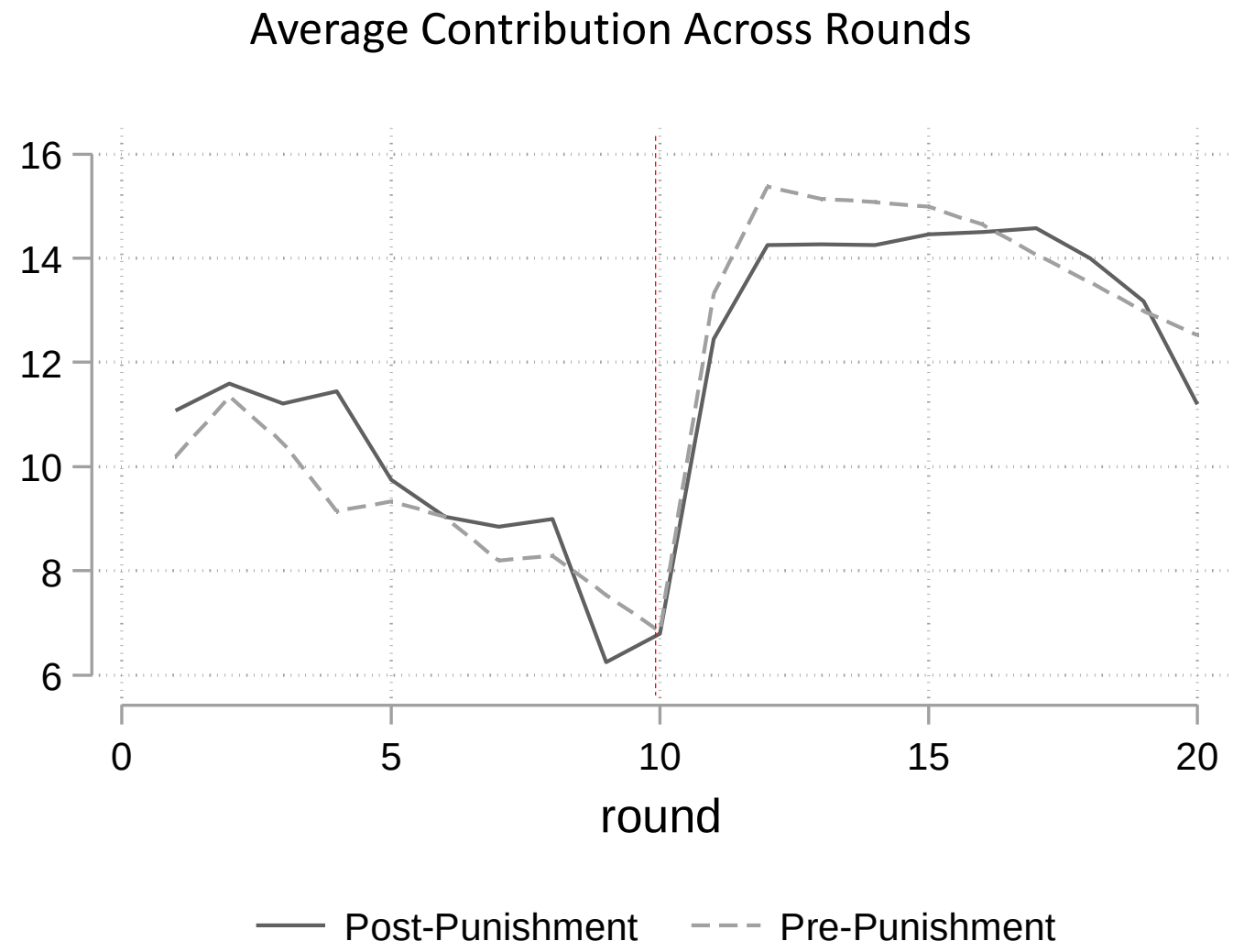
Experimental Procedure

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

- Post-punishment: 52 participants
  - 36 with pupil dilation data
  - 27 with skin conductance response data

- Pre-punishment: 56 participants
  - 36 with pupil dilation data
  - 23 with skin conductance response data

Results: Punishment Opportunity Increases Contributions



Both Punishment Rules Increase Contribution Equally Well

Outcome Variable: Contribution

	(1) Post	(2) Pre	(3) Whole
WithPun	3.731***	3.913***	3.805***
	(0.940)	(0.793)	(0.621)
WithPun*PrePunishTreatment			0.117
			(0.633)
Round	-0.204*	-0.213***	-0.210***
	(0.0896)	(0.0589)	(0.0521)
Belief	0.733***	0.744***	0.732***
	(0.0565)	(0.0474)	(0.0377)
Demographics	Yes	Yes	Yes
Cluster	Group	Group	Group
_cons	6.835**	7.054***	6.937***
	(2.131)	(1.143)	(1.378)
N	1040	1120	2160

Standard errors in parentheses.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

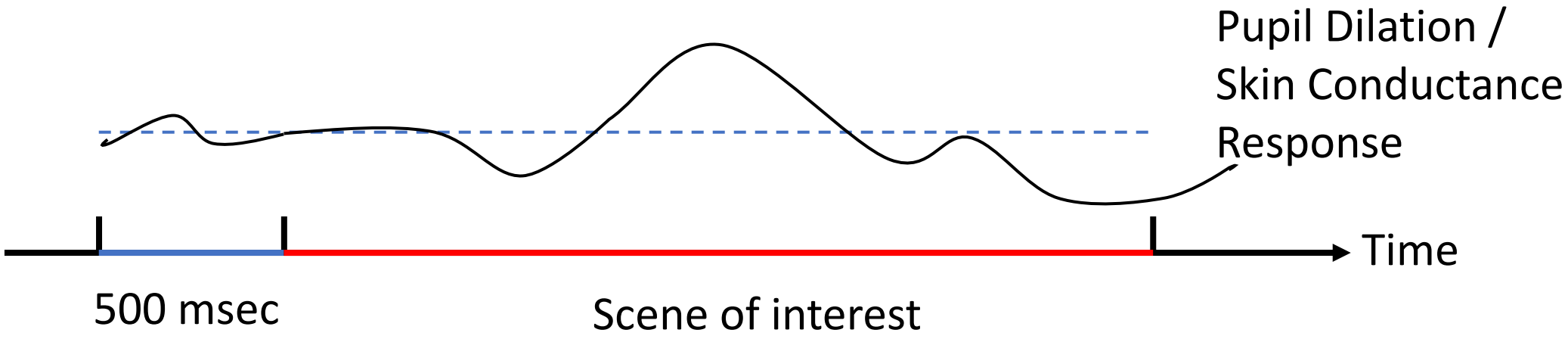
Biometric Analysis

- Part 1: Punishment decisions
  - Does contributing above group average cause more emotional arousals?
  - Do these emotional arousals predict more punishment?

- Part 2: Experiences of being punished
  - Does being punished cause more emotional arousals?
  - Do these emotional arousals predict higher subsequent contributions?

Biometrics Measures

- Change of biometric measures from baseline (Sirois & Brisson, 2014)
  - Baseline: the average raw biometric measures during the 0.5 second before a scene



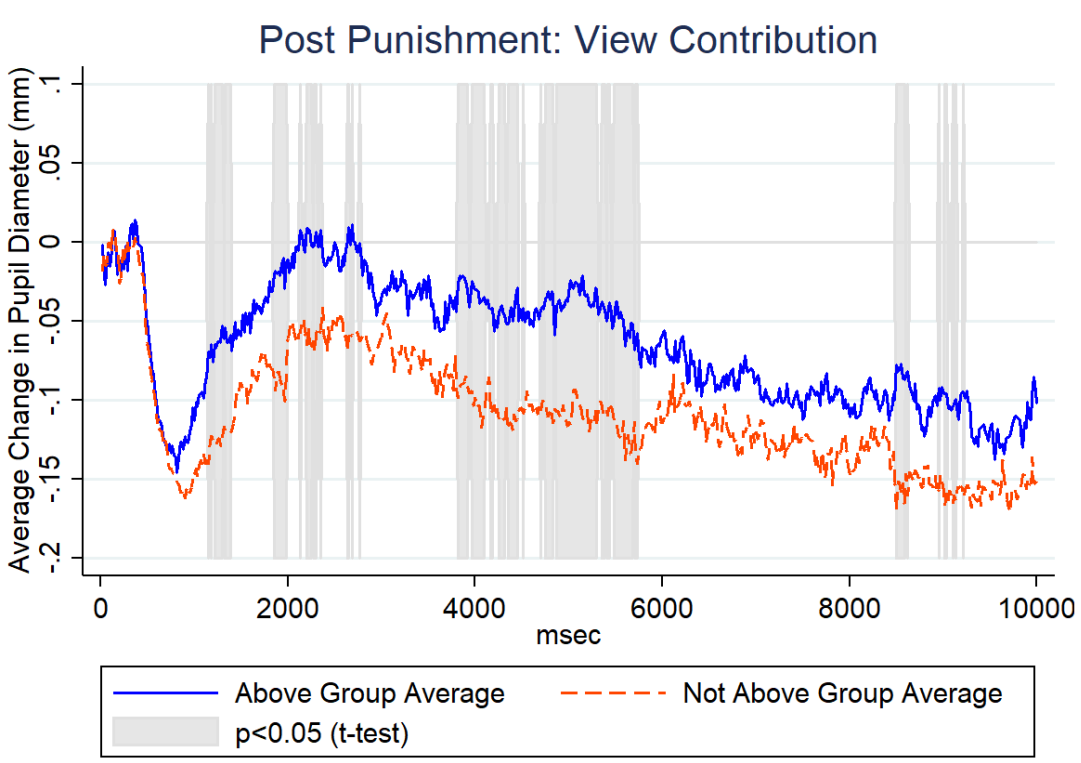
  - Measure:

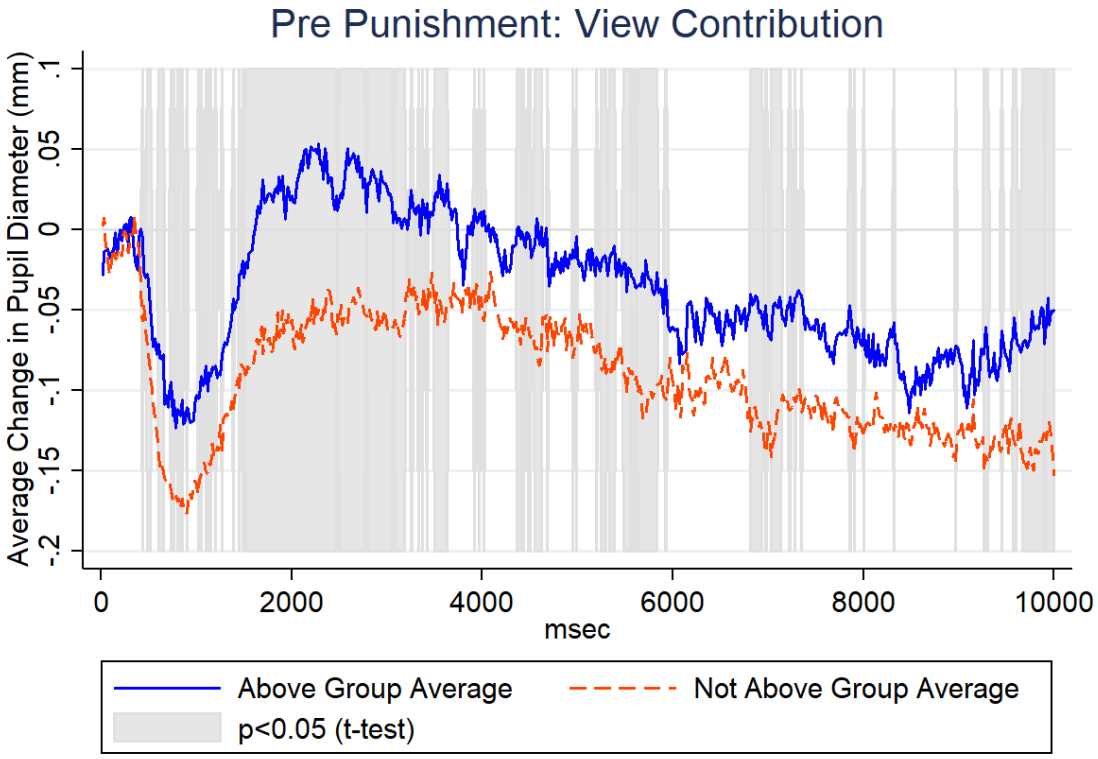
$$BioMeasure_t = RawBioMeasure_t - Baseline$$

  - Take average of $BioMeasure_t$ across a scene.

When Viewing Contribution: Larger Pupil for High Contributors

- Pool round 11~20 together.





Under Post Punishment:
Higher Arousals Predict More Punishment

Outcome variable: Amount of Punishment Sent (**Post Punishment** Treatment Only)

	(1)	(2)
AboveAverage	0.391***	0.300**
	(0.0876)	(0.0929)
PupilDilation	-0.335	
	(0.252)	
PupilDilation*AboveAverage	0.645	
	(0.403)	
SkinConductance		-0.644
		(0.572)
SkinConductance*AboveAverage		1.612*
		(0.812)
_cons	0.391	0.368
	(0.276)	(0.340)
N	298	270

Other controls: Group FE; round.
Biometric measures are during the scene of viewing contribution.
Standard errors in parentheses.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Under Pre Punishment:
Higher Arousals Do NOT Predict Higher Cutoff

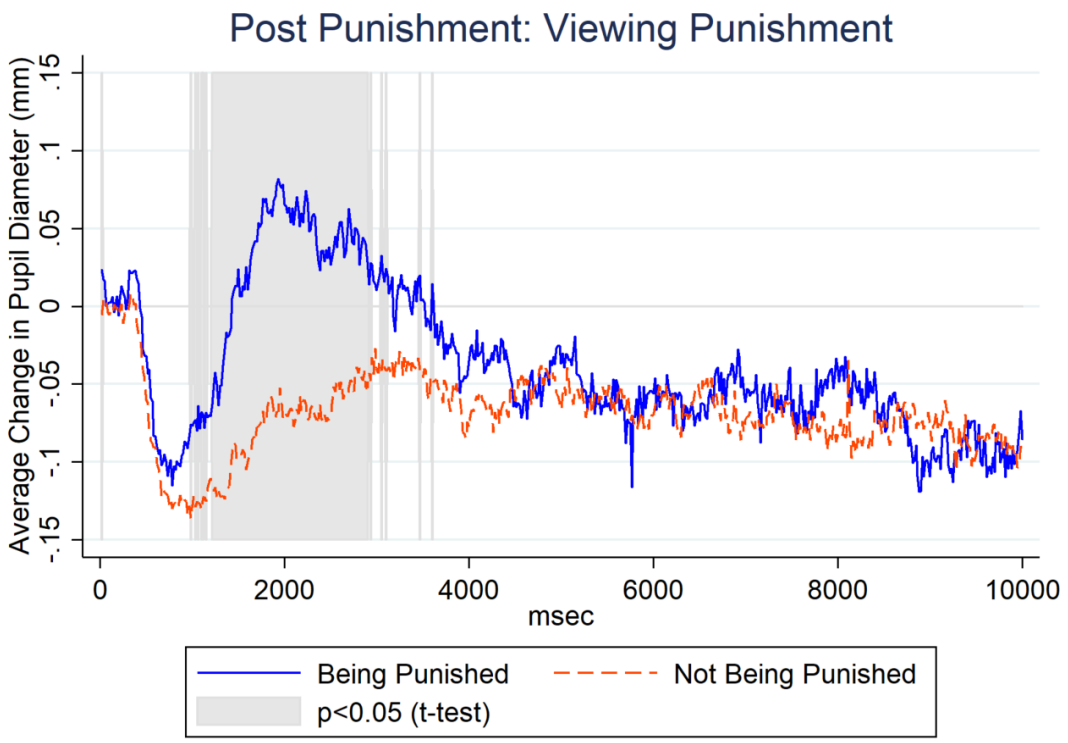
Outcome Variable: Cutoff (**Pre Punishment** Treatment Only)

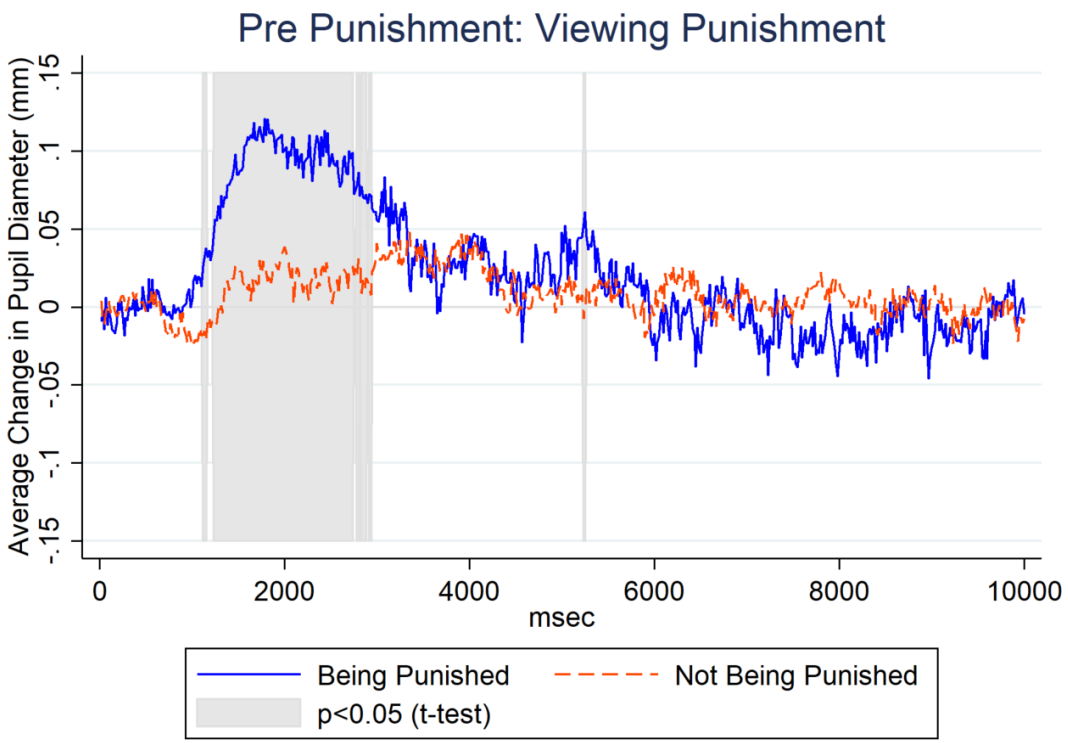
	(1)	(2)
$AboveAverage_{t-1}$	-0.215	0.379
	(0.730)	(0.757)
$PupilDilation_{t-1}$	2.613	
	(2.224)	
$PupilDilation_{t-1}$*$AboveAverage_{t-1}$	-2.832	
	(3.112)	
$SkinConductance_{t-1}$		5.639*
		(2.453)
$SkinConductance_{t-1}$*$AboveAverage_{t-1}$		-12.96**
		(4.955)
_cons	13.10***	12.54***
	(2.627)	(2.413)
N	291	217

Other controls: Group FE; round.
Biometric measures are during the scene of viewing contribution.
Standard errors in parentheses.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

When Viewing Punishment: Larger Pupil Dilation When Being Punished

- Pool round 11~20 together.





Higher Arousals Do Not Predict More Contribution

Outcome Variable: Contribution_t – Contribution_t-1

	(1) High Contributors	(2) Low Contributors
PupilDilation(ViewPunish) $_{t-1}$	1.381	3.834
	(2.581)	(3.024)
PupilDilation(ViewPunish) $_{t-1}$*BePunished$_{t-1}$	-0.959	-3.921
	(7.142)	(5.263)
PreTreatment*PupilDilation(ViewPunish)$_{t-1}$	-3.444	-2.602
	(4.526)	(4.258)
PrePunishTreatment*PupilDilation(ViewPunish)$_{t-1}$*BePunished$_{t-1}$	17.64	6.539
	(10.98)	(7.940)
BePunished$_{t-1}$	-1.449	3.674***
	(1.244)	(1.034)
PrePunishTreatment	-1.805	-0.622
	(5.791)	(2.450)
PrePunishTreatment*BePunished$_{t-1}$	1.233	1.078
	(2.194)	(1.479)
_cons	-0.732	4.981
	(5.572)	(3.158)
N	249	299

Other controls: Group FE; round; belief. Standard errors in parentheses.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Summary of Findings

- Behavioral data:
  - Both punishment rules work equally well in increasing contributions.

- Punishing behaviors:
  - Viewing contribution feedback: high contributors are more aroused than low contributors;
  - Higher arousals of the high contributor predict more punishments, only under post-punishment treatment.

  → Punishing decisions are more impulsive under the post-punishment treatment.

- Being punished:
  - Viewing the punishment feedback: those who are punished are more aroused.
  - This arousal does not encourage individuals to contribute more in the next round.

  → Lack of biometric evidence that punishment increases contribution by causing shame and guilt.

Conclusion

- Two punishment rules in public goods game, varying the timing of punishment.
- Direct examination of hypotheses on the emotional mechanism of punishment.

- Punishment decisions with a clear “target” involve stronger emotions.

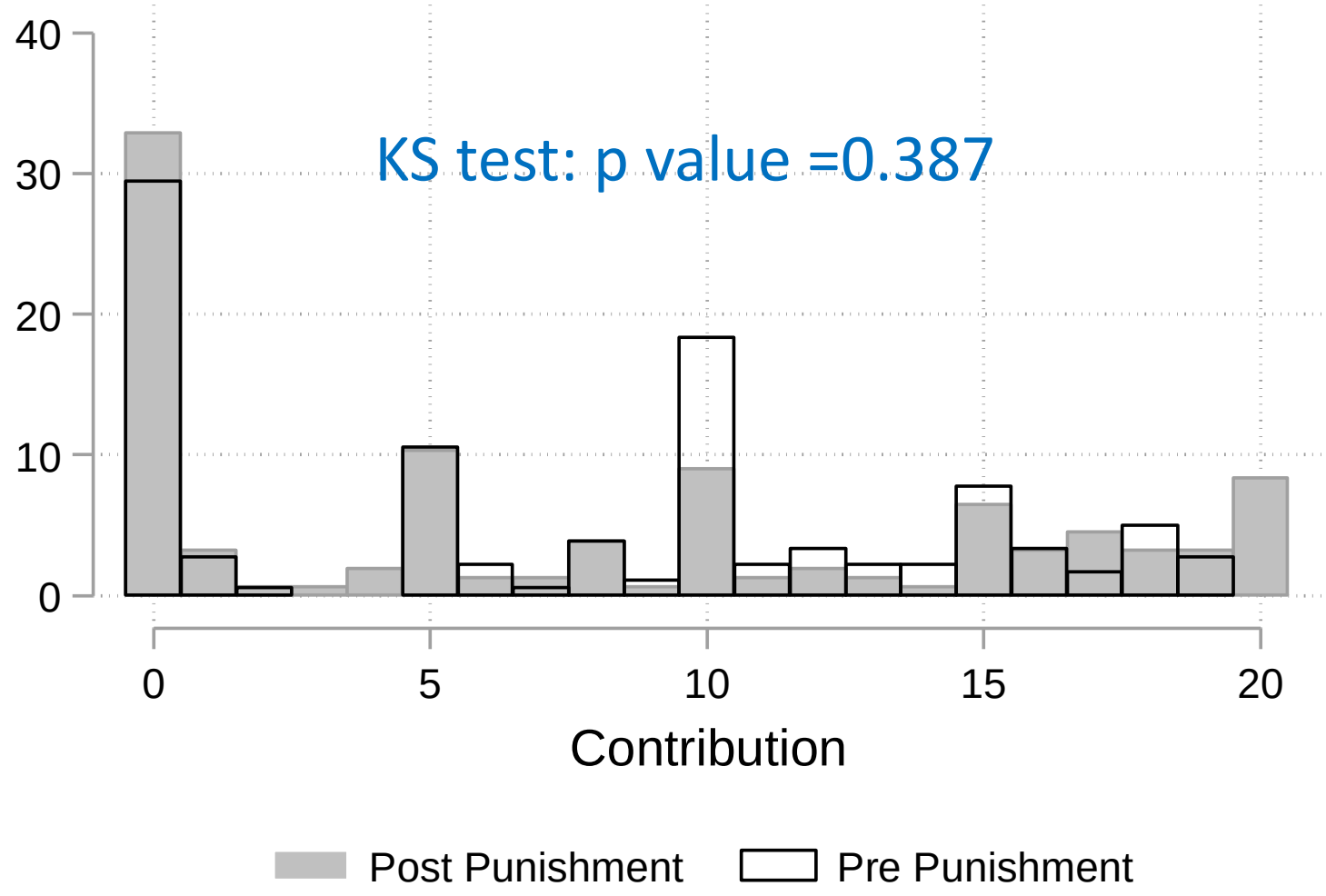
- Being punished causes stronger emotional arousals, but does not predict higher subsequent contribution.
  - Deviate from Joffily et al. (2014)

Thank You!

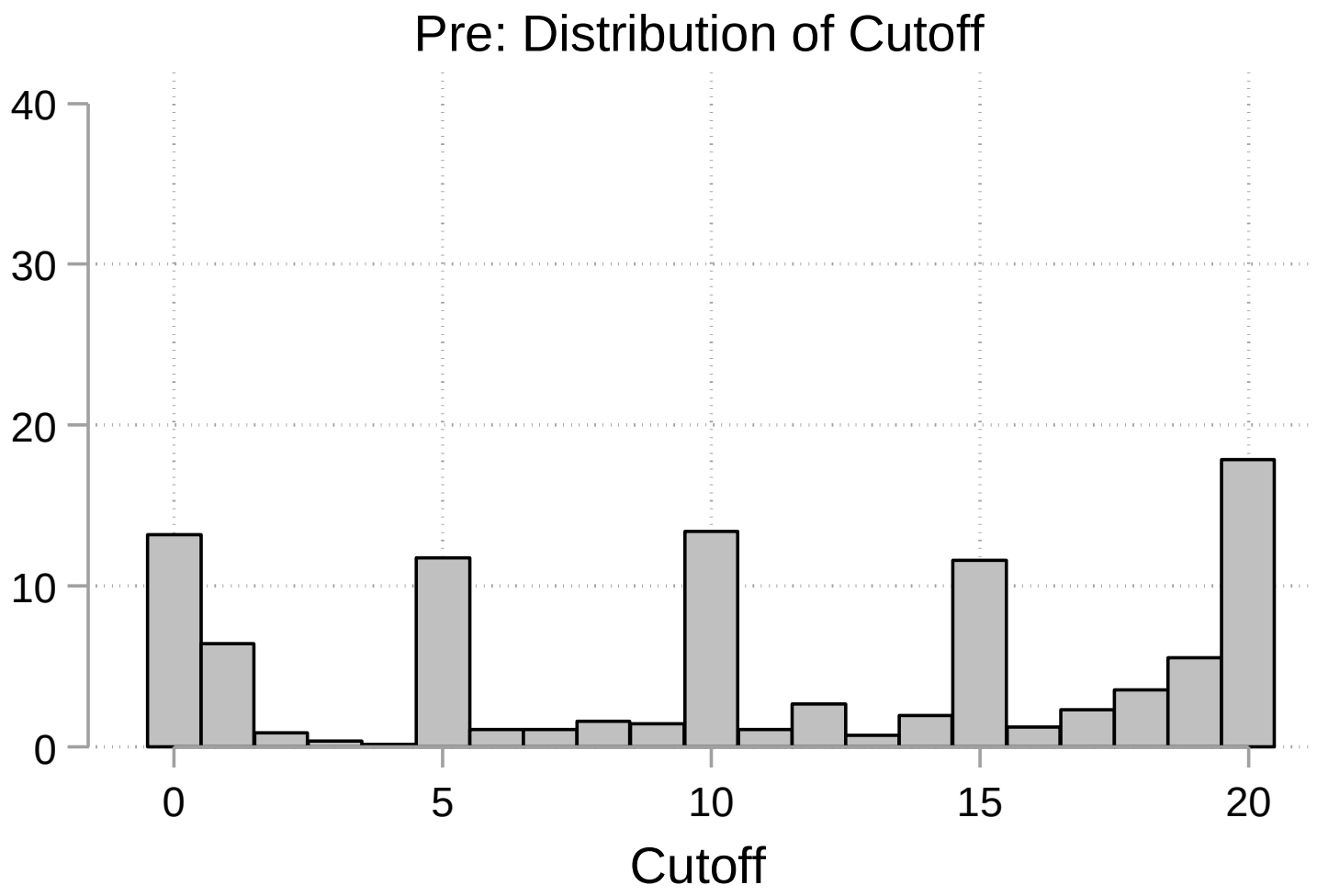
Please email me (yangnanyin@tamu.edu) for any further discussion!

Appendix

Distribution of Contribution Conditional on Being Punished



Distribution of Cutoffs in Pre-Punishment Treatment



Spillovers of Punishment on Subsequent Contributions

Outcome Variable: Contribution_t – Contribution_t-1	
	(1)
$PunishReceived_{t-1}$	0.860***
	(0.113)
$PunishReceived_{t-1}$*$AboveAverage_{t-1}$	-1.361***
	(0.329)
$PunishReceived_{t-1}$*$AboveAverage_{t-1}$*PreTreatment	0.731
	(0.455)
$AboveAverage_{t-1}$	-0.894
	(0.582)
PreTreatment	-1.337
	(1.186)
$PunishReceived_{t-1}$*PreTreatment	-0.0690
	(0.155)
$AboveAverage_{t-1}$*PreTreatment	-0.886
	(0.826)
_cons	0.293
	(1.489)
N	972

- Being punished increases low contributor's subsequent contribution.

Does Being A High Contributor Cause Higher Arousals?

Outcome variable: Biometric Measures When Viewing Contribution Feedback

	(1) Pupil Dilation	(2) Skin Conductance
PrePunishTreatment	-0.00741	0.0534
	(0.123)	(0.0805)
AboveAverage	0.0679*	-0.0111
	(0.0312)	(0.0229)
ContributeGap	-0.00475	0.000171
	(0.00469)	(0.00305)
PrePunishTreatment*AboveAverage	-0.0590	0.00317
	(0.0453)	(0.0356)
PrePunishTreatment*ContributeGap	-0.00160	-0.00400
	(0.00634)	(0.00451)
AboveAverage*ContributeGap	0.00603	0.00218
	(0.00800)	(0.00576)
PrePunishTreatment*ContributeGap*AboveAverage	0.0126	0.00902
	(0.0113)	(0.00892)
_cons	-0.121	0.0491
	(0.117)	(0.0762)

- Being a high contributor leads to higher arousals.

Does being punished cause higher arousals?

Outcome variable: Biometric Measures When Viewing Punishment Feedback

	(1) Pupil Dilation	(2) Skin Conductance
PrePunishTreatment	0.127	0.0570
	(0.0883)	(0.0784)
BeingPunished	0.0466*	0.0101
	(0.0209)	(0.0184)
PrePunishTreatment*BeingPunished	-0.0374	0.00697
	(0.0315)	(0.0296)
_cons	-0.114	0.0481
	(0.0862)	(0.0745)
N	600	482

Other controls: Group FE; round. Standard errors in parentheses.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

- Larger pupil dilation when being punished.

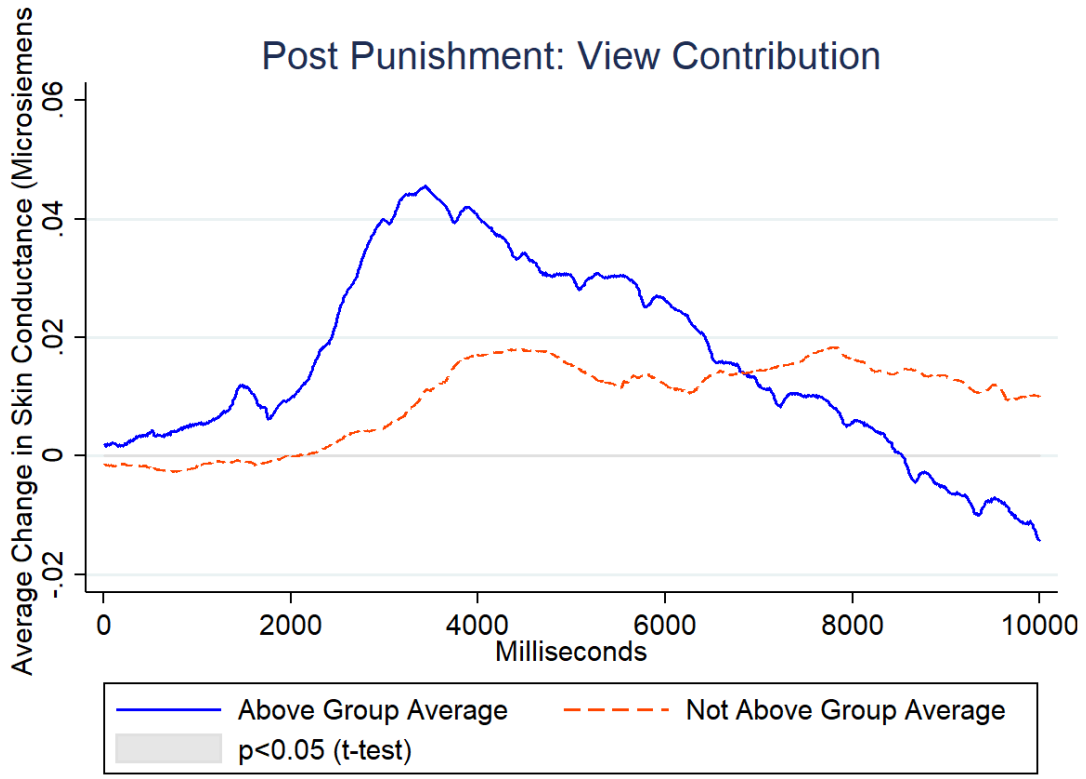
Does this arousal lead to more contributions?

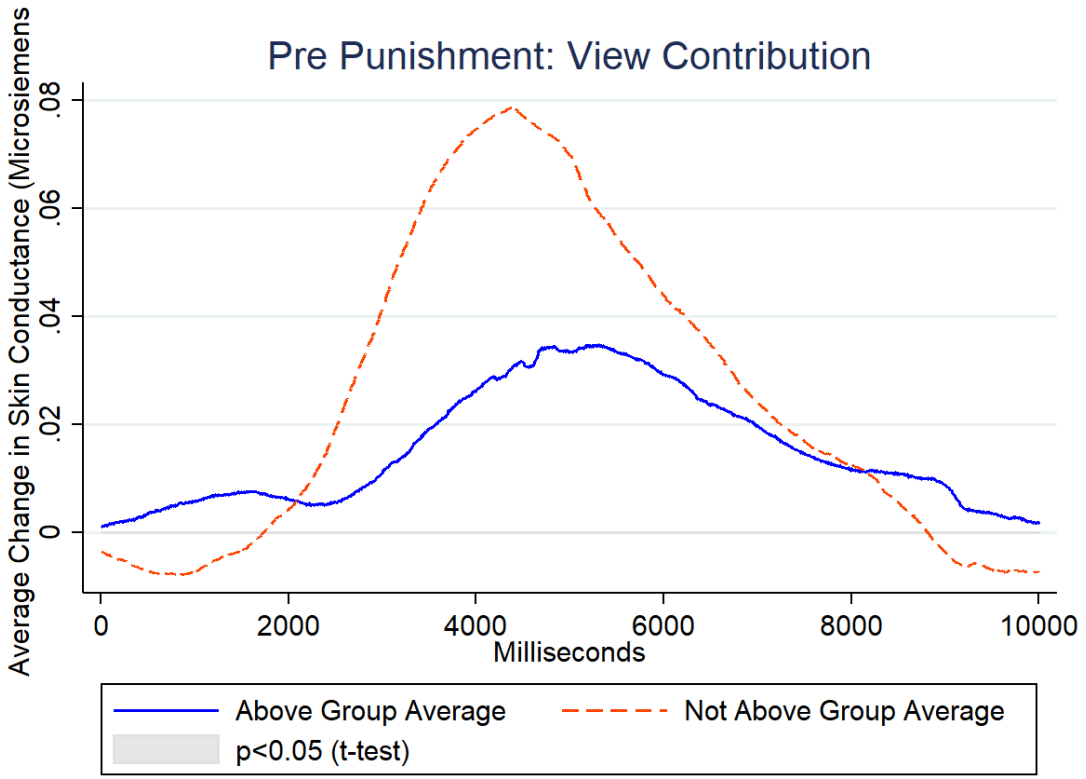
Outcome Variable: Contribution_t – Contribution_t-1

	(1) High Contributors	(2) Low Contributors
$SkinConductance(ViewPunish)_{t-1}$	1.007	11.20
	(2.083)	(8.512)
$SkinConductance(ViewPunish)_{t-1}*PunishReceived_{t-1}$	-3.774	6.736
	(6.925)	(15.10)
$PrePunishTreatment*SkinConductance(ViewPunish)_{t-1}$	-5.611	-10.68
	(4.873)	(9.481)
$PrePunishTreatment*SkinConductance(ViewPunish)_{t-1}*PunishReceived_{t-1}$	-787.5***	-2.977
	(207.7)	(18.83)
$PunishReceived_{t-1}$	-1.555	5.663***
	(1.452)	(1.082)
PrePunishTreatment	-1.636	-0.620
	(5.375)	(2.035)
$PrePunishTreatment*PunishReceived_{t-1}$	0.247	-1.423
	(2.613)	(1.712)
_cons	-2.378	4.288

- Conditional on being punished, higher arousal does not predict higher subsequent contributions.

Skin Conductance Response When Viewing Contribution





Analyzing Skin Conductance Response