

# Examining the effects of construal on financial decision-making using

## fnirs

BPS Cognitive Section Conference, Sept 2022

Dr. Christopher J. Wilson

# Cognitive effects of financial distress

- Financial distress can increase cognitive load (Mani et al., 2020; Vohs, 2013)
- This can affect cognitive processes such as planning, reasoning and decision-making (de Bruijn & Antonides, 2022; Hinson et al., 2003; Hofmann et al., 2012; Mani et al., 2013; Roby & Scott, 2022).
  - Need to attend to finances constantly / stress is draining
  - Payday effect - closer to payday = less money more resource needed to manage
  - Need to constantly exercise self control

# Self-control depletion and financial decisions

# Self-control depletion and financial decisions

- Debate about whether this is self-control, or general cognitive fatigue. ([Hagger et al., 2010; Inzlicht et al., 2014](#))
- In the current research, inhibitory control tasks are also used (Stroop, Go-noGo)
- For the purposes of this research, we will refer use the term **Cognitive Exertion**

Construal could moderate the relationship  
between CL and financial decisions

- Construal level (Trope & Liberman, 2003) can affect financial decisions (Schmeichel et al., 2011; Ülkümen & Cheema, 2011)
- Construal theory:
  - High-level construal = thinking about goals in a more abstract sense such as why we are trying to achieve a goal
  - Low-level construal = thinking in more detail about the necessary steps to achieve a goal
- Construal is both a cause and consequence of cognitive exertion effect (Bruyneel & Dewitte, 2012; Khenfer et al., 2017; Raue et al., 2015; Wan & Agrawal, 2011)

Much of the support offered to those in financial difficulty is knowledge focused

# The current research

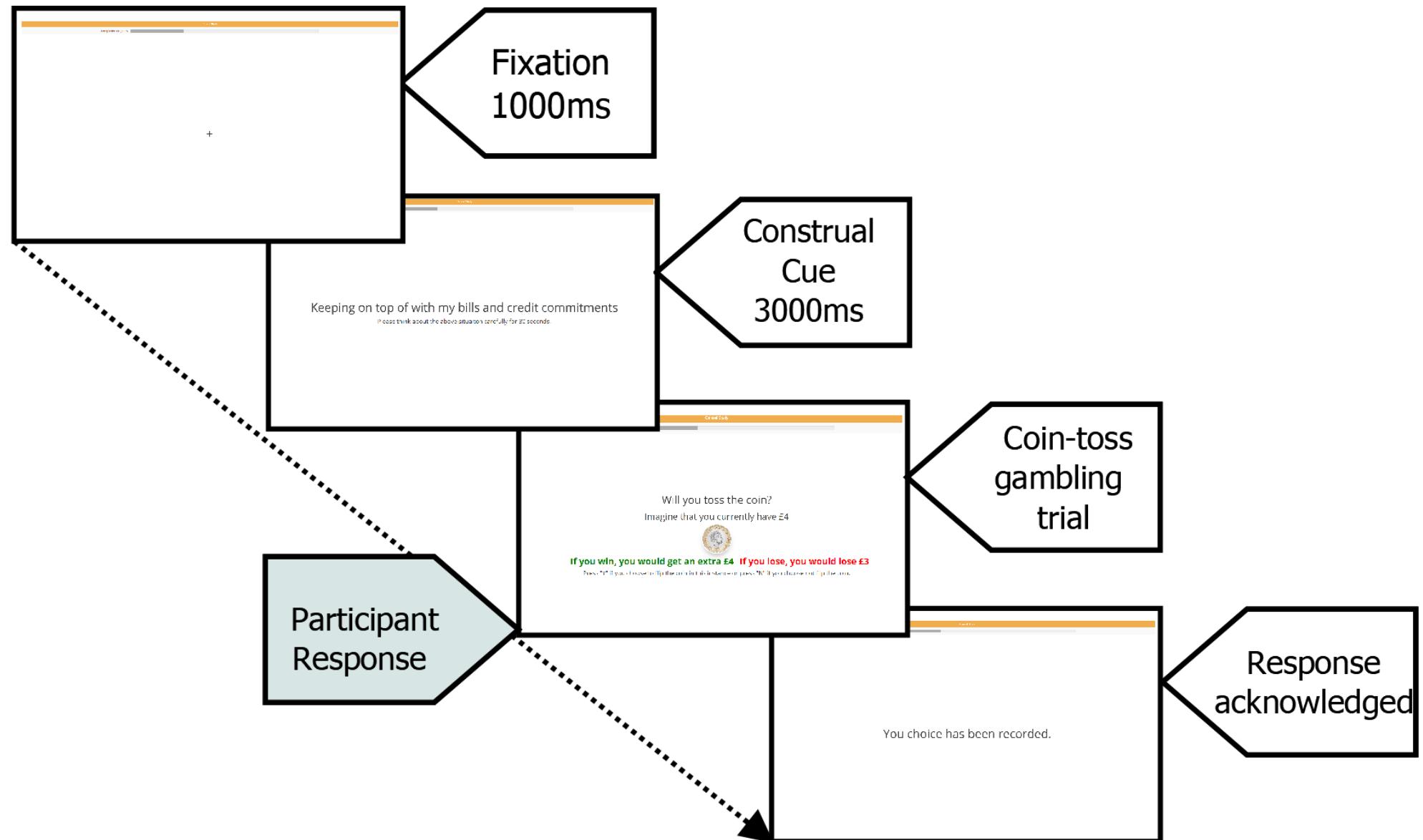
# General Overview

- In 2 lab-based studies, participants are exposed to cognitive exertion task(s), followed by a financial decision task where each trial is preceded by a construal cue (low/high or control condition)

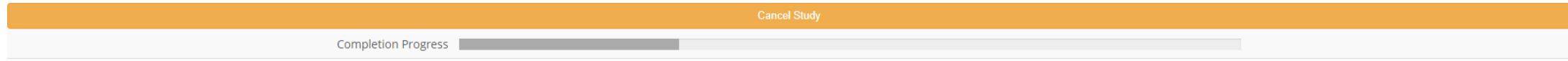
## Research Questions

- Study 1: Following cognitive exertion, how does construal affect financial decision-making?
- Study 2: Are there any neurological indicators that distinguish high- and low-construal decisions?

# Financial decision task: Studies 1 and 2



# Financial decision task: Construal cues

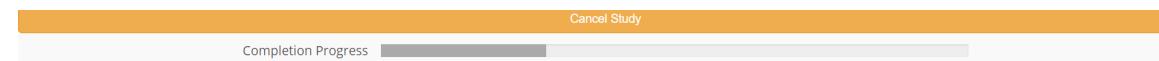


Keeping on top of with my bills and credit commitments  
**Please think carefully for 30 seconds about why you would want this to happen**

# Financial decision task: Coin Toss Decision

# Financial decision task: Coin Toss Trials

- n trials = 20
- Expected value of trials calculated as:  
*value of gain \* probability of gain - value of loss \* probability of loss*
- Expected value of trials: 0, 2.5, 5, 7.5, 10



Will you toss the coin?

Imagine that you currently have £4



If you win, you would get an extra £4 If you lose, you would lose £3

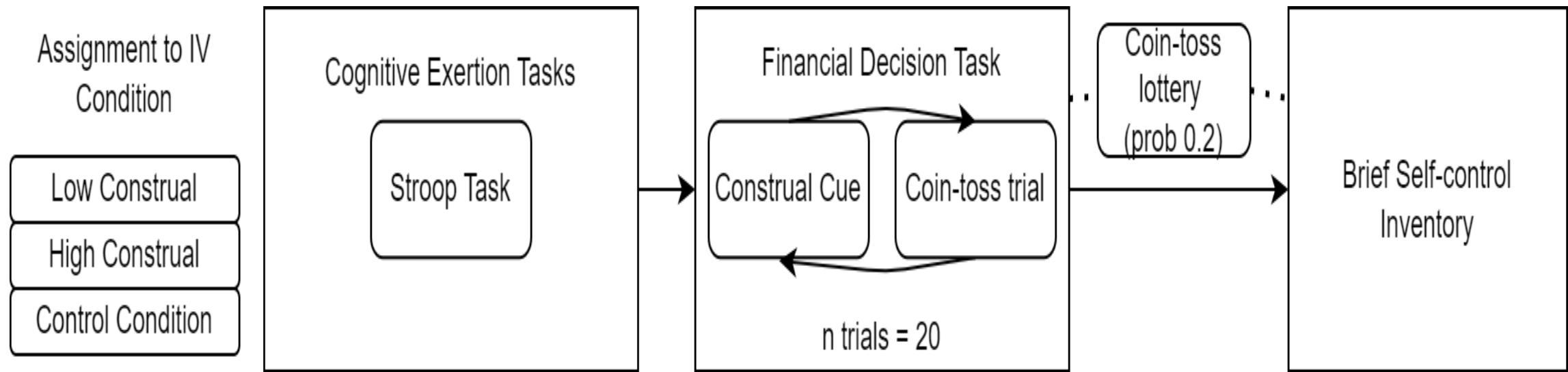
Press "Y" if you choose to flip the coin in this instance or press "N" if you choose not flip the coin.

# Study 1: Design

- 1-way independent, experimental design with 3 conditions.
- IV: construal level (High-Construal, Low-Construal and Control condition).
- Construal cues were presented as part of the financial decision (coin-toss gamble) task [\(adapted from Brevers et al., 2018\)](#).
- DV: Did participants gamble on coin-toss trials? (yes/no)

# Study 1: Participants

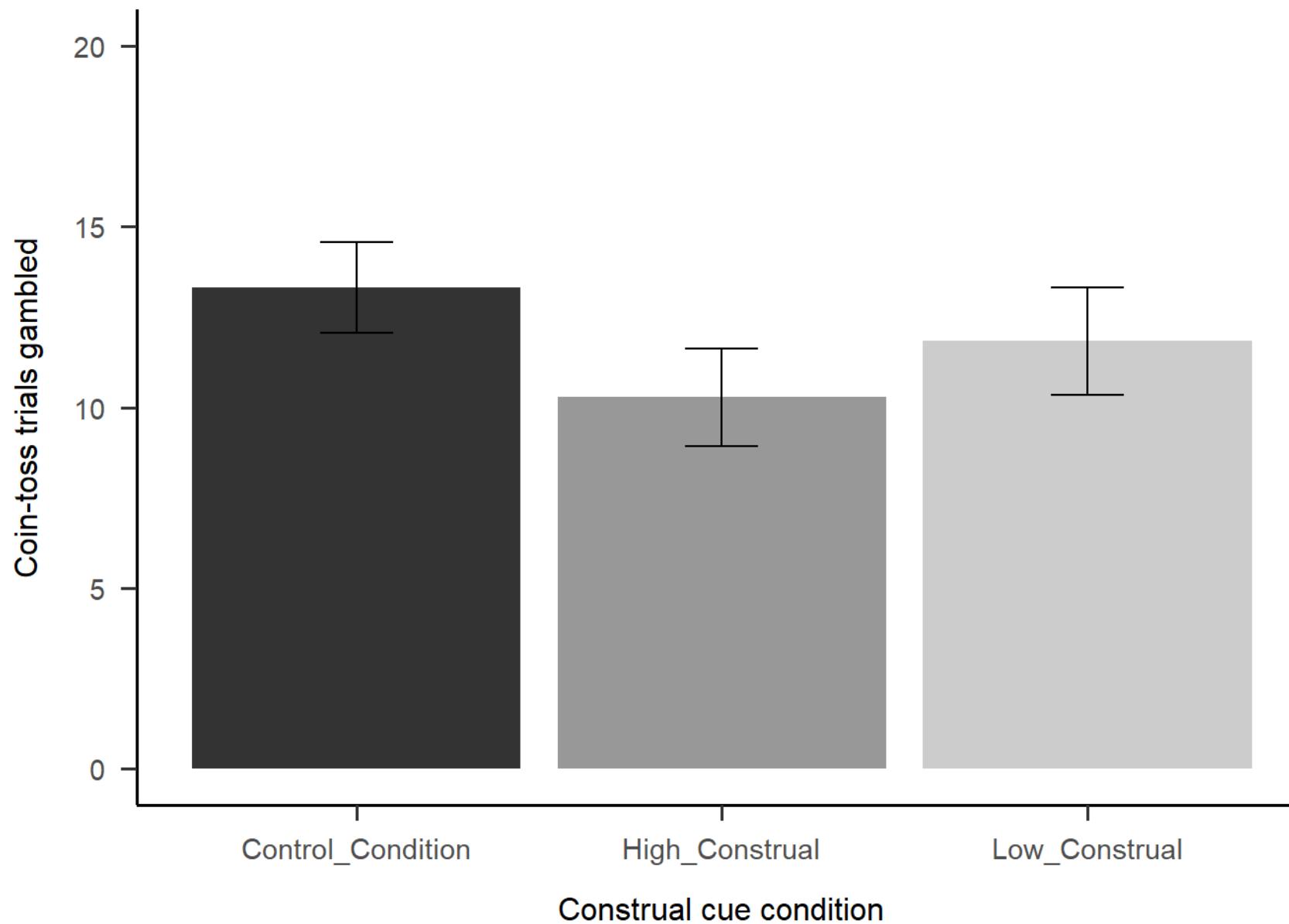
# Study 1: Procedure



- Participants are informed that they will be entered into a lottery at the end of the study
- If they are randomly selected, one of their coin-tosses will be chosen and they can win the outcome of that specific toss for real
- "Your choices in this task do matter"

# Study 1: Results

# Mean trials gambled in each condition



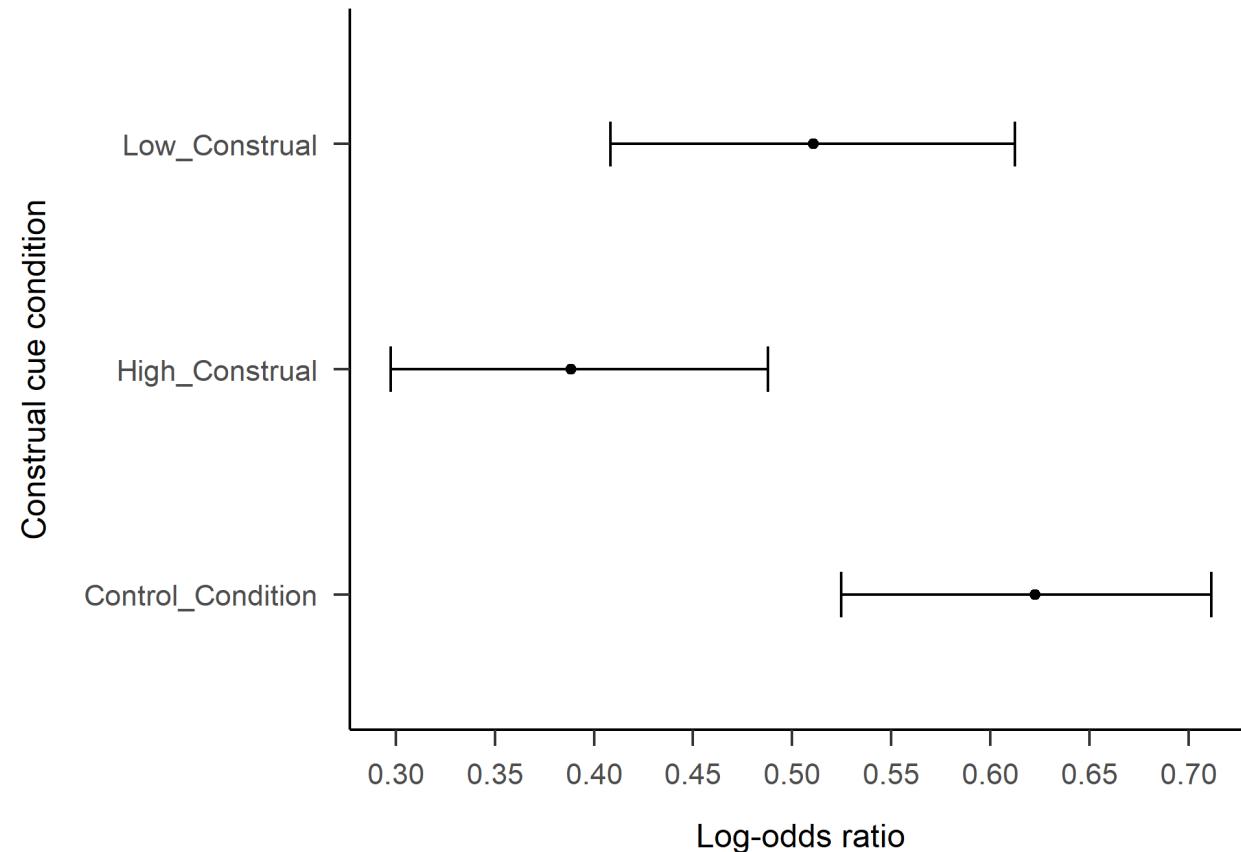
# Model 1: Does expected value predict likelihood of gambling?

- The model was a significantly better fit than the null model ( $\chi^2(4) = 441.47, p < 0.01$ ) , Pseudo  $\bar{R}^2$  (fixed effects) = 0.30
- A significant likelihood of not gambling when expected value of the coin-toss was 0 and significant likelihood of gambling in trials with higher expected values than 0 (with the exception of the Expected Value at 2.5)

# Model 2: Does construal condition predict likelihood of gambling?

- Model 2 was a significantly better fit than Model 1  $\chi^2(2) = 10.60, p < 0.01$ ,  $\Delta AIC = -6.6$ , Pseudo  $R^2$  (fixed effects) = 0.32
- Examination of the coefficients showed that both Low Construal and High Construal were significant High Construal Condition ( $\beta = -0.97, p < 0.01$ ) compared to the Low Construal Condition ( $\beta = -0.49, p < 0.05$ ).

# Model 2: Comparison of lsmeans between condition



Pairwise comparison of the groups showed that High Construal was significantly different to the Control Condition

# Model 3: Does self control predict likelihood of gambling?

- Adding self control (BSCI score) did not have a significant effect on the model ( $\Delta AIC = 1.23, p > 0.05$ )

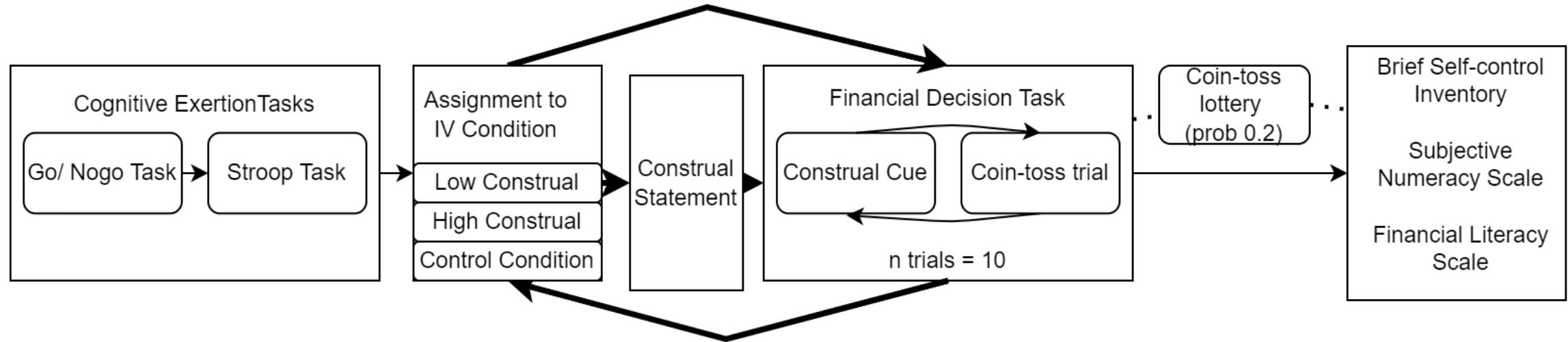
# Study 1 Discussion / Study 2 additions

- There is an effect of construal - High Construal associated with lowest probability of "gambling" and Control condition the highest
- Changes to Study 2:
  - Increase cognitive exertion effect with additional inhibition task
  - Make construal more explicit by having participants write construal-level statements before each condition/block

# Study 2: Research Question

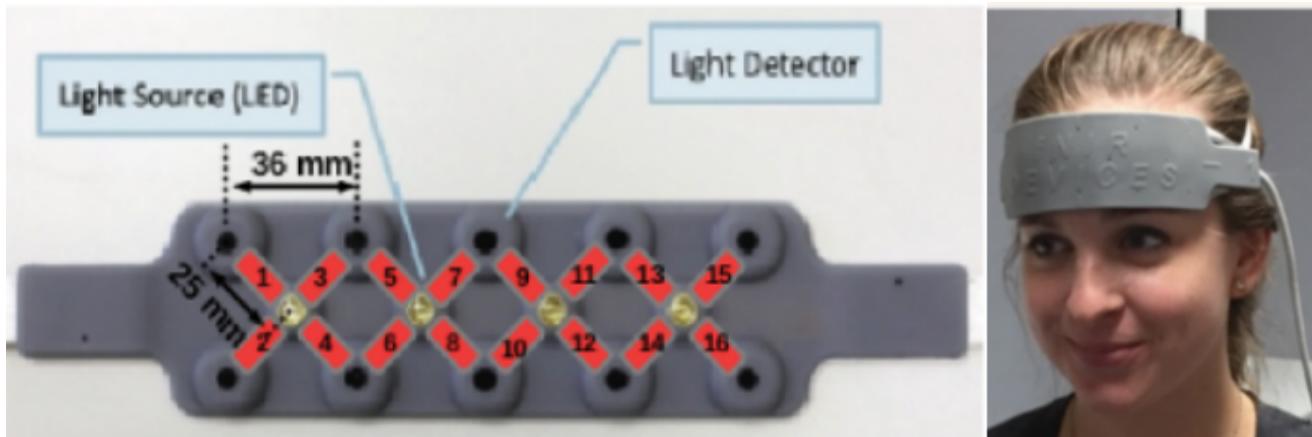
- Do the behavioural results replicate Study 1?
- Are there different patterns of neurological activation associated with high- and low-construal conditions?
- E.g., during the construal cue period immediately preceding the coin-toss decision

# Study 2: Design and Procedure

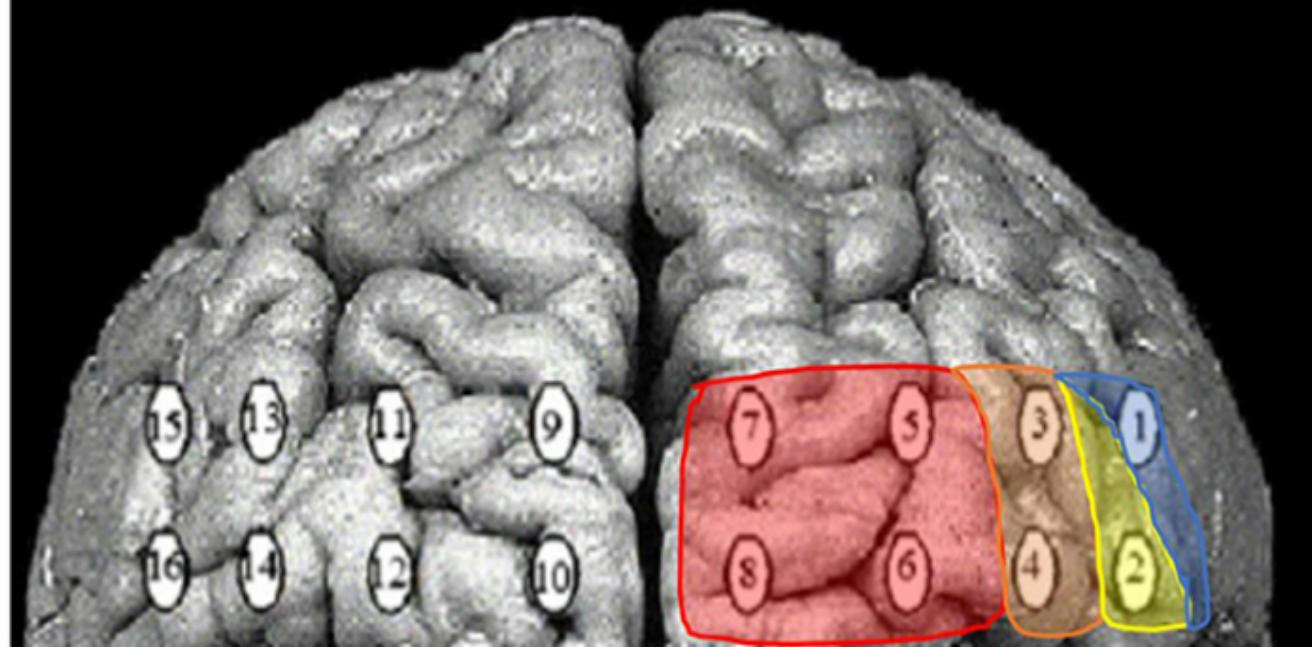


- Within-groups design necessitated by fNIRS
- Planned N = 33

# Study 2: fNIRS



Broadmann's Area 10 (Anterior PFC) Opt. 5,6,7,8	Broadmann's Area 46 (Dorsolateral PFC) Opt. 3,4	Broadmann's Area 45 (Pars Triangularis) Opt. 2	Broadmann's Area 44 (Pars Opercularis) Opt. 1
---	---	--	---



- Markers sent via serial/usb to fNIRS for specified events
- Levels of hbO and hbR are calculated during certain time periods relative to baseline



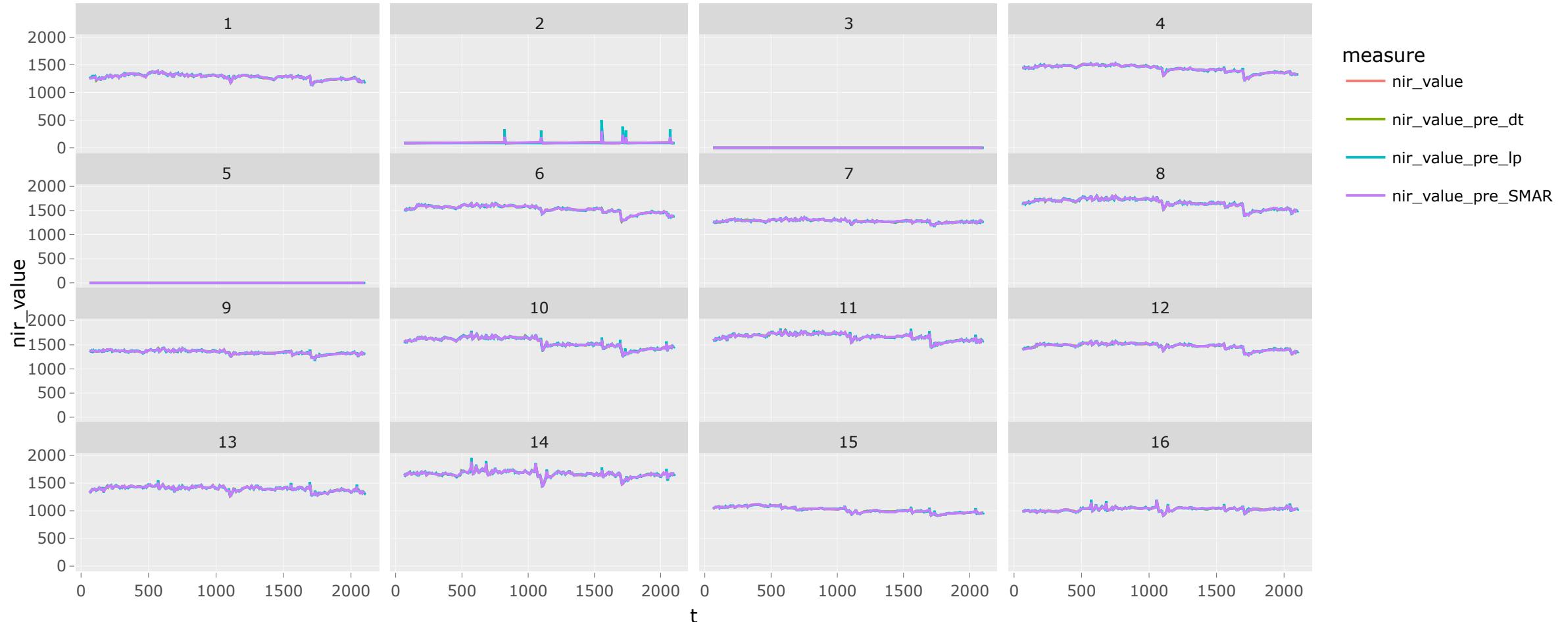
# Study 2: current status

- Current N = 13
- No inferential analysis run yet
- We can observe fNIRS patterns of activation

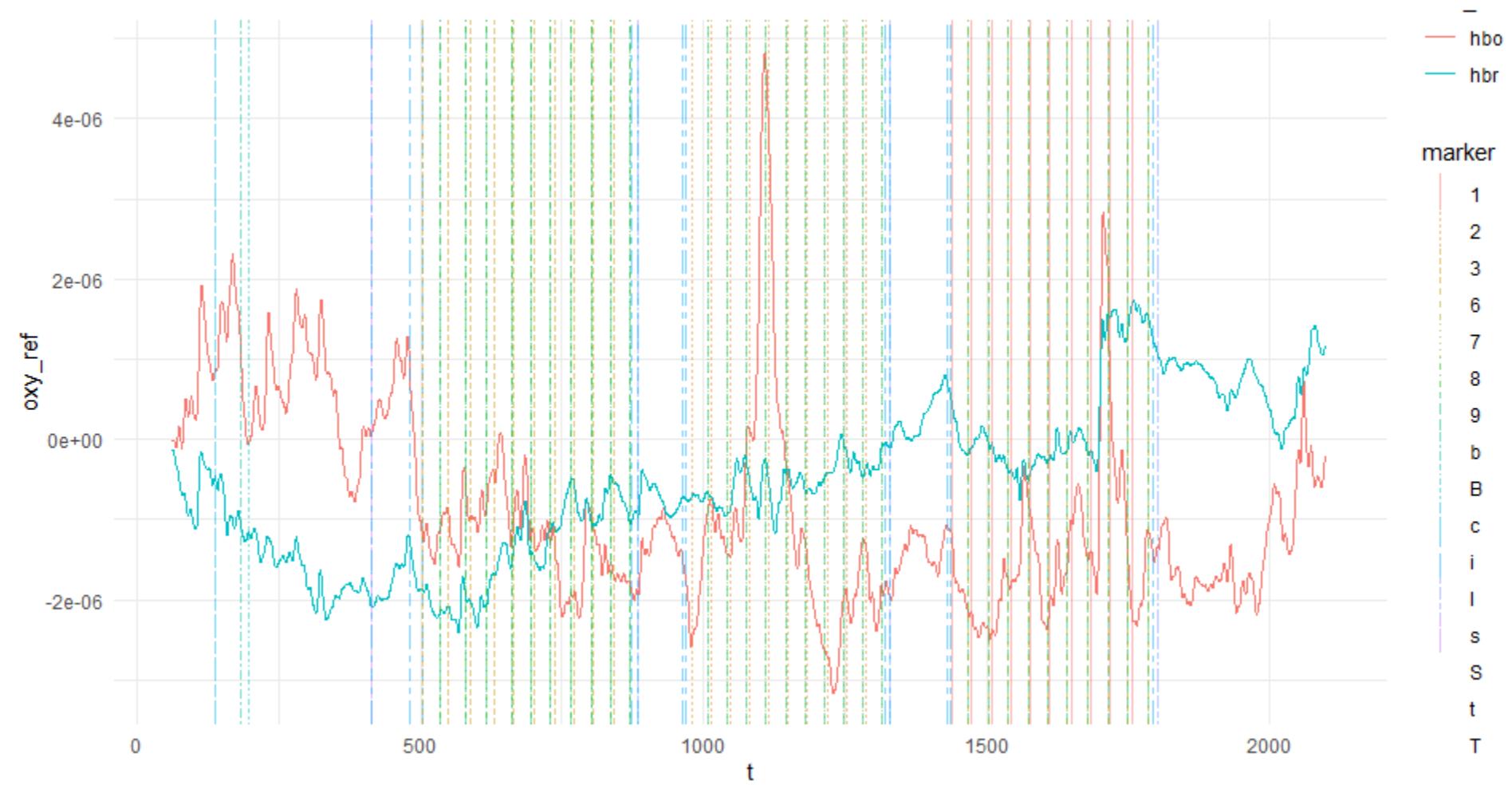
# fNIRS analysis - preprocessing

- Data analysed using a custom R script (will be available on Github)
- Preprocessing to remove noise, movement artifacts etc:
  - .1 Hz Lowpass filter (heartrate, respiration)
  - Moving average filter (1.5s)
  - Linear detrending

# fNIRS analysis - preprocessing



# fNIRS analysis - block level analysis

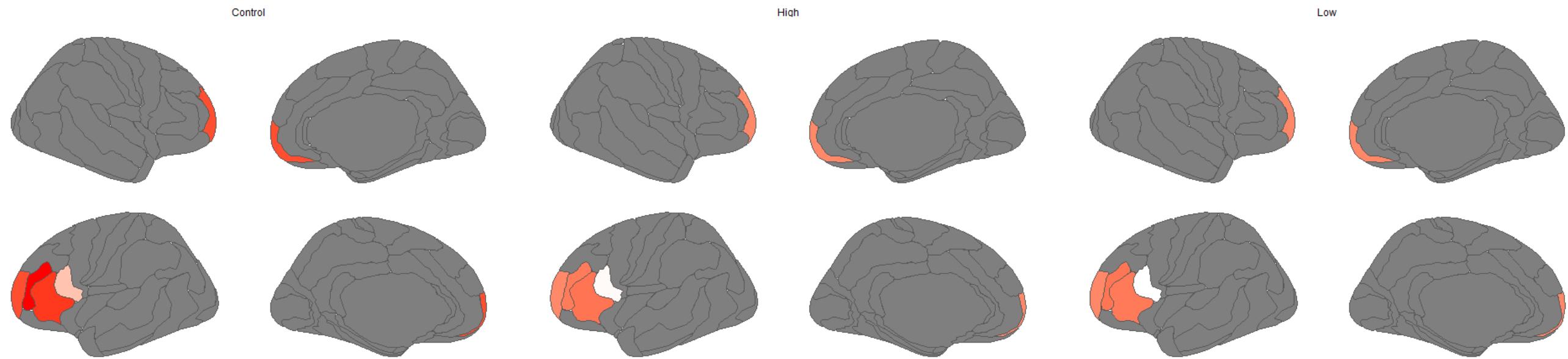


- Looking at mean levels of activation across trial types (i.e. different construal conditions) for each participant

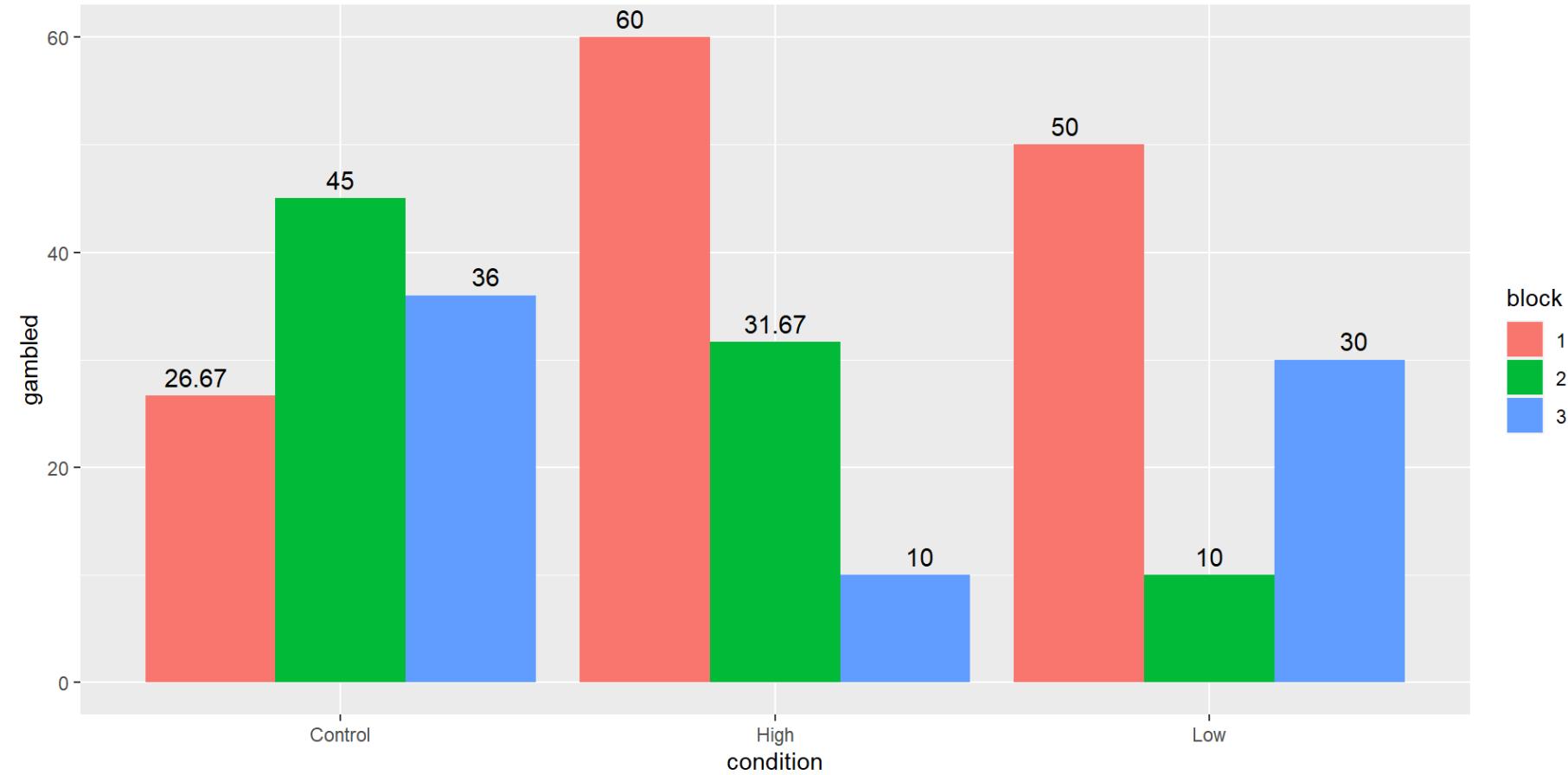
# Preliminary findings

# fNIRS analysis and financial decisions

# fNIRS: visualising activity - during construal cues



# Behavioural data: mean % gambled (block \* condition)



There might be an effect of Block as well as Condition

# Discussion / conclusions

# Current status

- Study 1 shows an effect of construal on gambling decisions
- Study 2 preliminary data indicates possible differences in neurological activity between conditions - not yet tested
- A lot more data yet to include when Study 2 models are tested (financial literacy, numeracy etc.)

# Further work?

- Will continue to explore Cognitive Load / Exertion effects on financial decisions
- Looking at more complex / ecologically-valid decisions
- Keep improving manipulations and manipulation checks

# Thank you

Christopher.Wilson@tees.ac.uk

@CWilsonPsych

<https://www.christopherjwilson.uk/slides/bps2022/>



# References

- Alessie, R., Bucher-Koenen, T., Lusardi, A., & van Rooij, M. (2013). Gender, confidence and financial literacy. *NeuroPsychoEconomics Conference Proceedings*, 16.
- Allgood, S., & Walstad, W. B. (2016). The effects of perceived and actual financial literacy on financial behaviors. *Economic Inquiry*, 54(1), 675–697. <https://doi.org/10.1111/ecin.12255>
- Amagir, A., Groot, W., Maassen van den Brink, H., & Wilschut, A. (2018). A review of financial-literacy education programs for children and adolescents. *Citizenship, Social and Economics Education*, 17(1), 56–80. <https://doi.org/10.1177/2047173417719555>
- Baumeister, R. F. (2014). Self-regulation, ego depletion, and inhibition. *Neuropsychologia*, 65, 313–319. <https://doi.org/10.1016/j.neuropsychologia.2014.08.012>
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego Depletion: Is the Active Self a Limited Resource? *Journal of Personality and Social Psychology*, 74(5), 1252–1265. <https://doi.org/10.1037/0022-3514.74.5.1252>
- Baumeister, R. F., Gailliot, M., DeWall, C. N., & Oaten, M. (2006). Self-Regulation and Personality: How Interventions Increase Regulatory Success, and How Depletion Moderates the Effects of Traits on Behavior. *Journal of Personality*, 74(6), 1773–1802. <https://doi.org/10.1111/j.1467-6494.2006.00428.x>
- Baumeister, R. F., Sparks, E. A., Stillman, T. F., & Vohs, K. D. (2008). Free will in consumer

behavior: Self-control, ego depletion, and choice. *Journal of Consumer Psychology*, 18(1), 4–13.  
<https://doi.org/10.1016/j.jcps.2007.10.002>

Baumeister, R. F., & Vohs, K. D. (2018). Strength model of self-regulation as limited resource: Assessment, controversies, update. In *Self-Regulation and Self-Control* (pp. 78–128). Routledge.

Brevers, D., Foucart, J., Turel, O., Bertrand, A., Alaerts, M., Verbanck, P., Kornreich, C., & Bechara, A. (2018). The Impact of Self-Control Cues on Subsequent Monetary Risk-Taking. *Journal of Behavioral Addictions*, 7(4), 1044–1055. <https://doi.org/10.1556/2006.7.2018.97>

Bruyneel, S. D., & Dewitte, S. (2012). Engaging in self-regulation results in low-level construals. *European Journal of Social Psychology*, 42(6), 763–769. <https://doi.org/10.1002/ejsp.1896>

Chardon, T., Freudenberg, B., & Brimble, M. (2016). Tax literacy in Australia: Not knowing your deduction from your offset. *Australian Tax Forum*, 31(2), 321–362.

Chen, J., Jiang, J., & Jane Liu, Y. (2018). Financial Literacy and Gender Difference in Loan Performance. *Journal of Empirical Finance*, 48, 307–320.  
<https://doi.org/10.1016/j.jempfin.2018.06.004>

de Brujin, E.-J., & Antonides, G. (2022). Poverty and economic decision making: A review of scarcity theory. *Theory and Decision*, 92(1), 5–37. <https://doi.org/10.1007/s11238-021-09802-7>

Fischer, P., Kastenmüller, A., & Asal, K. (2012). Ego Depletion Increases Risk-Taking. *The Journal of Social Psychology*, 152(5), 623–638. <https://doi.org/10.1080/00224545.2012.683894>

Foster, F. D., Ng, J., & Wee, M. (2015). Presentation Format and Financial Literacy: Accessibility

and Assessability of Retirement Savings Statements. *Journal of Consumer Affairs*, 49(3), 519–549.

Gerhardt, H. (2017). Does Self-Control Depletion Affect Risk Attitudes? *European Economic Review*, 25.

Hagger, M. S., Chatzisarantis, N. L. D., Alberts, H., Anggono, C. O., Batailler, C., Birt, A. R., Brand, R., Brandt, M. J., Brewer, G., Bruyneel, S., Calvillo, D. P., Campbell, W. K., Cannon, P. R., Carlucci, M., Carruth, N. P., Cheung, T., Crowell, A., De Ridder, D. T. D., Dewitte, S., ... Zwienenberg, M. (2016). A Multilab Preregistered Replication of the Ego-Depletion Effect. *Perspectives on Psychological Science*, 11(4), 546–573. <https://doi.org/10.1177/1745691616652873>

Hagger, M. S., Wood, C., Stiff, C., & Chatzisarantis, N. L. D. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin*, 136(4), 495–525.  
<https://doi.org/10.1037/a0019486>

Henager, R., & Cude, B. J. (2017). Financial Literacy and Long- and Short-Term Financial Behavior in Different Age Groups. *Journal of Financial Counseling and Planning*, 27(1), 3–19.  
<https://doi.org/10.1891/1052-3073.27.1.3>

Hinson, J. M., Jameson, T. L., & Whitney, P. (2003). Impulsive decision making and working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 29(2), 298–306. <https://doi.org/10.1037/0278-7393.29.2.298>

Hofmann, W., Vohs, K. D., & Baumeister, R. F. (2012). What People Desire, Feel Conflicted About, and Try to Resist in Everyday Life. *Psychological Science*, 23(6), 582–588.  
<https://doi.org/10.1177/0956797612437426>

- Holper, L., ten Brincke, R. H. W., Wolf, M., & Murphy, R. O. (2014). fNIRS derived hemodynamic signals and electrodermal responses in a sequential risk-taking task. *Brain Research*, 1557, 141–154. <https://doi.org/10.1016/j.brainres.2014.02.013>
- Inzlicht, M., Schmeichel, B. J., & Macrae, C. N. (2014). Why Self-Control Seems (but May Not Be) Limited. *Trends in Cognitive Sciences*, 18(3), 127–133. <https://doi.org/10.1016/j.tics.2013.12.009>
- Kaiser, T., & Menkhoff, L. (2020). Financial education in schools: A meta-analysis of experimental studies. *Economics of Education Review*, 78, 101930. <https://doi.org/10.1016/j.econedurev.2019.101930>
- Khenfer, J., Laurin, K., Tafani, E., Roux, E., & Kay, A. C. (2017). Interventionist external agents make specific advice less demotivating. *Journal of Experimental Social Psychology*, 73, 189–196. <https://doi.org/10.1016/j.jesp.2017.07.003>
- Koppel, L., Andersson, D., Västfjäll, D., & Tinghög, G. (2019). No Effect of Ego Depletion on Risk Taking. *Scientific Reports*, 9(1), 1–10. <https://doi.org/10.1038/s41598-019-46103-0>
- Krastev, S., Pilat, D., Martin, M., Montenegro, M., & Struck, B. (2020). *Construal level as a mediator of stress-induced bias in financial decision making* [Preprint]. PsyArXiv. <https://doi.org/10.31234/osf.io/hr8nk>
- Li, L., Lin, Z.-J., Cazzell, M., & Liu, H. (2012). Measurement of brain activations to examine gender-specific risk decision making using functional near infrared spectroscopy (fNIRS). In *Biomedical Optics, BIOMED 2012*. <https://doi.org/10.1364/BIOMED.2012.BTu3A.34>
- Lührmann, M., Serra-Garcia, M., & Winter, J. (2015). Teaching teenagers in finance: Does it work? 

- Journal of Banking & Finance*, 54, 160–174.
- Mandell, L., & Klein, L. S. (2009). *The Impact of Financial Literacy Education on Subsequent Financial Behavior* ({{SSRN Scholarly Paper}} No. 2224231).
- Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty Impedes Cognitive Function. *Science*, 341(6149), 976–980. <https://doi.org/10.1126/science.1238041>
- Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2020). Scarcity and Cognitive Function around Payday: A Conceptual and Empirical Analysis. *Journal of the Association for Consumer Research*. <https://doi.org/10.1086/709885>
- Meier, S., & Sprenger, C. D. (2013). Discounting financial literacy: Time preferences and participation in financial education programs. *Journal of Economic Behavior & Organization*, 95, 159–174.
- Raue, M., Streicher, B., Lermer, E., & Frey, D. (2015). How far does it feel? Construal level and decisions under risk. *Journal of Applied Research in Memory and Cognition*, 4(3), 256–264. <https://doi.org/10.1016/j.jarmac.2014.09.005>
- Roby, E., & Scott, R. M. (2022). Financial concern reduces child directed speech in a socioeconomically diverse sample. *Scientific Reports*, 12(1), 9173. <https://doi.org/10.1038/s41598-022-13177-2>
- Schmeichel, B. J., Vohs, K. D., & Duke, S. C. (2011). Self-Control at High and Low Levels of Mental Construal. *Social Psychological and Personality Science*, 2(2), 182–189. <https://doi.org/10.1177/1948550610385955>
- Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological Review*, 110(3), 403.