



## Substance Misuse

- 19.7 million Americans affected by a substance-use disorder in 2017<sup>[1]</sup>
- Costs approximately \$740 billion annually in terms of health care and lost productivity<sup>[2]</sup>
- Approximately 68,000 deaths due to overdose in 2017<sup>[3]</sup>

## Incentive-Based Treatments

- **Contingency management:** Provision of non-drug incentives contingently on proof of abstinence from drug taking<sup>[4]</sup>
- Effective treatment strategy for a range of substance-use disorders
- Large effect sizes reported during treatment<sup>[5,6]</sup>
- Effect size sharply decreases following withdrawal of treatment
- **That is, drug taking is susceptible to relapse following discontinuation of contingency-management treatments.**

## Resurgence

- Relapse of eliminated behavior when a source of reinforcement that was made available during treatment is removed or made worse<sup>[7,8]</sup>
- May pose a significant challenge to the long-term maintenance of positive treatment outcomes
- Often studied in laboratory settings to understand the factors that affect relapse
- **Laboratory analyses of resurgence may inform clinical practice by identifying:**
  - Situations likely to give rise to relapse
  - Treatments that minimize the likelihood that relapse will occur in the face of treatment challenges

## Example 1: Rate of Non-Drug Incentives<sup>[9]</sup>

Group	Phase 1		Phase 2		Phase 3	
	Target	Alt.	Target	Alt.	Target	Alt.
High	VR 20 Cocaine	-	EXT	VI 15-s Food	EXT	EXT
Low	VR 20 Cocaine	-	EXT	VI 60-s Food	EXT	EXT
Control	VR 20 Cocaine	-	EXT	EXT	EXT	EXT

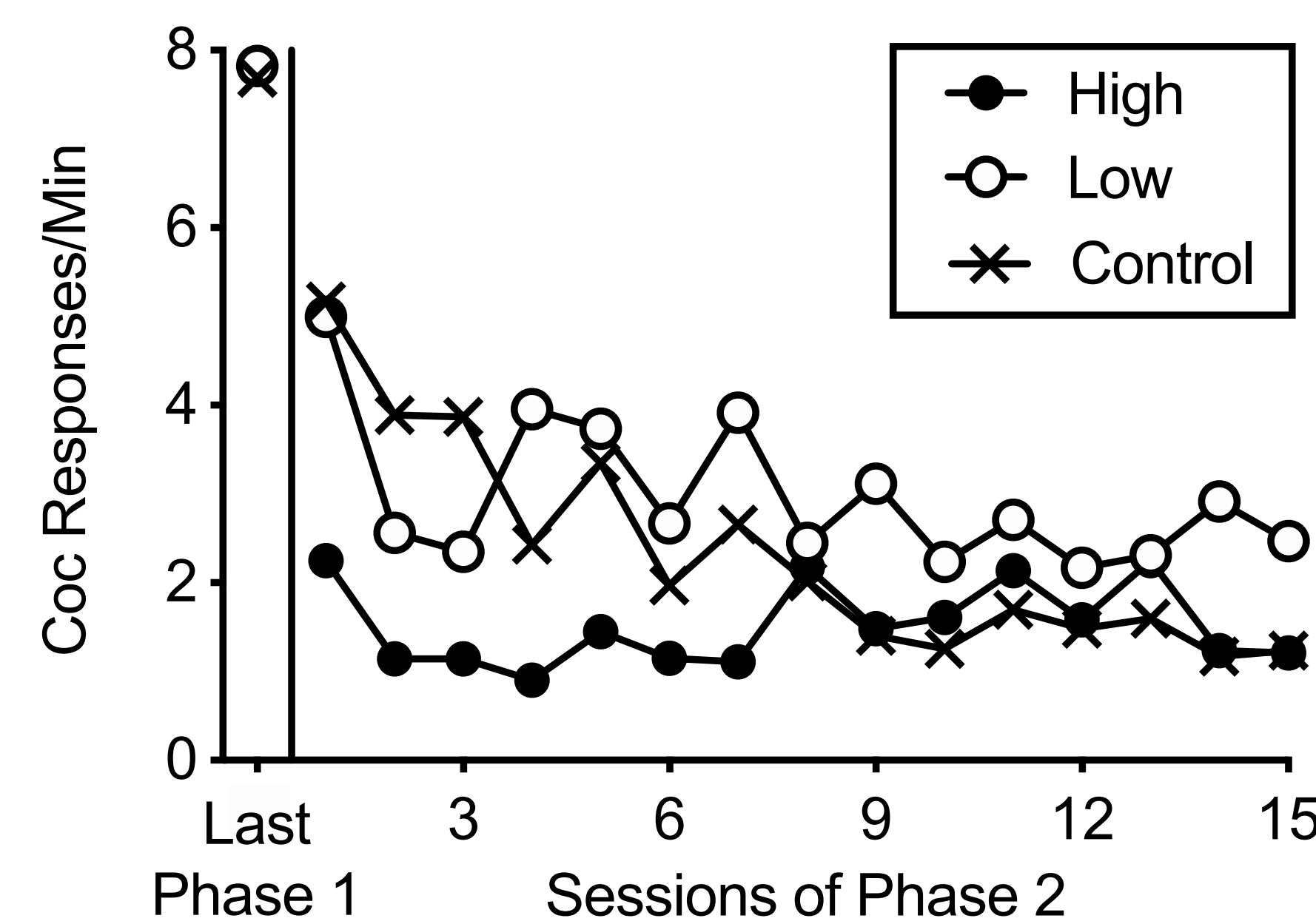


Figure 1. Cocaine responses per minute during the last session of Phase 1 and all sessions of Phase 2 for each group of rats in Craig et al.<sup>[9]</sup>

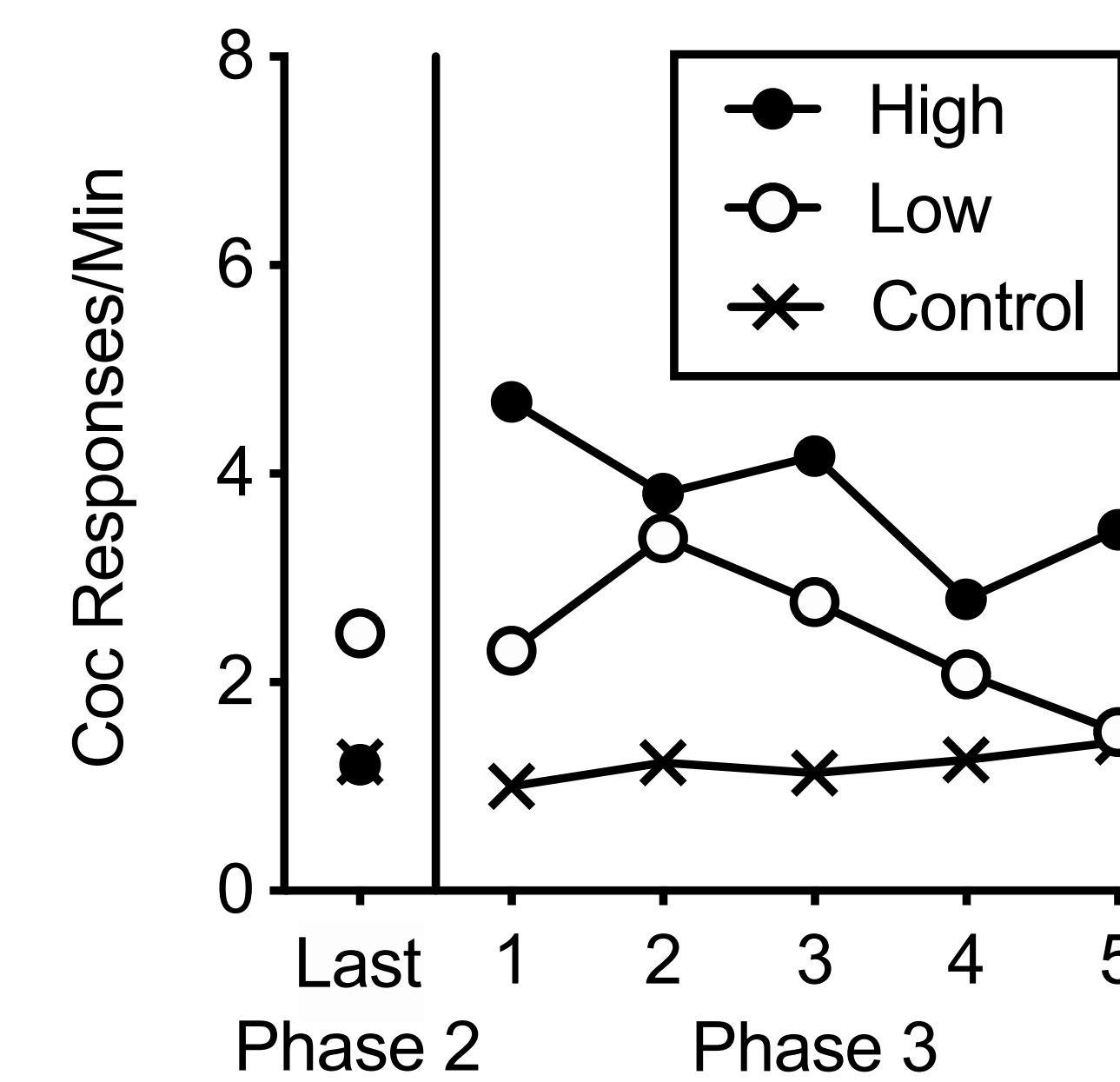


Figure 2. Cocaine responses per minute during the last session of Phase 2 and all sessions of Phase 3 for each group of rats in Craig et al.<sup>[9]</sup>

## Example 2: Duration of Treatment<sup>[10]</sup>

Group	Phase 1		Phase 2		Phase 3	
	Target	Alt.	Target	Alt.	Target	Alt.
Short	VR 20 Cocaine	-	EXT	5 Days VI 15-s Food	EXT	EXT
Long	VR 20 Cocaine	-	EXT	20 Days VI 15-s Food	EXT	EXT
Control	VR 20 Cocaine	-	EXT	EXT	EXT	EXT

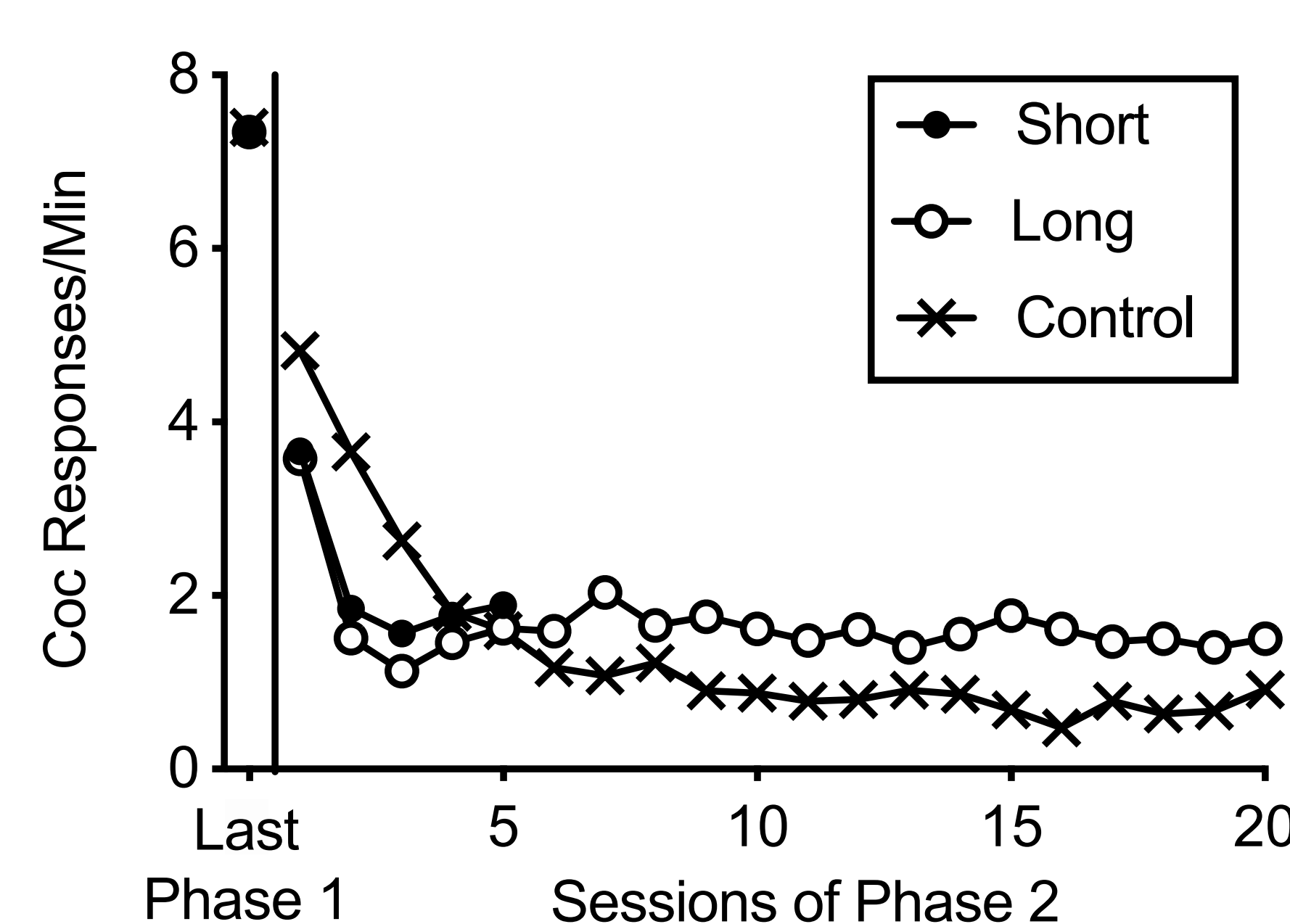


Figure 3. Cocaine responses per minute during the last session of Phase 1 and all sessions of Phase 2 for each group of rats in Nall et al.<sup>[10]</sup>

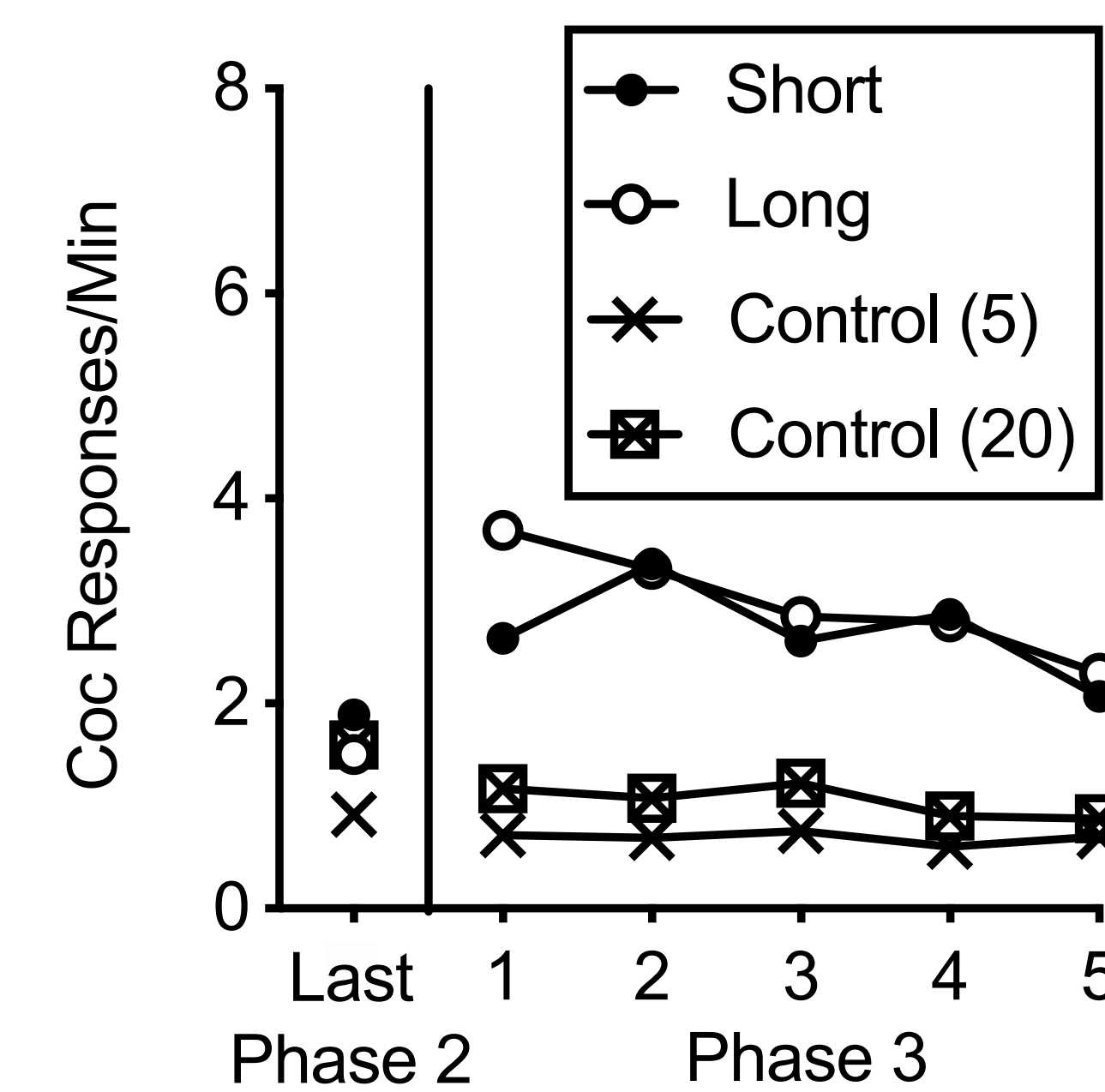


Figure 4. Cocaine responses per minute during the last session of Phase 2 and all sessions of Phase 3 for each group of rats in Nall et al.<sup>[10]</sup>

## Clinical Implications

- Smaller or less frequent incentives, relative to larger or more frequent incentives:
  - Produce slower reductions in target behavior
  - Result in behavior that is less likely to relapse
- Duration of treatment may have only a small impact on relapse. There may exist a complex interaction between treatment duration and contact with naturally occurring incentives for sobriety.

## Why Does Resurgence Occur?

- **Resurgence as Choice (RaC)**<sup>[8, 11]</sup>
  - Resurgence governed by the same processes thought to govern choice (à la the matching law)
  - Reduction to the value of alternative sources of reinforcement results in an increase in the conditional probability of target behavior.

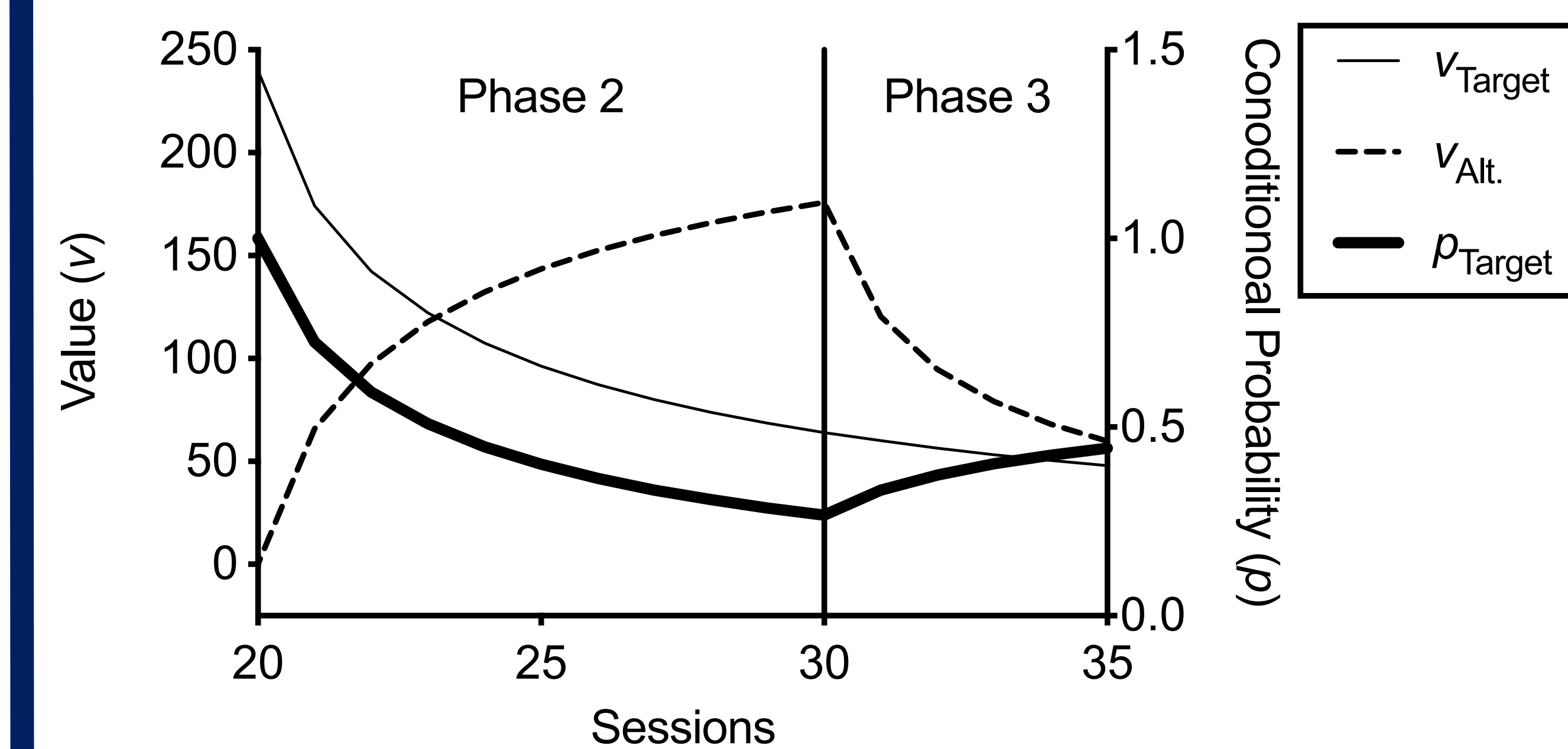


Figure 5. Hypothetical value functions for target ( $V_{target}$ ) and alternative ( $V_{alt}$ ) behavior, and the conditional probability of target behavior ( $p_{target}$ ), generated by RaC across sessions of Phases 2 and 3 of a resurgence preparation.

## References

- [1] Substance Abuse and Mental Health Services Administration. (2018). Key substance use and mental health indicators in the United States: Results from the 2017 National Survey on Drug Use and Health. Retrieved from: <https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHFRR2017NSDUHFRR2017.pdf>
- [2] National Institute on Drug Abuse. (2017). Trends and statistics: Costs of substance abuse. Retrieved from: <https://www.drugabuse.gov/drug-topics/trends-statistics/costs-substance-abuse>
- [3] Centers for Disease Control and Prevention. (2020). Drug overdose deaths in the United States, 1999-2018. Retrieved from: [https://www.cdc.gov/nchs/data/tables/ob356-h.pdf?deliverName=USCDC\\_171\\_DM21432](https://www.cdc.gov/nchs/data/tables/ob356-h.pdf?deliverName=USCDC_171_DM21432)
- [4] Higgins, S. T., & Petry, N. M. (1999). Contingency management: Incentives for sobriety. *Alcohol Research and Health*, 23, 122-127.
- [5] Benishke, L. A., Dugosh, K. L., Kirby, K. C., Matejkowski, J., Clements, N. T., Seymour, B. L., & Festinger, D. S. (2014). Prize-based contingency management for the treatment of substance abusers: A meta-analysis. *Addiction*, 109, 1426-1436.
- [6] Prendergast, M., Podus, D., Finney, J., Greenwell, L., & Roll, J. (2006). Contingency management for treatment of substance use disorders: A meta-analysis. *Addiction*, 101, 1546-1560.
- [7] Lattal, K. A., & Wacker, D. (2015). Some dimensions of recurrent operant behavior. *Mexican Journal of Behavior Analysis*, 41, 1-13.
- [8] Shahan, T. A., & Craig, A. R. (2017). Resurgence as choice. *Behavioural Processes*, 141, 100-127.
- [9] Craig, A. R., Nall, R. W., Madden, G. J., & Shahan, T. A. (2016). Higher rate alternative non-drug reinforcement produces faster suppression of cocaine seeking but more resurgence when removed. *Behavioural Brain Research*, 306, 48-51.
- [10] Nall, R. W., Craig, A. R., Browning, K. O., & Shahan, T. A. (2017). Longer treatment with alternative non-drug reinforcement fails to reduce resurgence of cocaine or alcohol seeking in rats. *Behavioural Brain Research*, 341, 54-62.
- [11] Shahan, T. A., & Craig, A. R. (2017). Resurgence as choice. *Behavioural Processes*, 141, 100-127.