Caffeine's Effects on Pausing During Alternating Work Requirements

Benjamin M. Libman & Jonathan W. Pinkston
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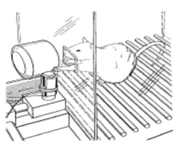
Introduction

- Caffeine is the most widely consumed psycho-active stimulant in the world (Mitchel 2014)
- Behavioral effects of caffeine are still not well understood (Randall et al. 2011)
- Evidence that:
  - The largest effects can be seen during "low arousal states" (Smith, 2002)
  - Consumption might increase with increases in relative effort (Górnicka et al., 2014)
  - May effect relative response effort (Salamone, 2009)
- B-pharm related effort research typically utilizes other drugs or progressive-ratio (PR) schedules to measure effort
- No evidence that caffeine use is used to ameliorate the effects of other drugs
- PR schedules do not allow for repeated examination of low-high effort alternations within a single session
- Perone and Courtney (1992) examined pausing between larger and smaller schedules of reinforcement
  - rapidly alternating between relatively richer and leaner food deliveries
- In the current study we examined caffeine's effects on effort by utilizing a procedure similar to Perone and Courtney (1992)

Subjects & Setting

- Eight male, non-naive, Sprague Dawley Rats
- Four custom built operant chambers
  - Each chamber situation in a sound attenuating box and affixed with a force sensing load-cell for response capture



Methods

- Rats trained to press a force transducer for food
- 41 ratios presented semi-randomly in a mult FR-FR
  - 20 rich (FR5) / 20 lean (FR45 or 100)
  - Four transition types 10x each:
    - Rich-Rich; Lean-Lean; Lean-Rich; Rich-Lean
  - Rich ratios signaled by a flashing light
  - Lean ratios signaled by a solid light
  - Between ratios:
    - 2-s limited hold
    - No house lights
    - No responses counted
- After stable PRP dosing cycle began
  - Seven doses (2x each) 0-56 mg/kg caffeine

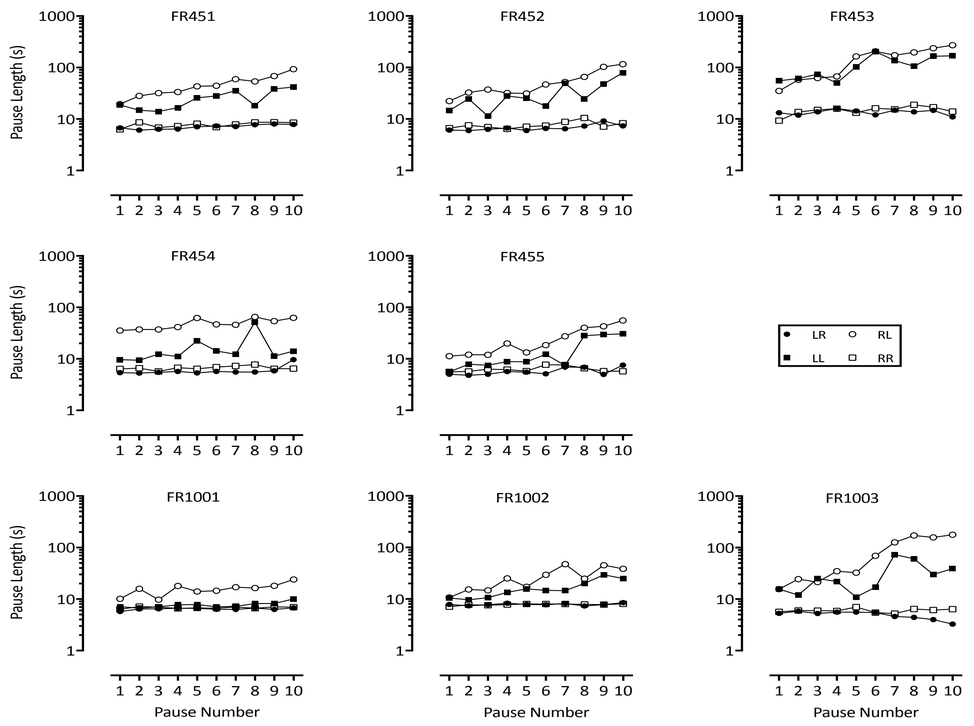


Figure 1. Average within session baseline PRP. Ordinate shows pause length; abscissa shows pause number.

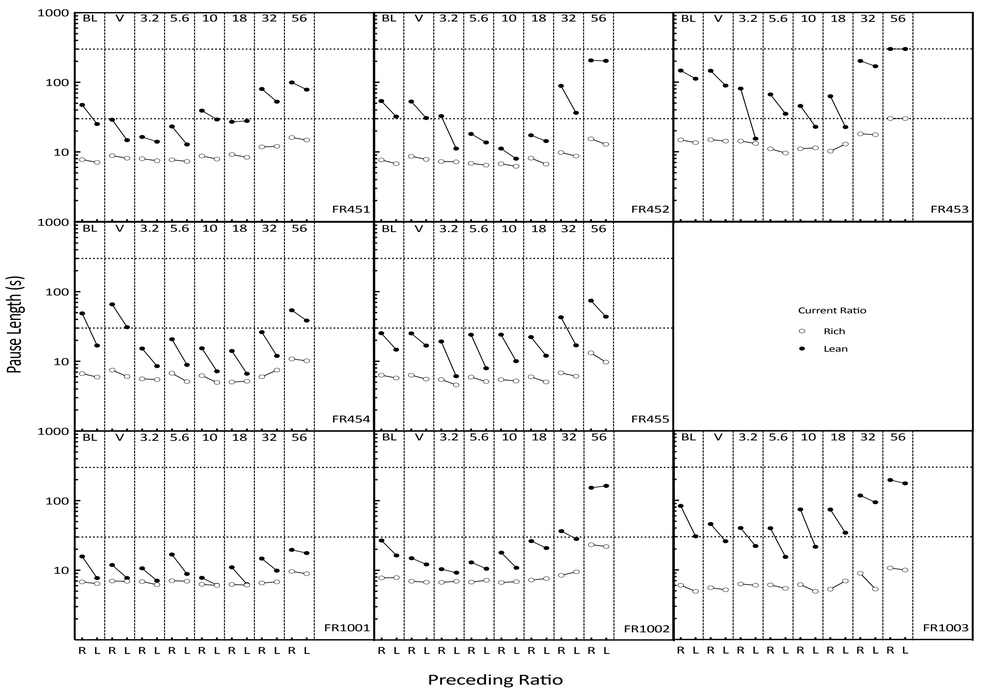


Figure 2. Average PRP across Doses. Ordinate shows pause length; abscissa dose preceding ratio. Points show the current ratio.

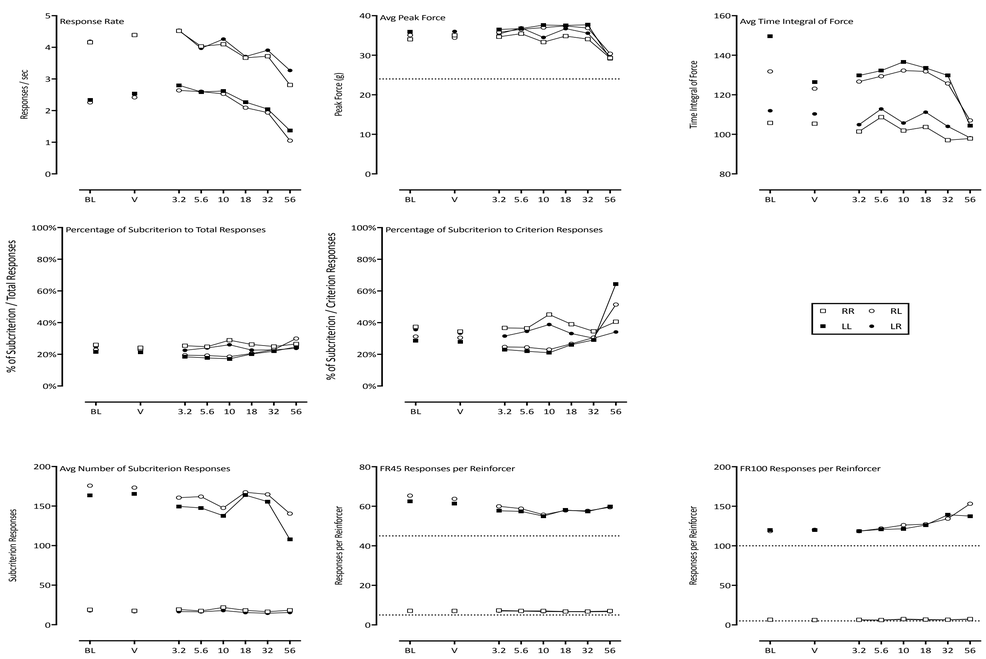


Figure 3. Average response rate, peak force, time integral of force, proportion of subcriterion to total responses, proportion of subcriterion to criterion responses, number of subcriterion responses, and average responses per reinforcer (separated by lean ratio size). All figures show averages across rats. Abscissa shows dose.

Results

- Baseline:
  - Replicated the findings of Perone and Courtney (1992) – Longest pauses when transitioning from a richer to a leaner schedule
- Drug:
  - At the lowest doses:
    - Shorter PRPs when the next schedule was lean
  - At the higher doses
    - Increases in all PRP types
      - (likely due to an overall suppression of responses)
- Overall:
  - No systematic effects of ratio, peak force, time integral of force or subcriterion response

Discussion

- Conflicts between human and animal findings
  - Humans research:
    - Decreases in relative effort and increases in responding (Ferré, 2008)
  - Animal research
    - Decreases in response rates and/or total suppression of responding (Sheppard et al., 2012; Briscoe et al., 1998)
- Findings suggest caffeine does not effect rate, or the actual pattern of responding at all
- Effects of caffeine only seen between ratios, not during the ratios
  - Faster to return to work, but not necessarily working faster overall

Acknowledgements

Thank you Alyssa Moore, Danton Shoemaker, Erica Foss, and Emily Hillz for all of your hard work and dedication to helping me complete my thesis

References

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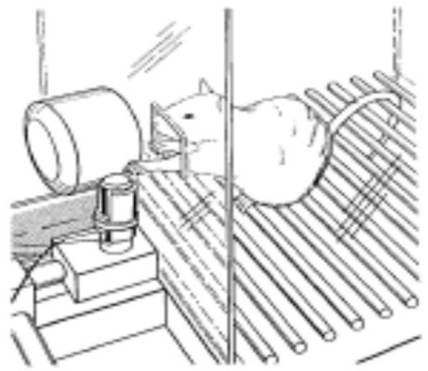
- Stimulant effects of caffeine have been difficult to demonstrate in the laboratory (Randall et al. 2011)
- Possibly due to a failure to capture the conditions under which caffeine is typically consumed
- Perone and Courtney (1992) examined pausing between larger and smaller schedules of reinforcement
  - rapidly alternating between relatively richer and leaner food deliveries
- In the current study, we examined caffeine's effects on pausing between richer and leaner schedules of reinforcement

Methods

- Eight male, non-naive, Sprague Dawley Rats
- Rats trained to press a force transducer for food
- 41 ratios presented semi-randomly in a mult FR-FR
  - 20 rich (FR5) / 20 lean (FR45 or 100)
  - Four transition types 10x each:
    - Rich-Rich; Lean-Lean; Lean-Rich; Rich-Lean

Apparatus



Results

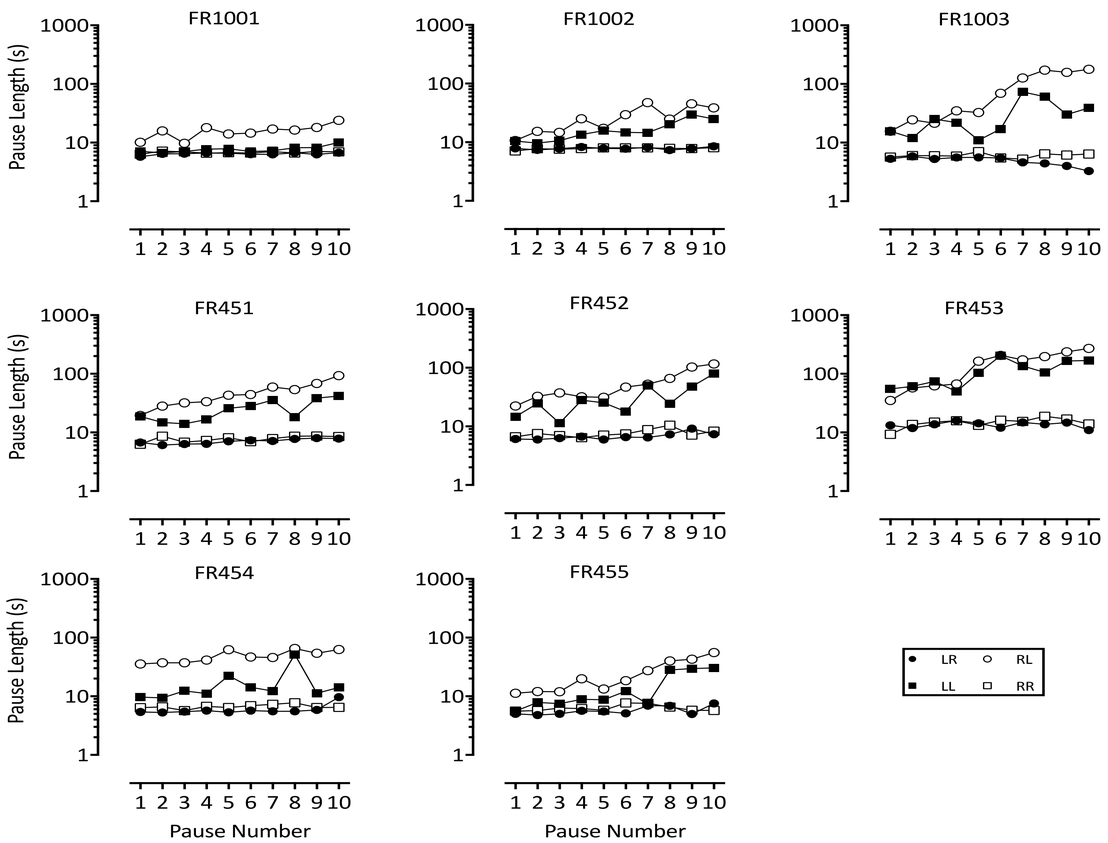


Figure 1. Average within session baseline PRP. Ordinate shows pause length; abscissa shows pause number. Each point is the average of the last 5 days of baseline for the particular pause's occurrence within the session.

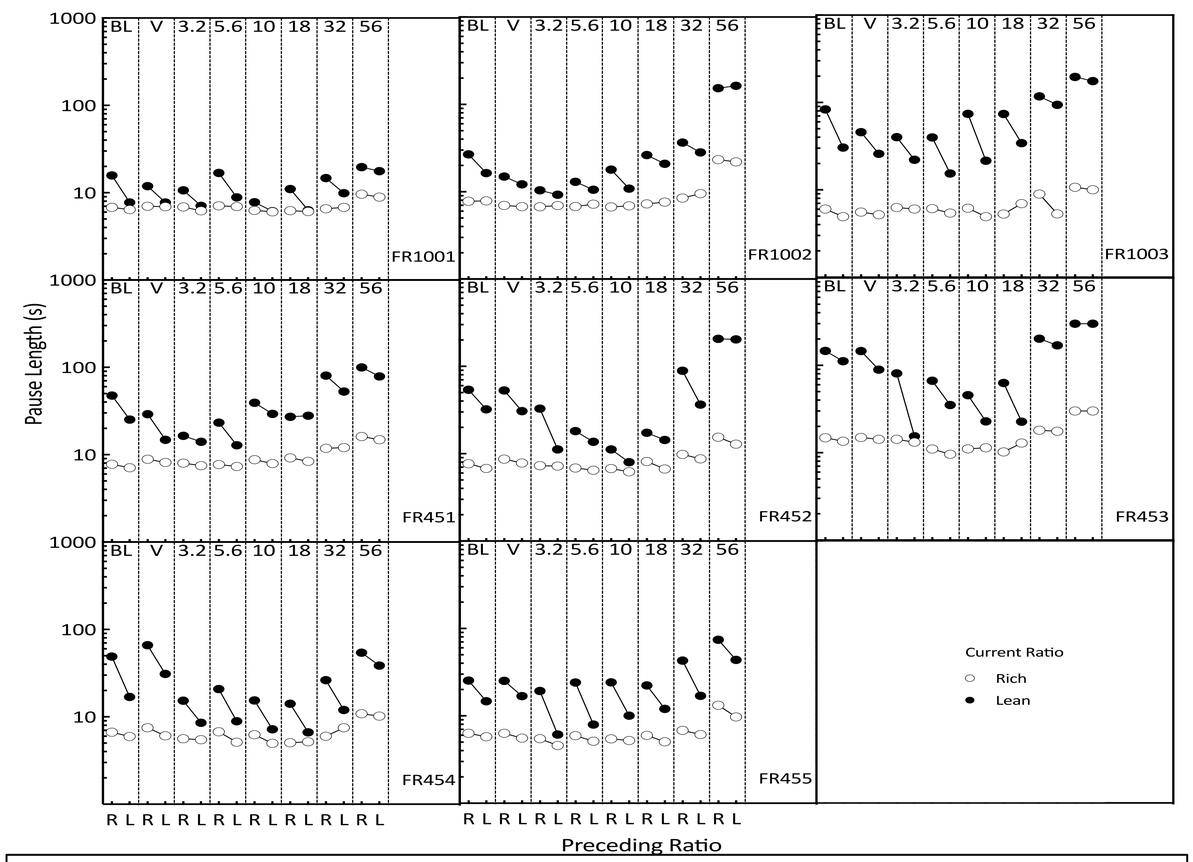


Figure 2. Average PRP across doses. Ordinate shows pause length; abscissa shows the preceding ratio. Points show the current ratio.

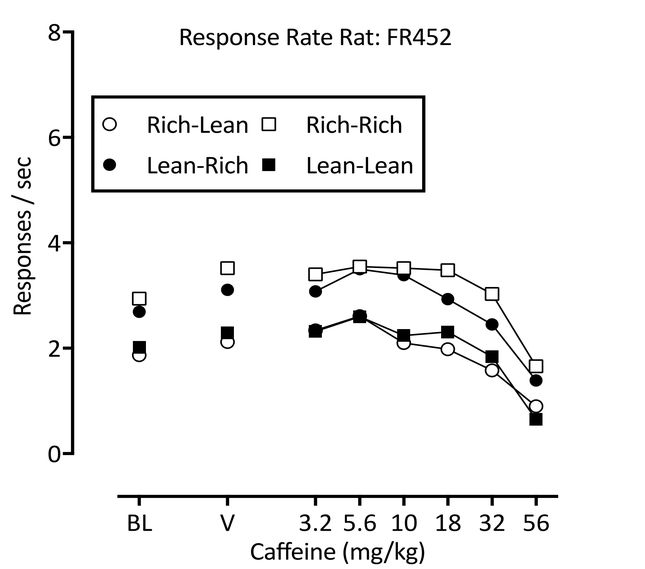


Figure 3. Response rate for rat FR452. Data are representative of all animals. Abscissa shows responses per second; ordinate shows the dose in mg/kg.

Results & Discussion

- Baseline:
  - Stable pausing between rich-lean and lean-lean transitions
  - Linear increases in pausing during rich-lean transitions
- Caffeine:
  - At lower doses (3.2-10 mg/kg):
    - Shorter PRPs when the upcoming schedule was lean
  - At higher doses (18-56 mg/kg):
    - Increases in all PRP types
  - No systematic relationship between caffeine and run-rate
  - Effects of caffeine only seen between ratios, not during the ratios
    - Faster to return to work, but not necessarily working faster overall
- Findings suggest caffeine has no effect on run-rate
- Future research might investigate the effects of caffeine on response bouts using different schedules of reinforcement

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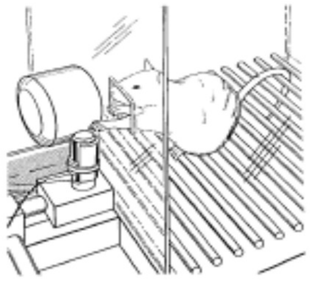

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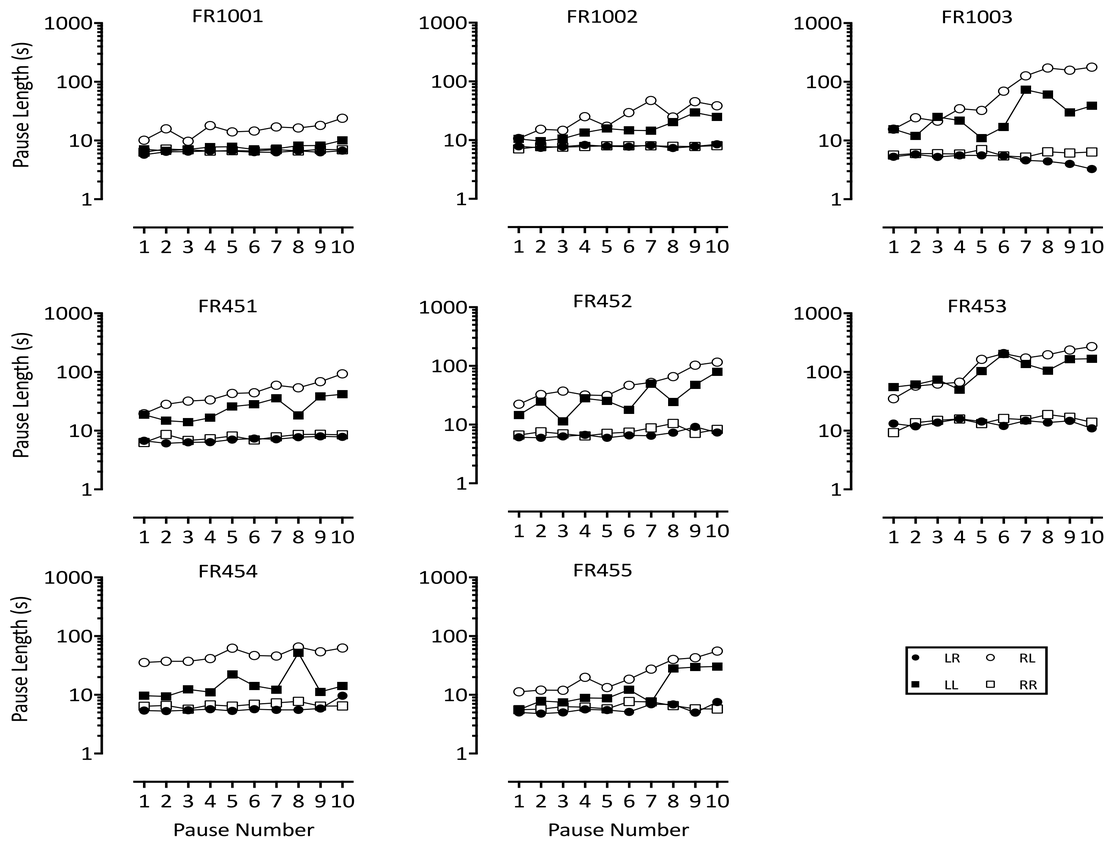

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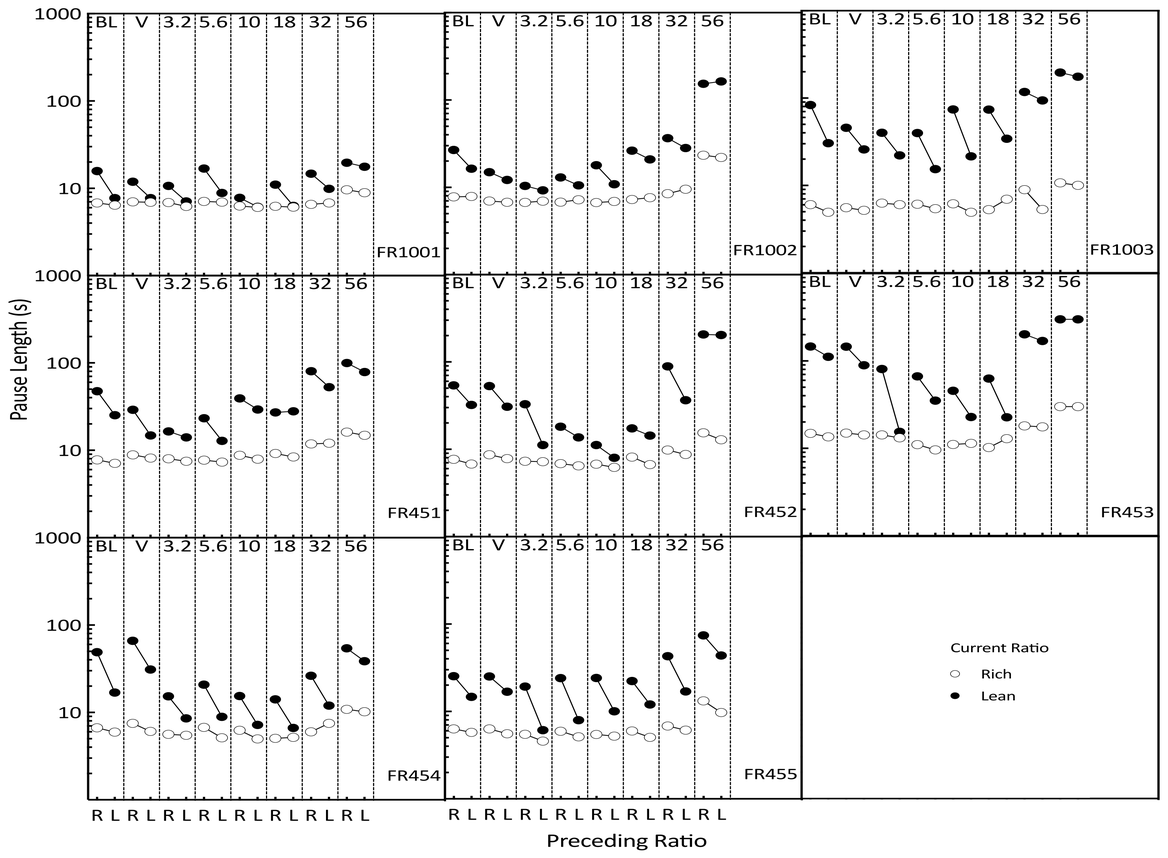

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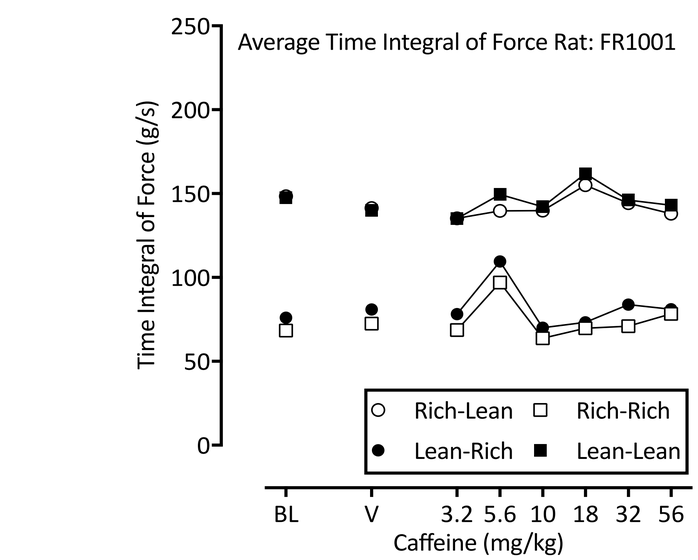

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