Exercise as a Means to Reduce Stereotypic Behaviors Among Children and Adolescents with Autism

Shawn M. Arent, PhD, CSCS

Stefanie Schmitz

RUTGERS

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Stereotypic Behaviors

Self-stimulation

- Rocking
- Hand/finger flapping
- Object tapping
- Mouthing
- Head-nodding
- Inappropriate vocalizations
- Repetitive movements
- Off-task behavior

Maladaptive Behaviors

- Aggression
- Self-injury
- Property destruction

Methods to Correct Behaviors

- Punishment
- Physical restraint
- Electric Shock
- Social disapproval
- Time-out
- Sensory extinction
- Exercise

Previous Studies

Watters and Watters (1980)

- 5 adolescent males with autism
- 8-10 min of “jogging” vs. TV control
- 32.7% reduction in behaviors w/ exercise

Elliott et al. (1994)

- 3 treatment groups: no-exercise, motor training/”light exercise”, “vigorous exercise”
  - 2 adults w/ autism or mental retardation per group
  - 20 min sessions
- Measured pre & post HR (not during)
- Only the “vigorous exercise” group showed improvement

Previous Studies

Bachman and Fuqua (1983)

- 4 mentally impaired children
- Heart rate fell within moderate to vigorous ranges; taken at intervals (every 3rd lap) during workout
- 20.8% decrease with vigorous vs. moderate exercise

Levinson and Reid (1993)

- 3 preadolescent subjects with autism
- Took pre and post-exercise heart rates
- 17.5% reduction in jogging vs. walking conditions

Intensity interaction with exercise duration??

Participants

- 7 male autistic children and adolescents (M_{age} = 13.0, SD = 1.43)
- Behaviors were specific to the participant and were recorded on an individual basis
  - Must have had observable stereotypic behaviors and able to tolerate intense exercise
- All participants were enrolled in a developmental program for children with autism

Procedures

- Within-subjects design
- 4 randomly ordered exercise conditions varying exercise duration (*10 vs. 20 min*) and exercise intensity (*low [L] = 50-65% HR_{max} vs. high [H] = 70-85% HR_{max}*) and a no-exercise control
  - 10L; 10H; 20L; 20H; C
- Both pre and post-exercise observations took place in a classroom familiar to the participants during normal instruction hours
  - A video camera was set up in the classroom to record behaviors
- Participants were observed and recorded for 15 min before exercise and 60 min after exercise

Monitoring Intensity

- HR monitored using Polar S810 HR monitors
- OMNI Rating of Perceived Exertion (RPE)
  - Validated for cycling (Robertson et al., 2000), running, and walking (Utter et al., 2002) in male and female children and adolescents
  - Pictorial representation of RPE
  - Used in conjunction with HR monitoring
  - L = 0-3; H = 4-7

Measures

- Stereotypic Behaviors
  - The number of stereotypic behaviors performed by each participant were recorded
    - 15 min intervals
  - Coders were blind to which treatment the participants received

Analysis

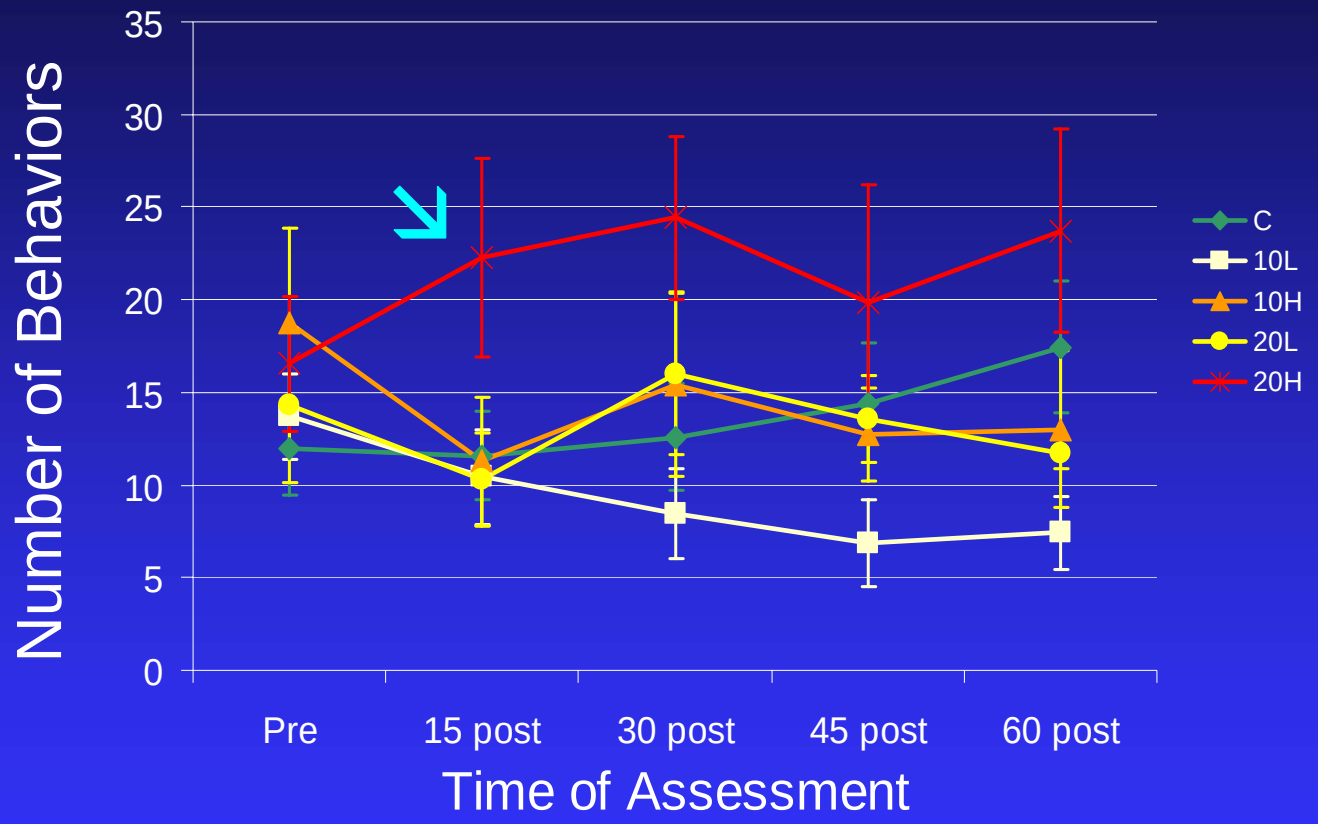
- A 5x5 (Condition x Time) repeated measures ANOVA was used to examine the effects of the conditions on stereotypic behaviors
  - Interaction effects were followed-up by examining simple effects of Condition w/in Time
    - Pairwise comparisons were then used to determine significant differences in behaviors for each condition at each time point
- α=.10

Analysis: Overall Effects

- Significant Condition Main Effect ($p<.01$) and Condition x Time Interaction ($p<.10$)

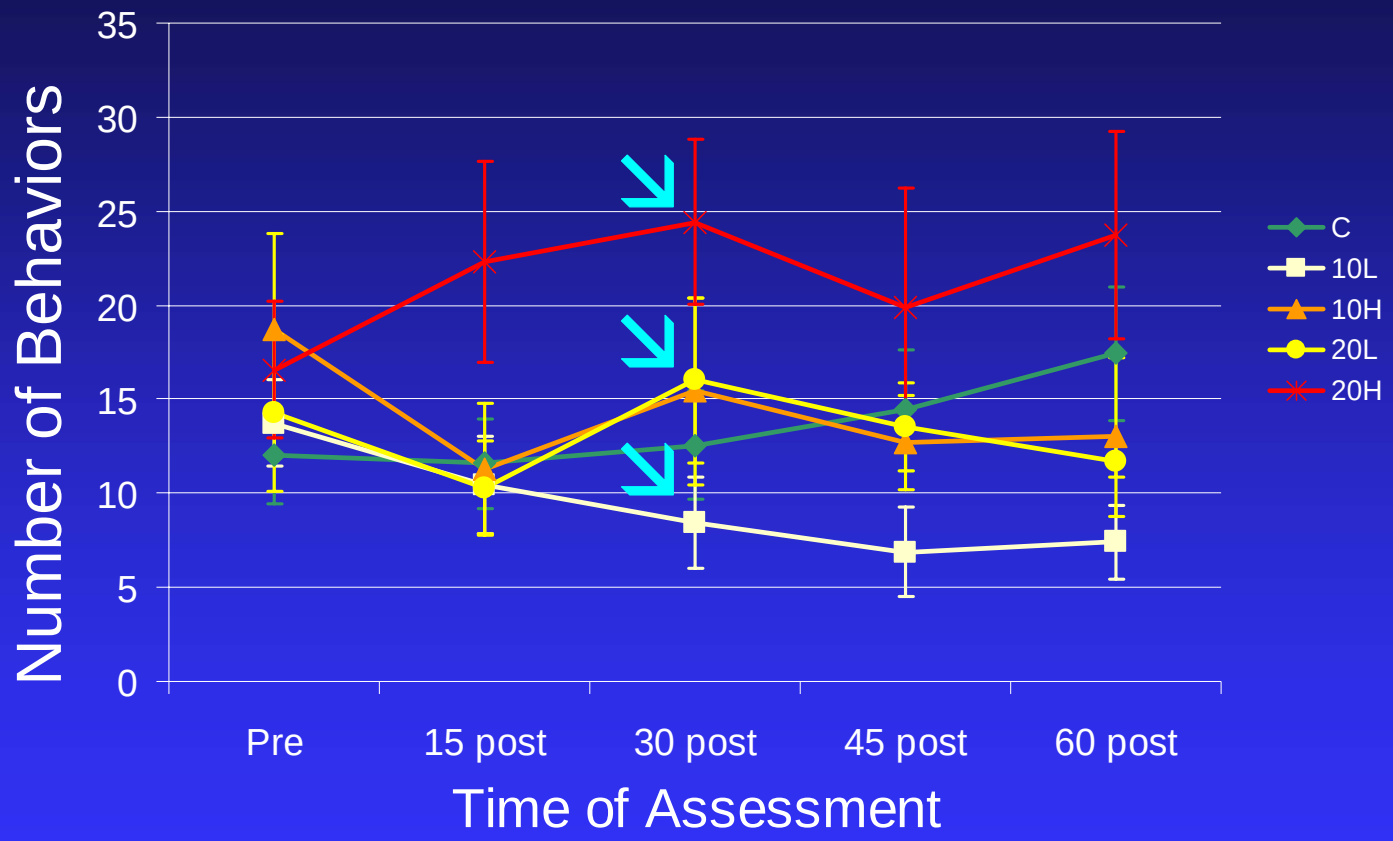
- *Simple Effects of Condition w/in Time were used as follow-ups*
  - No significant difference in pre-exercise behaviors across conditions ($p>.45$)
  - Simple effects were significant at all other time points ($p<.08$)

Results: 15 min Post



- 20H produced significantly worse behaviors ($p<.10$) than all other conditions except the control

Results: 30 min Post

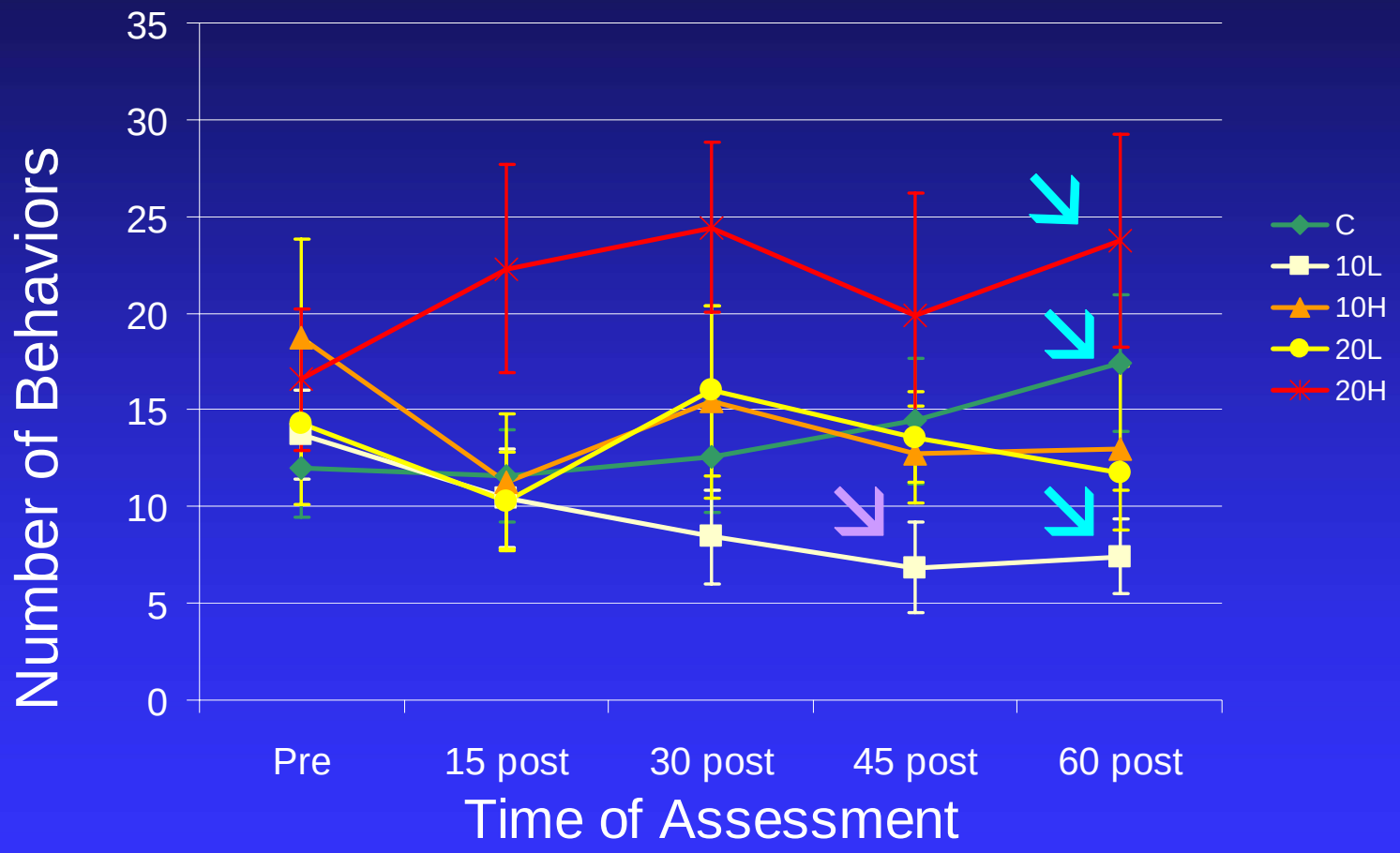


- 10 L was significantly better than either 20-minute condition ($p<.10$)

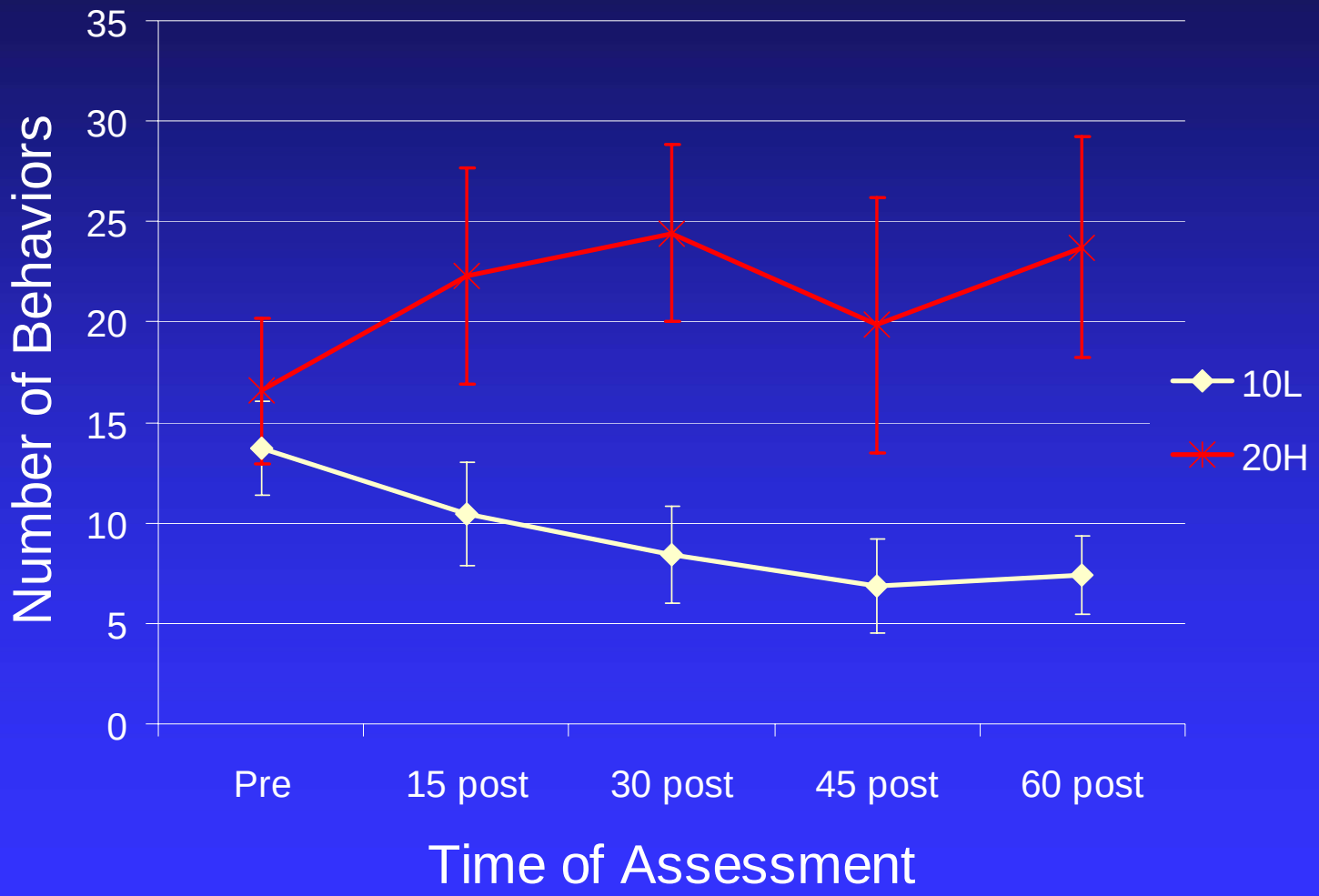
Results: 45 & 60 min Post

- 45 minutes following exercise, 10L produced significantly fewer behaviors than all other conditions ($p<.10$)
- 60 minutes post-exercise:
  - Behaviors were worse following 20H compared to 10L, 10H, & 20L ($p<.10$)
  - 10L was better than C and 20H ($p<.05$)

Results: 45 & 60 min Post



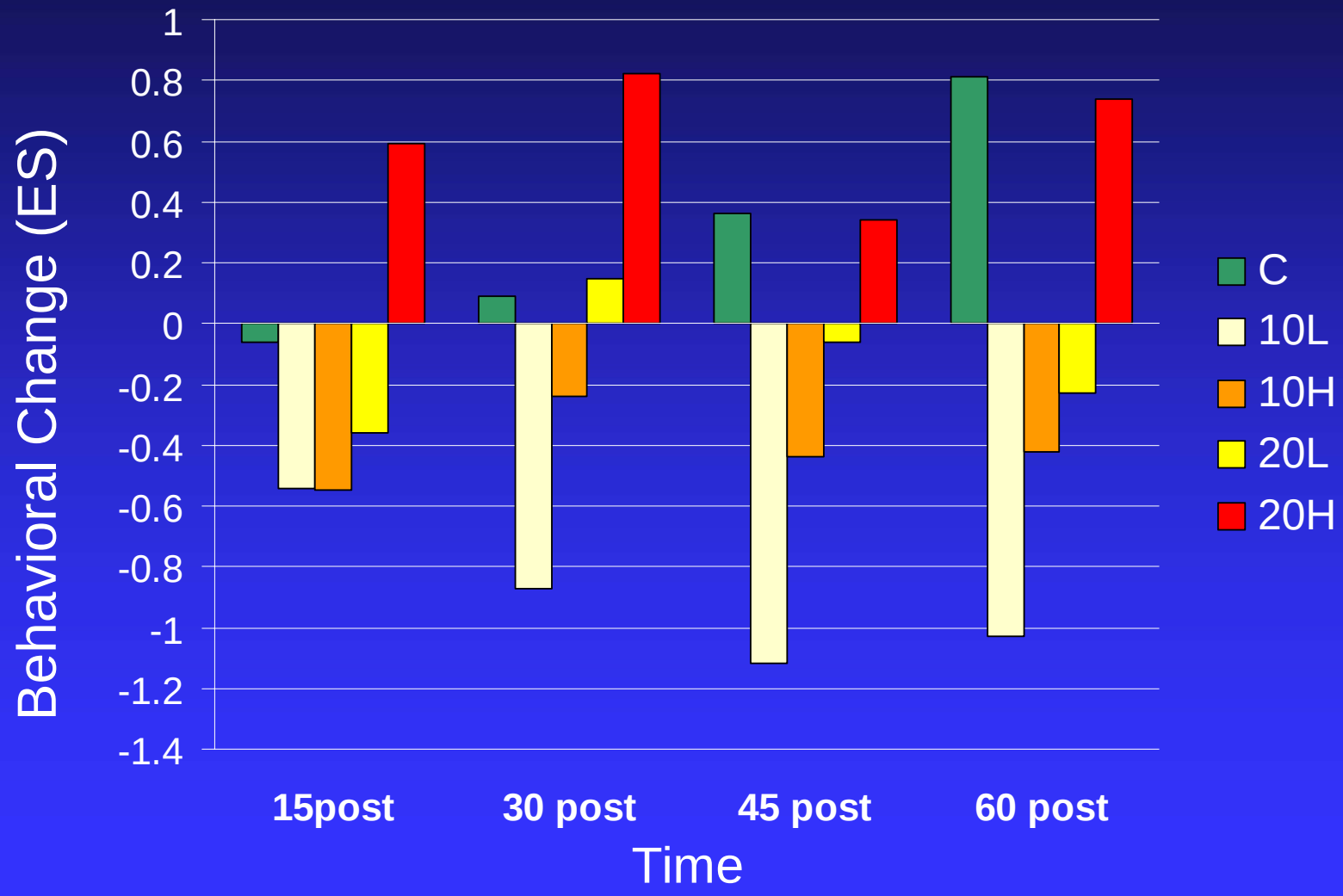
Results: Low 10 vs. High 20



Analysis: Magnitude of Effect

- Effect sizes were calculated to determine the magnitude of behavior changes compared to pretest for each condition

Results


Behavioral Change (ES)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
15post
30 post
45 post
60 post
Time
C
10L
10H
20L
20H

Rationale for the Observed Dose-Response Effect

- Apparent dose-response relationship between exercise workload and behaviors
- High intensity exercise may increase physiologic arousal to a point that “overstress” the system
- More moderate exercise doses may provide a more optimal challenge to the system and decrease anxiety (Arent et al., 2005; Landers & Arent, in press)

Implications

- Practical application
  - "Short" bouts of exercise may alleviate behavior problems
    - Control for intensity and volume
  - Frequency of exercise may also impact responses throughout the day
  - Dose-response effects for "fitness" vs. "behavior" appear to be different
  - ADHD effects?
- The duration of the response is consistent with recent findings for the duration of reductions in stress reactivity following an acute bout of exercise (Alderman, Arent, et al. In Press. *Psychophys*)

Acknowledgements

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