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Background

- Successive negative contrast (SNC) has been shown in animals to be sensitive to reductions in either qualitative or quantitative value of food reward. When the hedonic value of a reward is reduced goal-directed behaviour is retarded compared to animals only ever exposed to the lesser reward (Crespi, 1942).
- Pharmacological evidence suggests that this negative contrast effect has an element of aversiveness as its recovery is promoted by anxiolytics (Flaherty, 1991).
- Behavioural and neuropsychological responses of humans with excessive amounts baseline anxiety have been shown to be more sensitive to the loss of reward (Hajcak et al, 2004).
- An acute anxious state representing generalised anxiety disorder (GAD) can be induced in healthy human volunteers via inhalation of 7.5% CO₂ (Bailey et al, 2005)
- This study seeks to translate the rodent SNC task into an instrumental human paradigm and to assess the influence of acutely induced GAD-like symptoms via CO₂ inhalation on task performance.

Method

- Healthy volunteers ($n = 30$) were recruited from the University of Bristol.
- Participants were trained to respond to quickly alternating visual cues (the words 'High' and 'Low') paired with obtaining positive outcomes of High Reward (4 x 5pence reward) or a Low Reward outcome (1 x 5pence Reward).
- A negative affective state was induced in half the participants via a 7.5% CO₂ inhalation protocol.
- During inhalation participants completed the testing session, where they were instructed to win as much money as possible.
- Testing was equally divided into three blocks of 16 trials, the first and third blocks being defined as high-payout blocks, with a 'High' payout for 80% of trials, 20% of trials were programmed to return a 'Low' payout.
- The second block was defined as low-payout block which was the reverse.
- Participants did not know that response outcomes were predetermined.
- Median response latency to each trial block was recorded. Participants were given a series of self-report measures of mood before and after the task. The study design produced a within-session SNC effect with between-subject effects of anxiety.

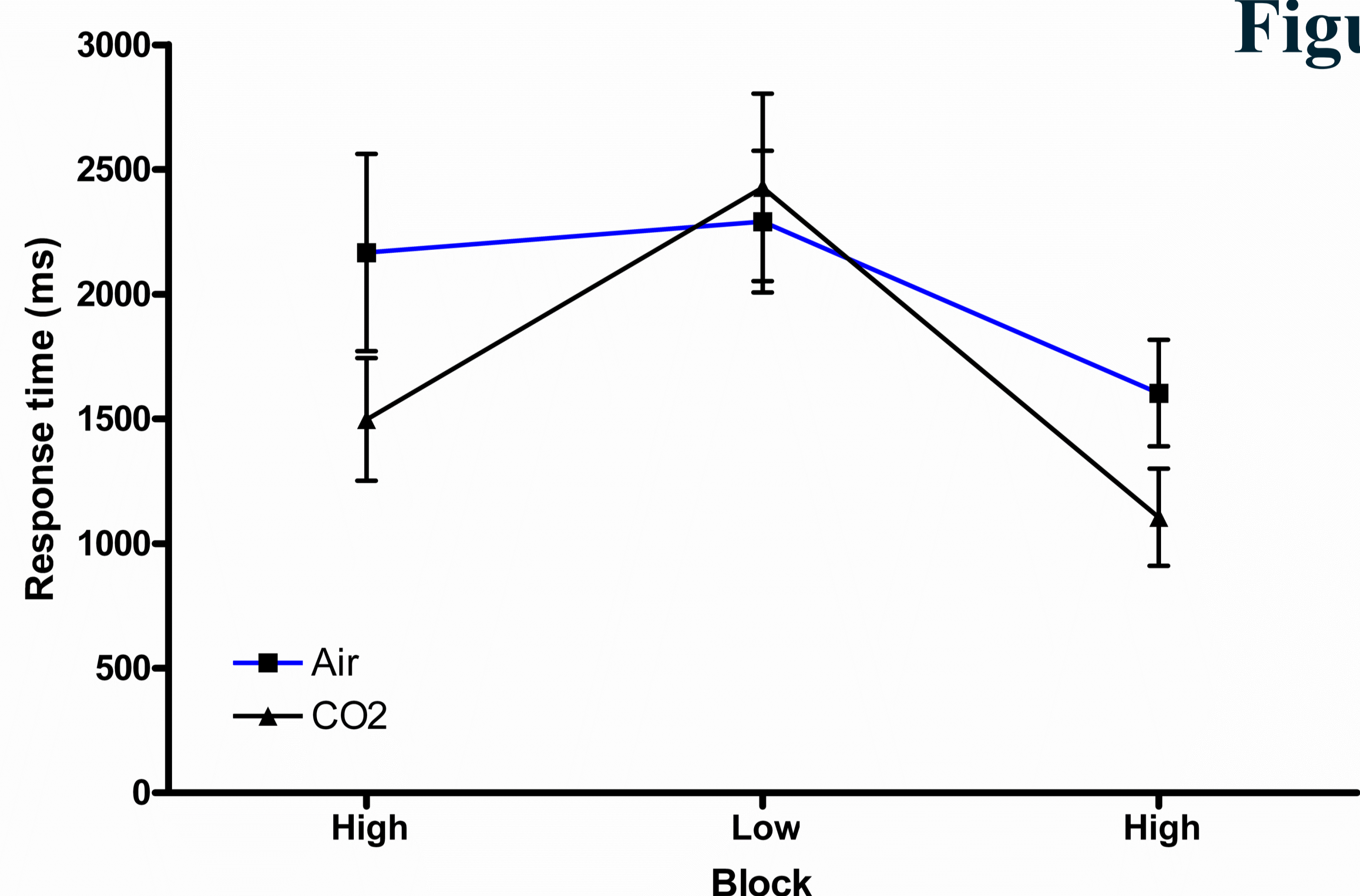


Figure 1. A significant quadratic interaction of Gas x Block was observed ($p = 0.039$), this represented a slowing from the first 'High' block to the 'Low' block for the CO₂ group. A quickening was observed for both groups when moving from the 'Low' to final 'High' block for both groups. Bars represent \pm SEM.

Figures

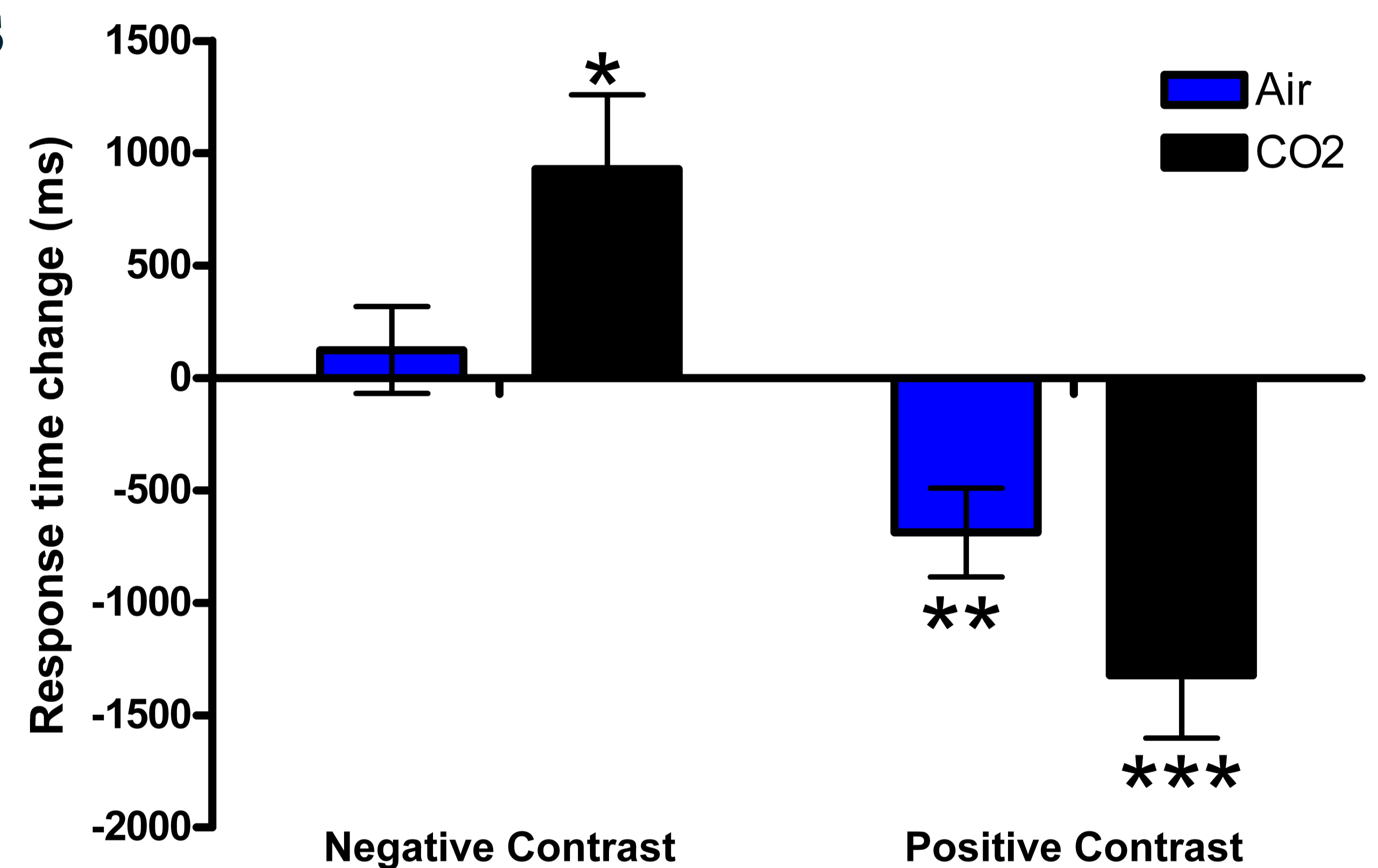


Figure 2. A contrast score was formed by calculating the change in response time between blocks, representing a negative and a positive contrast. A significant correlation between positive contrast scores and PANAS Negative scores were found ($p = 0.009$) with larger PANAS Negative scores correlated to a smaller positive contrast for the CO₂ inhalation group only. Bars represent \pm SEM.

Results

- Two participants (both air group) were excluded from analyses due to slowing ($> 2s.d$) from trial blocks two and three, resulting in a final sample of 28 for analysis.
- No significant differences were found between the two inhalation groups ($ps > 0.305$) for age, sex, STAI-trait, ASI and BDI.
- RM ANOVA for before and after self-report scores found a significant Time x Gas Type x Measure interaction ($F [4.719, 113.251] = 6.032, p < 0.001$) which was qualified as significant increases in STAI-State and PANAS-Negative scores for the CO₂ inhalation group.
- A significant quadratic interaction of Block x Gas was found for response times representing a slowing between the first high and low payout blocks for the CO₂ inhalation group ($p = 0.014$, see Figure 1)
- A quickening was observed from the low to the second high payout block for both the air and CO₂ inhalation groups ($p = 0.004$ and < 0.001 respectively)
- In order to facilitate correlation analyses, a contrast score was derived by subtracting the latency to respond during trial block 1 from block 2. A positive score, therefore, reflects slowing of responses when moving from the first high-payout block to the low payout block, reflecting a negative contrast. A second contrast score, derived by subtracting latency to respond to the low-payout block from the final high-payout block, reflecting a positive contrast was calculated, with a negative score reflecting a quickening in RTs (See Figure 2).
- A significant Pearson's r correlation ($r = 0.687, p = 0.009$) was found for the change in response time for positive contrast scores with PANAS Negative score for the CO₂ inhalation group signifying that a larger increase in PANAS Negative scores correlates with a smaller positive contrast effect.

Conclusion

CO₂ significantly increased anxiety-related scores representative of anxiety-like mood. CO₂ produced a significant negative contrast effect between the first high-payout and low-payout blocks, followed by a positive contrast effect when moving from the low-payout to the final high-payout blocks. Only the latter was seen in the normal air inhalation group. These data could suggest that an anxious state not only effects how healthy participants respond to disappointment and adversity but may also effect how they 'bounce-back' after negative life experiences.

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