

Response time slowing by glucose dependent on strength of stimulus response association: investigations with the flanker task

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Background

➤ Empirical evidence suggests that glucose drinks can boost cognitive performance, ensuring that the brain does not run low on energy during cognitive functioning (Riby, 2004).



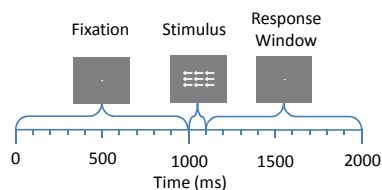
➤ On the other hand there are reports from schools suggesting that glucose consumption can worsen cognitive performance (Park, 2008). However such effects have never been confirmed experimentally.

➤ Here we demonstrate that response times (RTs) can be slowed by the administration of glucose drinks, while leaving error rates unaffected. Our research suggest that weak stimulus-response (S-R) association is necessary to show this effect



Experiment 1 – Arrow Flanker Study

Method



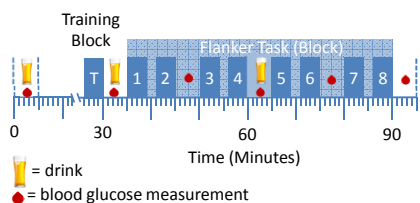
Stimuli – central target arrow, surrounded by congruent, neutral or incongruent flankers

Presentation - equiprobable and randomised order in 8 blocks of 120 trials

Task – press one of two buttons on the same side indicated by the target arrow

Design - within participants double-blind placebo-controlled design (n = 12)

Drinks - 3 × 25g glucose or saccharin spaced apart by 30 minutes to participants.

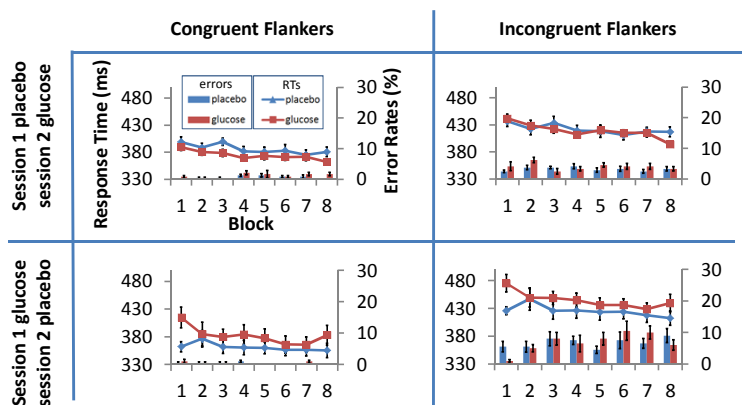


Results

Flanker Congruency Effect - We observed the typical flanker effect; i.e. responses for incongruent trials were slower than in congruent trials ($p < 0.01$).

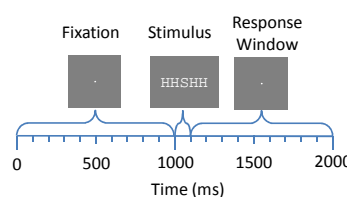
Drink Effect - In the first block, RTs were slower in the **glucose** relative to the **placebo** session ($p=0.03$). Flanker congruency effects were not modulated by the Drink type ($p>.05$).

Drink Effect dependent on Drink Order - In the first block, the drink effect was further modulated by the factor drink order ($p=0.01$). More specifically, RTs in the **glucose** session were slower than in the **placebo** session when **glucose** was given before **placebo** ($p=0.02$). However, this was not the case when **placebo** was before **glucose** ($p=0.56$).



Experiment 2 – Letter Flanker Study

Method



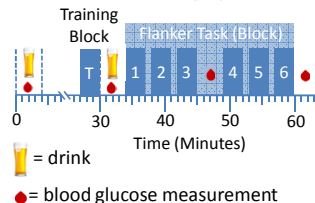
Stimuli – central target letter surrounded by congruent or incongruent flankers

Presentation - equiprobable and randomised presentation order in 6 blocks of 80 trials

Task – press one of two buttons assigned to the target letter

Design - between participants double-blind placebo-controlled design (n = 12)

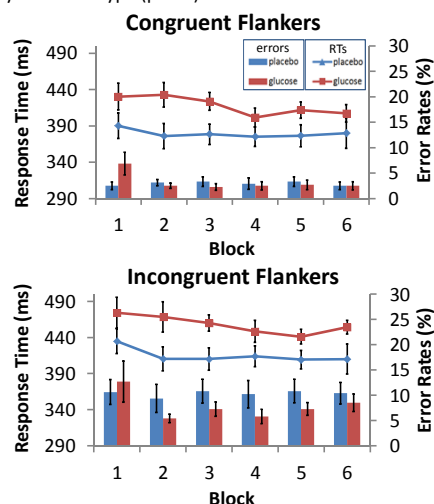
Drinks - 2 × 25g glucose or saccharin spaced apart by 30 minutes to participants.



Results

Flanker Congruency Effect – We observed the typical flanker effect; i.e. responses in incongruent trials were slower and less accurate than for congruent trials ($p<0.01$).

Drink Effect - RTs were slower in the **glucose** compared to the **placebo** session for all blocks of the flanker task ($p < 0.05$). The effect was not significant for error rates ($p > 0.05$). Flanker congruency effects were not modulated by the Drink type ($p>.05$).



Conclusions



➤ Experiment 1 Arrow Flanker Study - Our findings suggest that glucose may slow RTs when participants are inexperienced with a sensorimotor task (1st block effects). Once experience is gained this effect vanishes, this is possibly because sensorimotor processing becomes too automatic as S-R association is strengthened over successive trials.

➤ Experiment 2 Letter Flanker Study – This experiment aimed to keep S-R association low for the duration of the experiment by using novel stimuli on successive blocks of trials. By doing this we demonstrated that glucose can consistently slow RTs on a sensorimotor task for a prolonged period of time (at least 30 minutes).



➤ General Discussion – Together both experiments suggest that when S-R associations are low that glucose can slow RTs.

➤ In terms of physiology, an increase in glucose metabolism as a result of glucose drink administration may cause oxidative stress. This can impair Na⁺/K⁺ channels in the neural membrane and slow neural conduction velocity, and thereby might slow RTs.

