The treatment of anxiety-based psychopathology often hinges upon extinction learning. Research in nutritional neuroscience has observed that the regular consumption of perilla oil (30% alpha-linolenic acid (ALA)) facilitates extinction learning in rats (Yamamoto et al., 1988). However, acute facilitation of extinction learning by oils rich in ALA has not been reported for rats or humans, though the acute consumption of rapeseed oil (10% ALA) has been observed to improve cognitive processing speed in humans (Jones et al., 2014). For this reason, the present laboratory work examined the effects of adding walnut oil (12% ALA) to a chocolate milkshake on the acquisition, generalization, and extinction of a fear-based prediction in young adults. It compared performance between subjects. The other participants consumed a similar milkshake with either an aperitif or a cup of coffee (control). Acquisition and generalization of the fear-based prediction were similar for all conditions. However, those who consumed the chocolate milkshake extinguished most rapidly and profoundly. This finding may be relevant to the clinical treatment of anxiety disorders.

METHODS

Power calculation. A placebo controlled double blind pilot study examining whether saturated fat (cream or coconut milk) affects memory observed a large effect size (d=1.38). A priori power calculation using G-power revealed that with such a large effect size, alpha set to .05 (two-tailed) a sample size of 15 would be required for 95% power (Efrerfeld et al., 1996).

Participants. Sixty-two participants were recruited from KU Leuven. The data from three of these participants were not included in the final analysis because 1) of a technological problem, 2) failure to drink the entire milkshake solution, and 3) failure to follow directions. Of the remaining, 37 were female and 22 were male (M=19.89 yrs; SD=2.46; range 18-31 yrs).

Design. Randomized, double-blind, placebo-controlled, between-subjects design. Participants abstained from consuming anything with calories, caffeine, and nicotine for 3 hours prior to participating.

Chocolate Milkshakes

<table>
<thead>
<tr>
<th>Nutritional Information</th>
<th>Walnut</th>
<th>Cream</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>23</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>Fat</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Saturated</td>
<td>21</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Procedure.
1. Pre-acquisition:
   - The CS+ and the CS- were each presented 8 times without the outcome.
   - Participants were instructed to imagine that the CS+ was an attacking German shepherd dog as the to-be-predicted outcome.

2. Acquisition:
   - The CS+ and the CS- were each presented 12 times. The CS+ was co-terminated with the presentation of the CS-.

3. Generalization:
   - Each of three generalization blocks consisted of one presentation of each of the seven generalization stimuli, two presentations of the CS+ (50% reinforced), and two presentations of the CS-.

4. Extinction:
   - The extinction phase consisted of twelve identical trials: a presentation of the CS- that was never followed by the outcome.

RESULTS

Temperature. The mean predictive ratings for all of the line stimuli presented during the generalization test phase. Error bars represent ± SEM.

<table>
<thead>
<tr>
<th>Time (in Minutes)</th>
<th>Cream</th>
<th>Walnut</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
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<tr>
<td>40</td>
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</tbody>
</table>

Predictive Learning Test.

Profile of Mood States questionnaire (Dutch version; Wald and Meillenboer, 1990).

Acquisition:
- The mean predictive ratings per condition, stimulus (CS+ and CS-), and trials during the pre-acquisition and acquisition phases. Error bars represent ± SEM.

Extinction:
- The mean predictive rating for the CS- across trials during the extinction phase. Error bars represent ± SEM.

DISCUSSION

- Walnut oil improved extinction learning.
- Why no differences in acquisition and generalization?
  - Simple discriminative learning is not affected by dietary manipulations (Davidson et al., 2012).
  - Stimulus discrimination is not sharpened, and generalisation reduced, by drug administration (Luyten et al., 2015).
  - How did Walnut oil facilitate extinction?
    - Vagal afferent activation by nutrients? (Jones et al., 2012).
    - Could explain differences between Walnut and Control.
    - Cannot explain differences between the Walnut and Cream.
- Why did those who consumed Cream extinguish more slowly than those who consumed Walnut oil?
  - Facilitation by cream attenuated by systemic inflammation?
  - Cream increases inflammation more than other nutrients (Deopurkar et al., 2010).
  - Increases in systemic inflammation impair mood and memory (Reichenberg et al., 2001).

CLINICAL RELEVANCE
The efficacy of exposure treatment (which relies on the extinction of fear) may be sensitive to the contents of a patient’s diet, and even the meal preceding a clinical session.

REFERENCES


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