

Effects of Food Pellets, Granulated Chow, and High Carbohydrate on Rats Trained to Discriminate 2 Hour and 22 Hour Food Deprivation

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Introduction

We have developed a food-deprivation discrimination task where subjects are trained in a two-lever choice task to recognize and report the differences in internal states between food deprivation lasting 22 hours ("hunger") or 2 hours ("relatively full"). We use the model to investigate neurochemical and dietary factors that influence "hunger".

Previously, we demonstrated that 20 minutes access to food pellets (Teklad Chow) eliminated the internal states associated with food deprivation (e.g., reduced responding on the lever associated with 22 hour food deprivation, Jewett et al., 2006). We have also determined that sucrose solutions and corn oil solutions, but not saccharin solutions, and a high-fat, high carbohydrate diet significantly decreased the effects of 22 hour food deprivation.

In the present study, we seek to further investigate the effects of food on the "hunger" discrimination. We wish to compare two identical diets, differing only in the size of the food. Consumption of food presented as standard pellets (3-4 g per pellet) was compared to consumption of a granulated form of the identical diet (each piece of the food weighed less than 0.1 g). Additionally, we assessed the effects of consuming a high-carbohydrate diet on the "hunger" discrimination.

Method

Subjects and apparatus:

- Male Sprague-Dawley rats were housed in individual cages in a room with 12:12 light/dark cycle.
- 45-mg food pellets (Bioserve F#0021) were delivered as reinforcers in standard two-lever operant chambers (Med-Associates).

Behavioral training:

- Rats were trained to lever press a fixed number of times in order to acquire a food pellet (fixed ratio schedule of reinforcement, FR).
- Rats were placed in operant chambers, during the five minute period which the chamber was illuminated, and reinforcers could be earned.
- Correct lever presses (e.g., left lever presses following 22 hour food deprivation or right lever presses following 2 hour food deprivation) were reinforced with food pellet delivery under a FR-15.
- Incorrect lever presses (e.g., left lever presses following a 2 hour food deprivation or right lever presses following a 22 hour food deprivation) resulted in an 8 second period of darkness and no food pellet delivery.

- Each training session included two response cycles that ended after five food reinforcers were earned or 5 minutes elapsed, whichever occurred first.
- Training continued until subjects emitted greater than 80% condition-appropriate responses within a session for 8 out of the last 10 sessions.
- Once training was completed, rats would be scheduled for generalization test probes in-between training sessions.

Generalization tests under 22 hour deprivation:

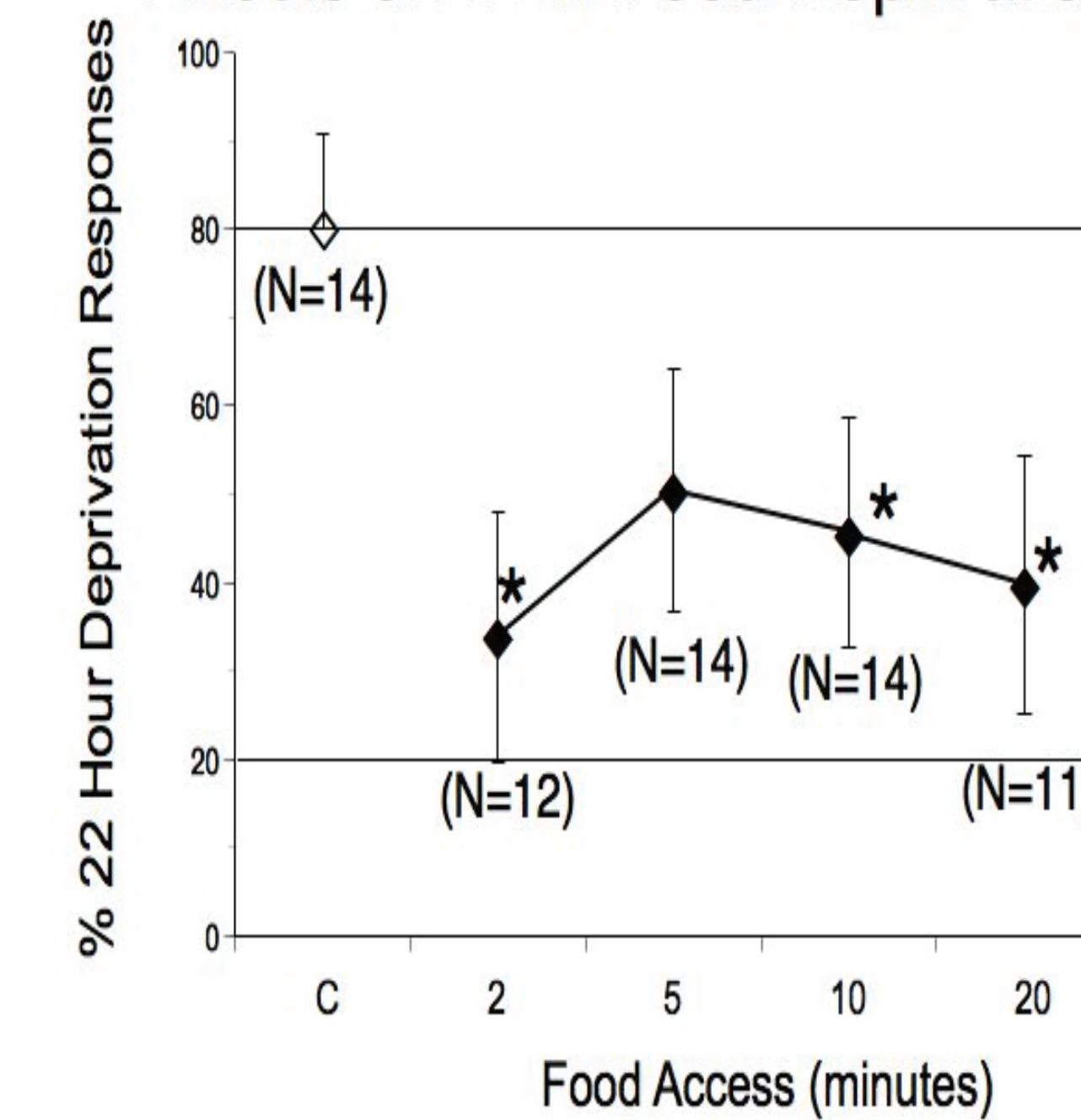
- All test sessions were conducted under the 22 hour deprivation condition.
- Subjects completed a one-cycle training session pre-test where presses on the condition-appropriate responses were reinforced.
- After the pre-test cycle, either a Teklad diet (food pellets or granulated food) or a high carbohydrate diet was made available in a separate environment.
- Following food access, rats were placed back into the operant chamber and a second response period was initiated during which presses on either lever were reinforced.

Data Analysis:

Data are expressed as mean (+/- standard error of the mean) values. Analysis of variance (ANOVA) and LSD post-hoc tests were conducted. Asterisks indicate values significantly different than values following control or shortest access time conditions.

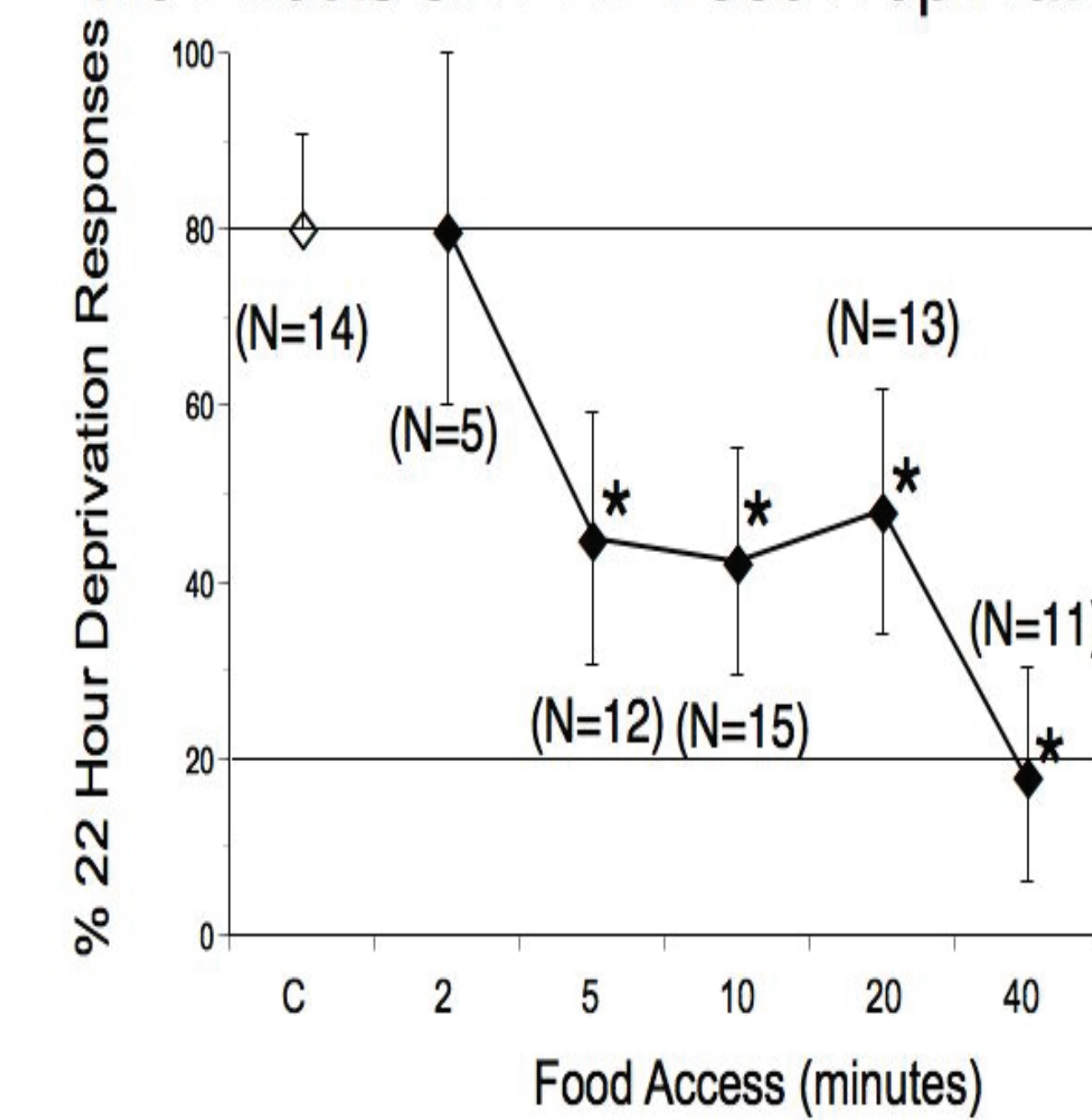
Food Pellets

Teklad Chow Consumption Decreases Effects of 22-hr Food Deprivation



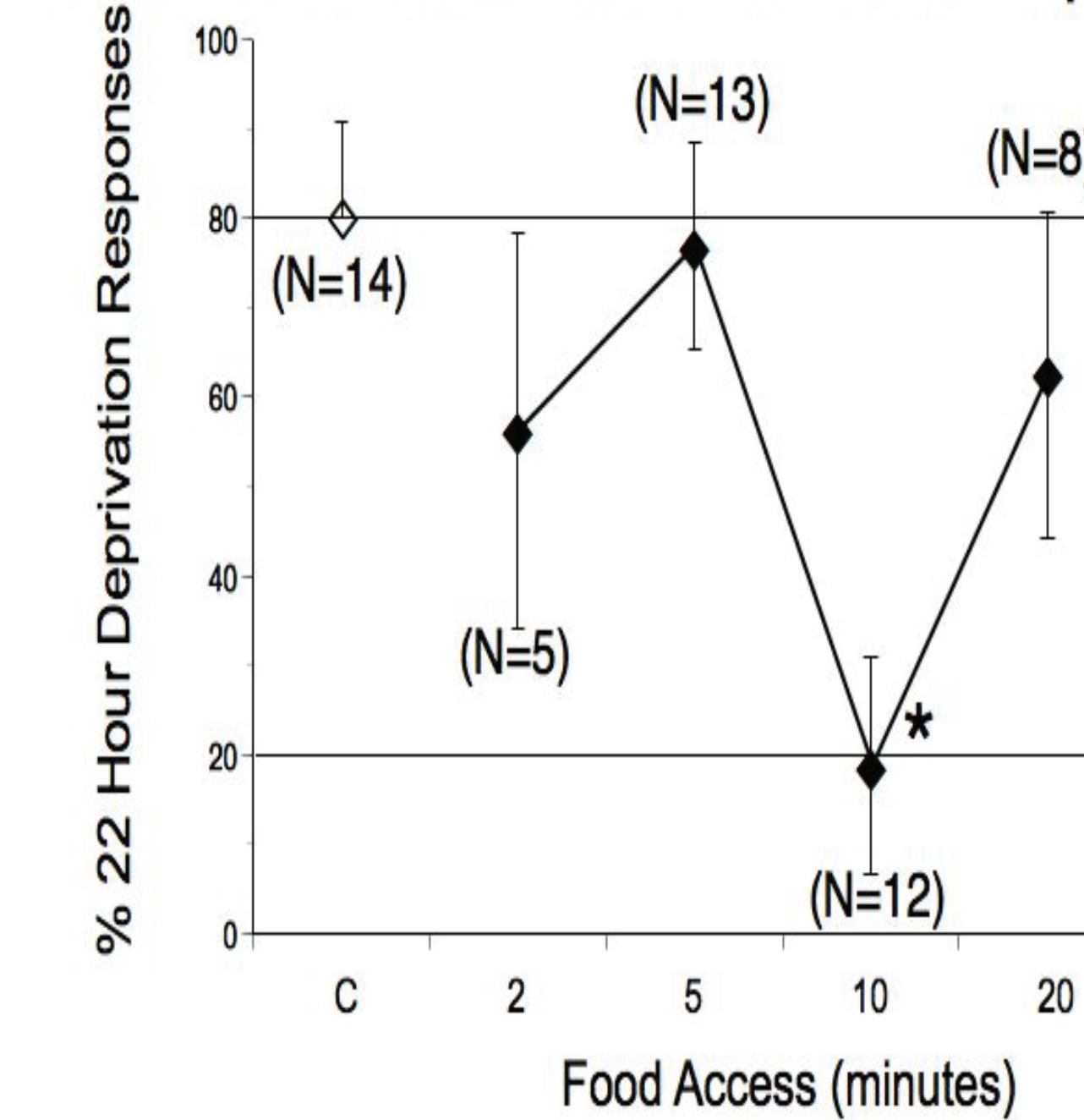
Granulated Chow

Granulated Chow Consumption Decreases the Effects of 22-hr Food Deprivation



High Carbohydrate

High Carbohydrate Consumption Decreases Effects of 22-hr Food Deprivation



Results & Conclusion

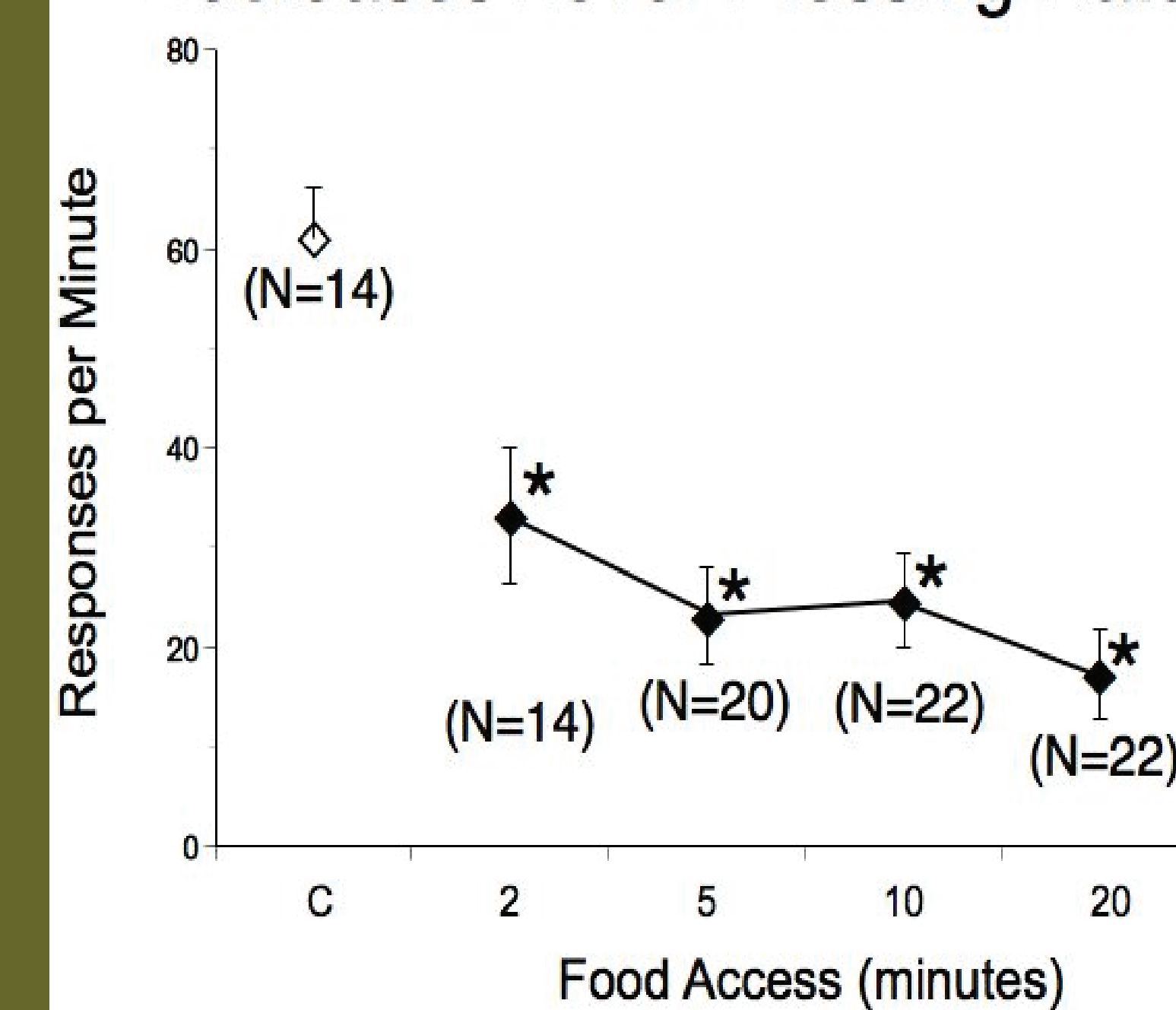
Food intake significantly reduced the internal stimulus effects of 22 hours acute food deprivation. When the standard Teklad diet was made available in pellet form, consumption resulted in significant decreases in reports of "hunger" (lever presses associated with 22 hours deprivation) and lever pressing rates at all time points tested (2-20 minutes).

Under conditions when the Teklad diet was presented in smaller pieces (less than 0.1 g per piece of food), our preliminary data indicate consumption during the smallest access time does not significantly affect the hunger discrimination nor significantly alter response rates. Data are still being collected for this condition. During all other access conditions (5-40 minutes) the stimulus effects of 22 hour deprivation and response rates were significantly reduced. Consumption of a high-carbohydrate diet for 10 min significantly reduced the discriminative stimuli associated with 22 hours acute food deprivation. Significant reductions in lever pressing were observed at all access times assessed (2-20 minutes).

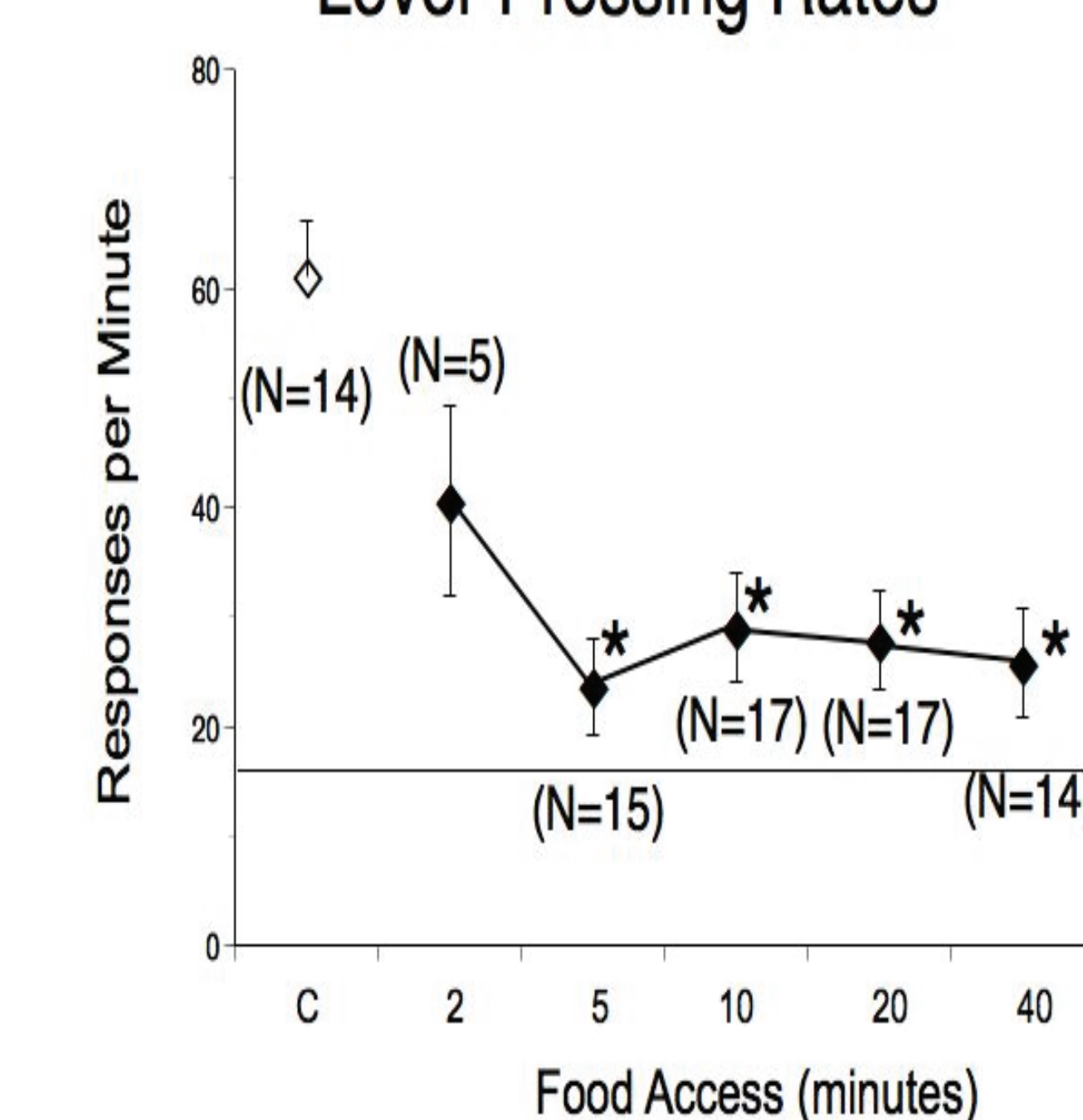
Independent of diet or form, food consumption significantly increased as access time increased. Food intake of the granulated form of the Teklad diet was reduced compared to intake of the standard form of the diet (Food Pellets).

These data indicate very brief access to food can quickly alter internal states associated with eating ("hunger"; measured by the percentage of responses toward the lever associated with 22 hours food deprivation) and affect motivation for food (measured by lever pressing rates). The form of the food may also affect consumption and how quickly the changes in internal state and behavior occur.

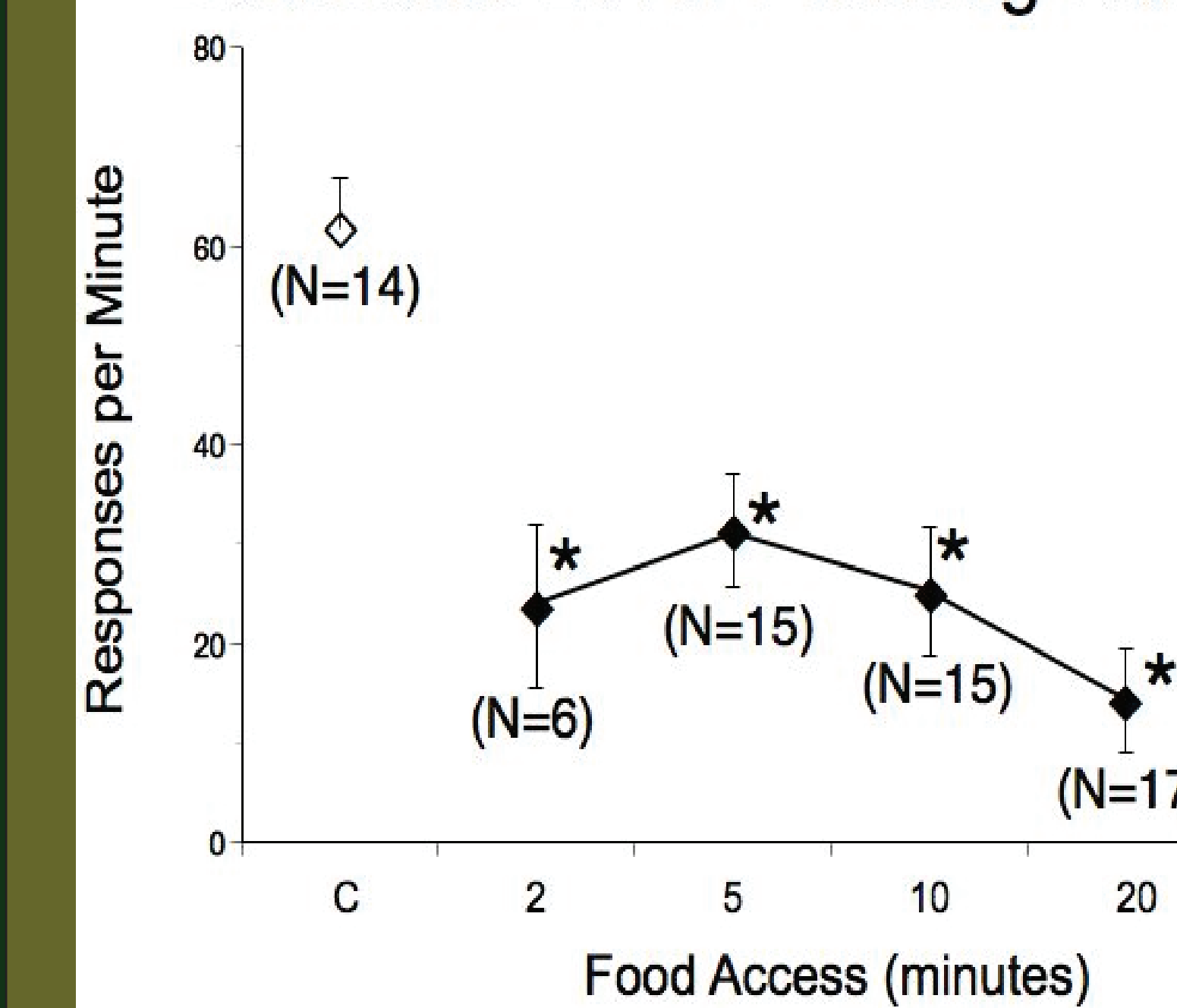
Teklad Chow Consumption Decreases Lever Pressing Rates



Granulated Chow Consumption Decreases Lever Pressing Rates



High Carbohydrate Consumption Decreases Lever Pressing Rates



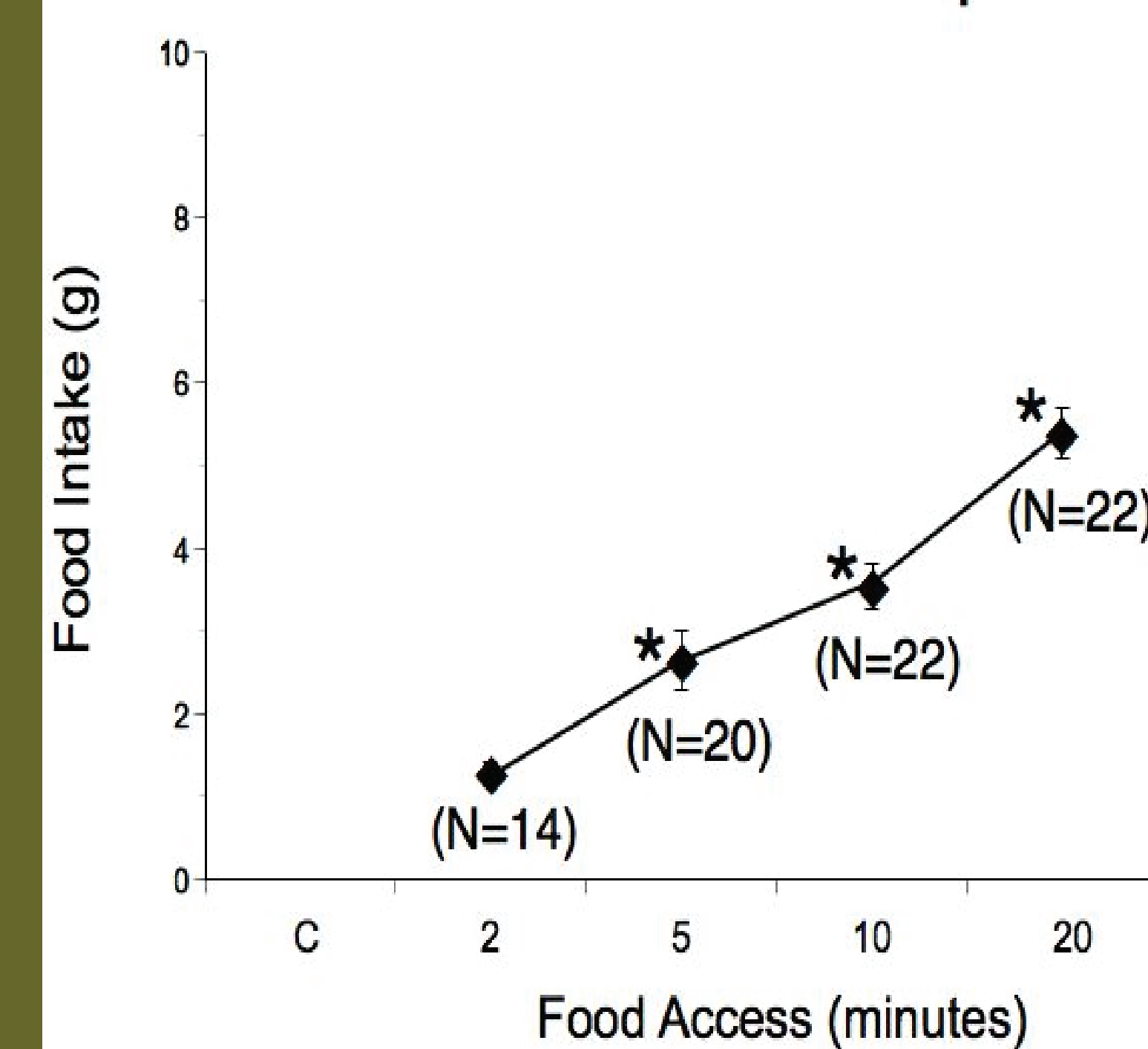
Reference

Jewett, D. C., Lefever, T. W., Flashinski, D. P., Koffarnus, M. N., Cameron, C. R., Hehli, D. J., Grace, M. K., & Levine, A. S. (2006). Intraparaventricular neuropeptide Y and Ghrelin induce learned behaviors that report food deprivation in rats. *NeuroReport*, 17, 733-737.

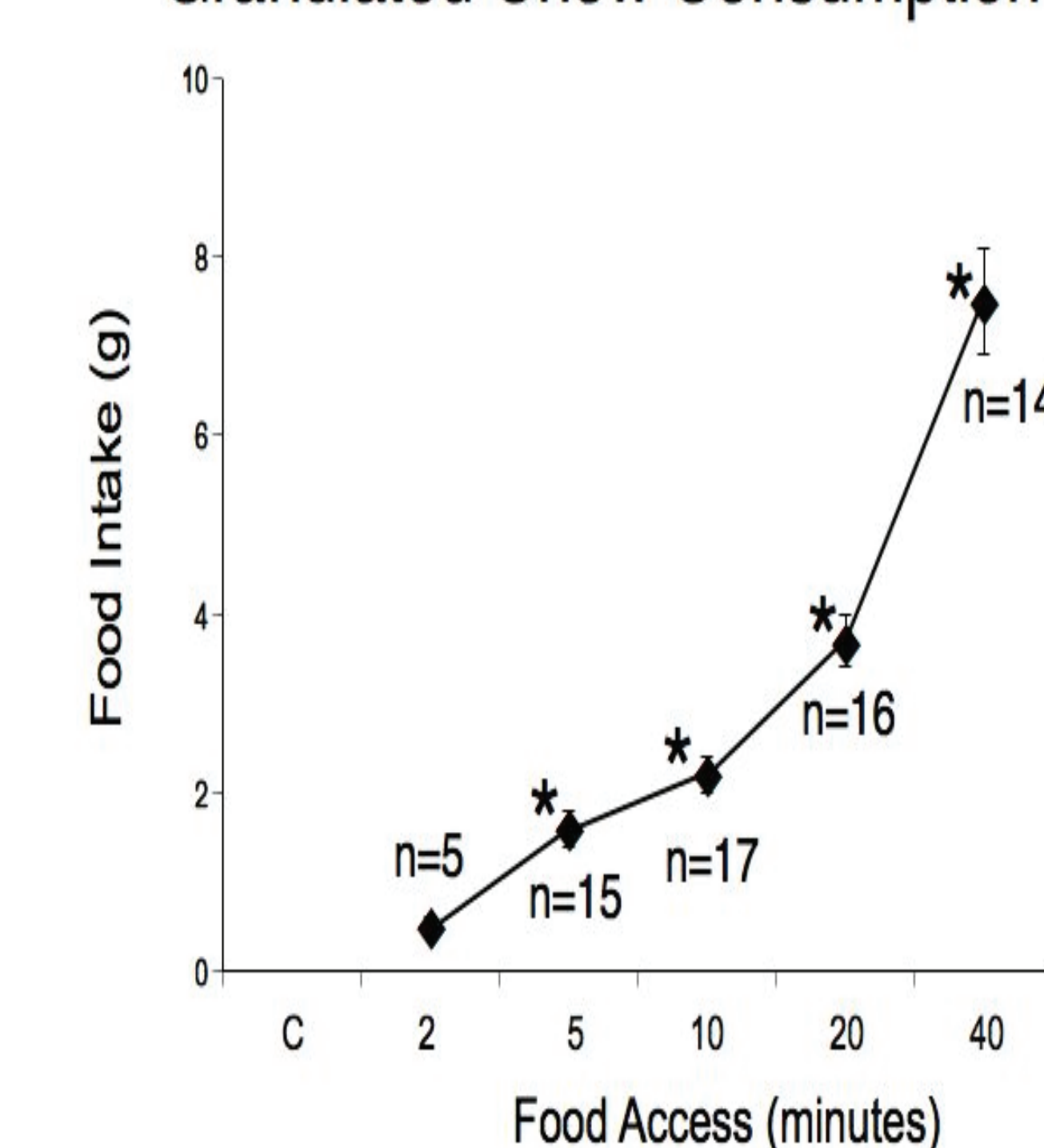
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Teklad Chow Consumption



Granulated Chow Consumption



High Carbohydrate Consumption

