

## INHIBITION OF BINGE EATING BY CHANGES OF FEEDING CONTEXT

### *INHIBICIÓN DE LA GRAN COMILONA POR CAMBIOS DEL CONTEXTO ALIMENTARIO*

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### Abstract

The objective of this experiment was to evaluate the effect of a change in context on inhibition in the incidence of binge eating. Eighteen experimentally naive Wistar rats were used and were divided into three groups. Each group began with a free access period of fifteen days and three days of food deprivation. The first experimental group was deprived in a different context than that of its home box and returned to it for a free access period of 15 days. The second group was deprived in its home box and placed in a different context with free access for 3 days post-deprivation and later returned to its home box for 12 days. The control group did not change context in any period. The results showed that the change in context modified food intake during post-deprivation period. The incidence of binge eating was inhibited by the change in context.

**Key words:** binge eating, inhibited, habituation, food consumption, rats.

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## Resumen

El objetivo de este experimento fue evaluar el efecto del cambio de contexto sobre la inhibición en la ocurrencia de la gran comilona. Se utilizaron dieciocho ratas Wistar, experimentalmente ingenuas que fueron divididas en tres grupos. Cada grupo inició con un periodo de quince días de libre acceso y tres días de privación de alimento. El primer grupo experimental fue privado en un contexto diferente al de su caja habitación y regresado a él en un periodo de libre acceso de 15 días. El segundo grupo fue privado en su caja habitación y colocado en un contexto distinto en libre acceso durante tres días post-privación y posteriormente regresado durante 12 días a su caja habitación. El grupo control no cambió de contexto en ningún periodo. Los resultados mostraron que el cambio de contexto modificó el consumo de alimento en el periodo post-privación. La ocurrencia de grandes comilonas fue inhibida por el cambio de contexto.

**Palabras clave:** gran comilona, inhibición, habituación, consumo de alimento, ratas.

## Introduction

A necessary element to consider in the analysis and experimentation of feeding behavior is the relation of the interdependency that exists between the behavior of an organism and its environment (Reynolds, 1986). The experimental evidence has shown that manipulation of environmental stimulus has an influence over the intake of water (Díaz-Resendiz, Franco-Paredes, Martínez-Moreno, López-Espinoza & Aguilera-Cervantes, 2009; Fink & Patton, 1952; Ordaz, López-Espinoza & Martínez, 2005) and food (Antelman Rowland & Fisher, 1976; Ordaz, et al., 2005). Rescorla, Durlach, and Grau (1985) pointed out in a particular way, that the context associated with no reinforcement acquires properties of an unconditioned stimulus. In other words, the context by itself modulates or controls the manifestation of behaviors associated to it.

In regard to this, Anderson (1941 a, b, c) stated that in the face of a physiological need such as hunger, the organism produces specific behaviors to reach its fulfillment. If the behaviors are produced in constant environmental situations, these behaviors will be controlled by the context. This statement is the foundation of the externalization of the drive theory. This theory got objections from Siegel (1943) who reproduced Anderson's (1941 a, b, c) experiments and obtained contradictory results. Bolles (1973) questioned the number of subjects used and the absence of a statistical analysis. However, for Bolles, the great void in the theory is the problem in identifying which elements of the environment act as a drive and which as reinforcement.

It is necessary to consider that Anderson's (1941, a, b, c) work was one of the first experimental approximations in which the role of the context was taken into account on feeding behavior, regardless of the objections he received at that time, his theo-

retic contributions have been of significance for the subsequent development that took place in the research area of the feeding context. One of these contributions to the study of the effect of the context on feeding behavior was the work of Nisbett (1968). This researcher carried out an experiment where he manipulated availability, portion, and the taste of the food with obese human subjects. His findings were discussed in terms of the influence of these environmental variables on food intake. Since the contribution Nisbett made, works were carried out to determine the effect of the contextual variables on food intake. However, the main theoretical problem of the experimental work with the context is to determine what the context is and which are the contextual variables.

Possibly, one of the first proposals to establishing a possible classification of the contextual variables is from the work of Rozin and Tuorila (1993). These researchers pointed out that it is not possible to talk about food acceptance without considering the context. They proposed a classification based on the food and non-food contextual effects by distinguishing the characteristics of temporality and simultaneousness in relation to the unit of analysis used. Rozin and Tuorila (1993) mentioned that it is necessary to take into account the contextual interactions between oral and nasal stimulation during food exposure and correlate them with the feeding context. They proposed that the conceptualization of the feeding context must include recent experiences with the food, temporary explicit effects, sounds, smells, the characteristics of the site where the feeding takes place, and information on the feeding experience.

Recently, in the works of Hirsch and Kramer (1993), Meiselman (1996), Meiselman (2006) definitions and characterizations of the feeding context were proposed. However, their great contribution was the tacit indication of the effects that the feeding context has over the preference and food intake. It is possible to point out that the majority of researches have been centered on identifying the effect of the context on the consumption and food preference, however, little work has been carried out on evaluating the effect of the context on the inhibition of food consumption. This is important since there are pathological behaviors related to the food intake as is binge eating.

Recently, the experimental study of binge eating has acquired an interest for its relation in developing pathologies such as obesity, bulimia, or anorexia (López-Espinoza, 2005). Evidence about this are the approximations that have been made to binge eating from the biological (Foulds, Kimberly, Xiaofei, & Bulik, 2009); psychological (Wolfe, Wood & Kelly-Weeder, 2009); and social perspectives (Steiger, Gauvin, Jabalpurwala, Séguin & Stotland, 2009). In the basic research field, binge eating has been characterized as the excessive food intake which is presented after a deprivation period and that exceeds the intake registered in the baseline (López-Espinoza, Ríos & Soto, 2004).

The experimental evidence shows that the incidence of binge eating is related with inherent components of the food (taste, smell, texture, temperature); stress;

deprivation; hormonal and biochemical alterations in the organism. However, controlling or inhibiting the incidence of binge eating is a field that has been researched very little. Parting from the previous evidence, the objective of this research was to evaluate the effect of the change of context in the inhibition of binge eating. It is relevant to point out that in this research the concept of binge eating inhibition will show the registered food intake below the individual or general intake average during the post-deprivation period.

## Method

### *Subjects*

Eighteen experimentally naive Wistar albino rats, nine males (230-270 g) and nine females (170-220 g), from the vivarium at the University of Guadalajara were used and were divided into three groups. Subjects were three months old at the beginning of the experiment and remained in a 12-hour light-dark cycle

### *Materials and Equipment*

Eighteen polycarbonate boxes (context A) were used as individual home boxes, measuring 13 cm high by 27 cm wide by 38 cm long, with a metallic grille on the top, with a division for feeders and drinking troughs. The bottom inside of the box was completely covered by sawdust, which was removed and replaced every five days. For registering food intake and body weight, an electronic precision scale was used.

The food provided, were pellets from the commercial brand *Nutricubos*, specific for laboratory animals, which a nutritional formula is as follows: 3% fats, 7% ashes, 1% calcium, 23% protein, 6% fiber, 49% NFE (nitrogen-free extract), 0.6% phosphorus, and 12% humidity. The beverage used was fresh drinking water and it was placed in plastic graduated troughs of 200 ml.

As an experimental context (context B) six wooden boxes were used measuring 17 cm by 27 cm by 38 cm, covered on top by a metal grille, and the bottom inside had a 4cm wide bed of gravel, which was removed and replaced every five days. Additionally, the internal walls of the boxes had circular cavities with fluorescent color backgrounds.

### *Experimental Design*

The subjects were randomly assigned to one of the three groups. Each group had three males and three females. All the groups initiated the experiment with a baseline period of 15 days under free access in context A. Group 1 was deprived of food during three days in context B, returning to context A for a 15 days period of free access to food and water. Group 2 was deprived from food in context A for three days and later placed in context B for three days with free access post-deprivation; to immediately return to context A for 12 days under free access conditions. The Control Group remained in context A throughout the experiment and was submitted to

the same deprivation program as the rest of the groups. The experiment consisted of seven phases; phases 1, 3, 5, and 7 were of free access (15 days each) and in phases 2, 4, and 6 a food deprivation program was applied for the duration of three days (see Table 1).

**Table 1.** Shows the experimental design. Phases 1, 3, 5, and 7, show the free access periods for the three groups. Phases 2, 4, and 6 demonstrate the food deprivation periods. The white squares represent the context in the polycarbonate box while the grey squares show the context in the wooden boxes.

Phases	Phase 1	Phase 2	Phase 3		Phase 4	Phase 5		Phase 6	Phase 7	
Condition	Free access	Food deprivation	Free access		Food deprivation	Free access		Food deprivation	Free access	
Group	Context A	Context B	Context A		Context B	Context A		Context B	Context A	
<b>Group 1</b>	Context A	Context B	Context A		Context B	Context A		Context B	Context A	
<b>Group 2</b>	Context A	Context A	Context B	Context A	Context A	Context B	Context A	Context A	Context B	Context A
<b>Control Group</b>	Context A	Context A	Context A		Context A	Context A		Context A	Context A	
DAYS	15	3	3	12	3	3	12	3	3	12

### Results

Figure 1 shows the mean and standard deviation of food intake throughout the experiment and Figure 2 the individual intake average during the first three days of the post-deprivation periods. In Figure 1, the top section represents the subjects from the Control Group, the middle section the subjects from Group 1, and the lower section the subjects from Group 2, the white circles represent the food intake in context A, and the black triangles the intake in context B. In turn, the grey circles represent the deprivation in context A and the grey dotted squares the deprivation in context B. In Figure 2 the grey bars represent the subjects of the Control Group, the white ones the subjects from Group 1, the black bars are subjects from Group 2, in all the groups the male data was placed on the left-hand side and the female data on the right. The line dividing the negative numbers from the positive ones represent the general intake average during the baseline for all the subjects.



As can be seen in the top section of Figure 1, that both males and females from the Control Group engaged in episodes of binge eating during the first 3 days of the post-deprivation period. In the middle section we can observe that the males from Group 1 presented binge eating after the first two days of the post-deprivation period and the females showed a tendency to reduce food intake in comparison to the baseline. Finally, both males and females from Group 2 showed a decrease in food intake during the first three days of the post-deprivation periods, and that for the next twelve days they presented a similar intake to the one registered in the baseline (Figure 1 bottom section).

In Figure 2 the analysis of individual food intake during the first three days of the post-deprivation period is shown. In the above graph the food intake during the first period of post-deprivation is shown. Five of the subjects from the Control Group showed a food intake above the four grams compared with general intake average (continuous line), only one female registered an intake of 1.7 g. In turn, from Group 1 only four subjects (two male and two female) showed consumptions above the general intake average on a range between 0.5 and 3 g, the two remaining subjects showed an intake below the average intake on a range of -1 to -2 g. In a particular way, all the subjects from Group 2 registered a food intake below the general intake average on a range between -1 and -6 g. The middle graph shows the second period or post-deprivation. In the Control Group we can observe that all the subjects showed consumptions above the general intake average on a range from 2 to 6 g, in Group 1 we can see that three subjects (two male and one female) showed consumptions above the general intake average on a range between 0.5 to 1 g, the three remaining subjects showed consumptions below the general intake average on a range of -1 to -2 g. The subjects in Group 2 maintained their consumption below the general intake average on a range between -4 to -6 grams, except for one subject whom showed consumption above the general intake average of 1 g. Finally, the lower graph shows the third period of post-deprivation. It is possible to observe that the subjects in the Control Group maintained their consumption above the general intake average on a range from 3 to 6 g. We can observe in the subjects of Group 1 that three subjects (two male and one female) showed consumption above the general intake average on a range of 2 to 4 g, the three remaining subjects showed consumption below the general intake average on a range of -2 and -3 g. In the subjects from Group 2 we can see that four subjects showed consumption between 0.5 and 3 g, while the two remaining subjects showed consumption on a range between -2 and 3 g.

## Discussion

The obtained results showed that: 1) In all the subjects from Group 2 the experimental context had an inhibitory effect over the intake of food during the post-deprivation period. 2) All the subjects in the Control Group engaged in binge eating episodes

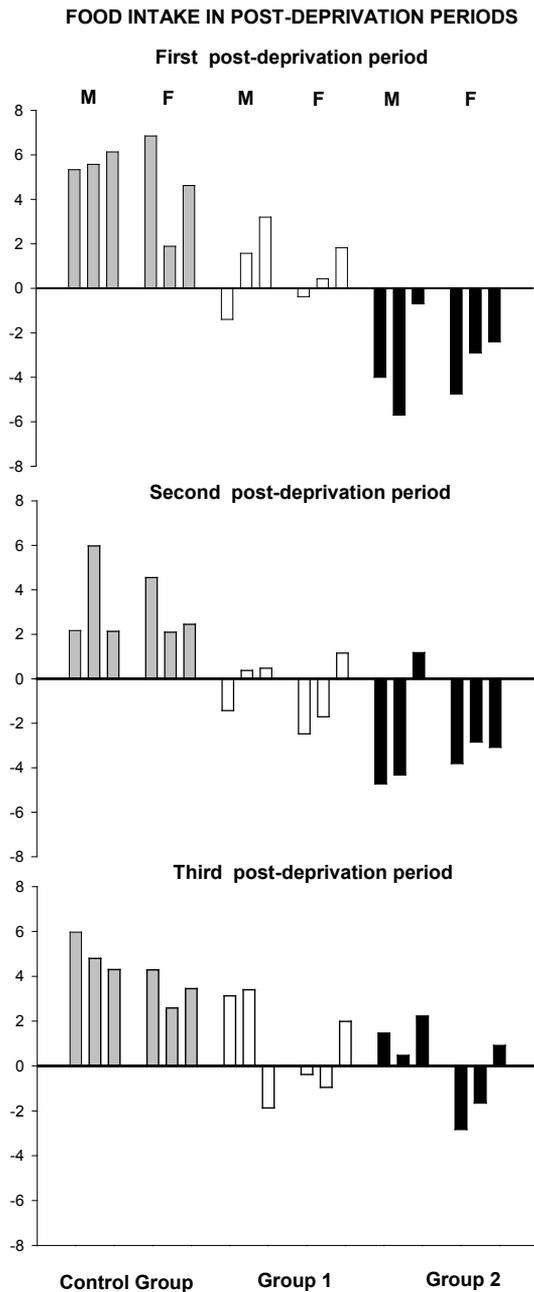


Figure 2. Individual food consumption average during the first three days of the post-privation period. The grey bars show the consumption of the Control Group, the white ones for Group 1, and the black bars of Group 2. Lines represent the general intake average. The letter M indicates the males of each group and the F the females.

in all of the post-deprivation periods. 3) The association between deprivation and context B which Group 1 was exposed to modified their food intake in context A. 4) The procedure of depriving in the habitual context (context A) and returning to free access conditions to a new context (context B) in Group 2 was inhibited occurrence of binge eating. 5) The effect of change the context had an equal effect over food intake on both males and females in groups 1 and 2. 6) The effect of change the context over on food intake seems to be temporary and linked with the necessary time to adapt to the experimental situation. These results are in line with the experimental evidence that shows the effect of context over food ingestion (Hirsch & Kramer, 1993; King, Meiselman, Hottenstein, Work & Cronk, 2007; Meiselman, 1996).

The data obtained from this experiment showed that the change in context, as well as having an effect on: the intake of new foods (Fragaszy, Visalberghi & Galloway, 1997); food intake and volume (Wansink, 2004); the decrease of intake associating the context to an aversive conditioning procedure (Mitchell & Heyes, 1996); the modification in behavior for searching food and surveillance (Arlettaz, 1996; Tchabovsky, Krasnov, Khokhlova & Shenbrot, 2001), also has an inhibitory effect on the incidence of binge eating. While the change in context has showed to be an important variable to modifying behaviors related with food consumption, the findings of this experiment showed that the manipulation of feeding context could be an important element in the treatment of Binge Eating Disorders. Franco, López, and Bautista (2009) stated that binge eating constitutes a problem of interests, in both areas, eating psychopathologies called BED and public health field. Furthermore, they pointed out that identifying periods of binge behavior is used as one of the criterion for the diagnosis of Bulimia Nervosa and for Binge Eating Disorder. Another factor is the clinical and epidemiological relevance that binge eating has on people who suffer from obesity.

However, the change in context has also shown another two characteristics: a) not having any type of effect; or b) that the effect is momentary. An example of the first is the null effect that the change of context has on the development of activity anorexia. Gutiérrez and Pellón (2008) carried out an experiment in which they manipulated the access, or non, to an activity wheel when exposed to, or not, to a change in context between the activity period and the food access. The results showed that the exposure to different contexts for the food and the activity wheel did not modify weight loss, food ingestion levels, nor the activity level. An example of the second characteristic, are the results obtained in this experiment since both procedures used (depriving in a new context and returning to the conditions of a habitual environment of free access applied to Group 1, and depriving in the habitual environment and returning to conditions of free access to a new context applied to Group 2) modified food intake in the post-deprivation periods. It is true that the applied procedure to Group 2 achieved the highest stability in binge eating inhibition, while registering in all subjects consumptions below the general intake average at least in one of the three occasions that the procedure was applied. Compared to

Group 1 in which at least 50% of the subjects showed binge eating inhibition in at least one occasion (Figure 2), we can state that both procedures achieved to inhibit binge eating in a temporary manner. In relation to this, it is necessary to point out that this inhibitory effect was clearly transitory, in Figure 2 it is possible to observe that the number of subjects that displayed binge eating inhibition decreased as the post-deprivation periods.

A possible explanation to this temporality in the effect of change the context on binge eating would be found in the habituation phenomenon. The behaviors related to eating are easily affected by habituation. The experimental evidence has shown that by keeping the properties of food (smell, taste, texture, temperature, appearance) during the feeding period and the subsequent periods, results in a decrease of the quantity of food and the feeding interval due to the habituation which develops on these properties (Swithers-Mulvey & Hall, 1994; Swithers-Mulvey & Hall, 1992; Swithers-Mulvey, Miller & Hall, 1991). However, even though we kept the properties of the food constant in our experiment, the habituation to the properties of the food could not be a plausible explanation. Since the experimental evidence has shown that the incidence of binge eating does not inhibit itself by maintain the same type of food, on the contrary, modifying the type of food causes a higher incidence (Martínez & López-Espinoza, 2007).

The best explanation possible to the transitory inhibitor effect for the change of context on the incidence of binge eating is the context habituation. McSweeney, Hinson, and Cannon (1996) on an extensive revision of their work, pointed out that the increase followed by a decrease in the rate of observed responses in the experimental sessions in operant conditioning procedures, known as the sensibilization and habituation phenomenon are found to be directly related to the discrimination of stimulus of the experimental context. They proposed as an explanation to the sensibilization – habituation phenomenon, that the conditioning is established within an experimental context which in itself is a discriminatory stimulus for the instrumental response. The decrease in the response is registered because the habituation occurs in the experimental context, however the response rate may increase yet again because the habituated response is recovered. With this they showed that maintaining the characteristics of the context produce a decrease in the instrumental response.

In our particular case, maintaining the change in context enabled to originate habituation to the particular characteristics of context B, this would explain why in the third post-deprivation period the number of subjects that exhibited binge eating inhibition decreased to 2 of 6 that presented the inhibition during the first post-deprivation period in Group 2. This could be interpreted in two possible ways: a) the change of context results in binge eating inhibition, when repeating the procedure a habituation to the context is produced which results in a recovery from binge eating; b) If binge eating is taken as a response, this is inhibited by the change of context, method that at the same time produces habituation causing sensibilization to depri-

vation and consequently the recovery from binge eating. When considering the two explanations appear a phenomenon in which sensibilization and habituation are overlapped and thanks to their combination binge eating inhibition disappears. At best, these affirmations are only possible work hypothesis to be reproduced in future experiments with greater detail on the effect that the context has on binge eating.

On the other hand, it is necessary to emphasize two aspects. First it was that the effect of the change of context on the incidence of binge eating was independent of the sex of subjects, since it presented itself both in males and in females. This is conscious as pointed out by López-Espinoza and Martínez (2005) whom indicated that the incidence of binge eating is irrespective to the sex of the subjects. The second aspect is the importance of these findings on basic research to demonstrate that an experimental procedure as simple as a change in the context can inhibit binge eating. This is a precedent to search for nonpharmacological alternatives for the control and treatment of binge eating and its relation to the development of some Eating Disorders.

To conclude, it is necessary to resume what Bolles (1973) points out on the theoretical difficulties to determine which elements from the context act as stimulus and which as reinforcers. It is undeniable to think that despite the advance in experimental context research on feeding behavior, the contributions that have been achieved are still incipient, an example of this is that only recently it has been shown that it is impossible to understand the consumption and acceptance of food without taking into account the context (Rozin & Tuorila, 1993). With this, it becomes necessary to go in depth into the theoretical work to establish that the context is what influences the behavior and in the future, avoid considering the context as the sole stimulus. It is also necessary to restore Anderson's (1941 a, b, c) work which although was severely criticized his contributions gave way in the study of experimental context.

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