

Restraint eating and sensitivity to stress: preliminary experimental evidence

Restrizione alimentare e sensibilità allo stress: evidenza sperimentale preliminare

JAIME R. SILVA

Departamento de Salud Mental y Psiquiatría, Facultad de Medicina, Universidad de La Frontera, Temuco, Región de la Araucanía, Chile

SUMMARY. Background. Restrained eaters (RE) typically display a recurrent pattern of restraint/overeating. This fluctuating behavior has recently been connected to mood and the affective style in general. In this context, it is argued that RE may be sensitive to stress. Nevertheless, there is no substantial evidence demonstrating that RE present behavioral or psychophysiological patterns that indicate this sensitivity. **Aim.** To test whether there is a differential modulation of punishment in RE behavior within an experimental paradigm that manipulates the reward/punishment contingency. **Method.** 104 female university students (31 RE and 73 controls) carried out an experimental task in which, under different reward/punishment contingencies, they had to choose an advantageous option. **Results.** A significant interaction was observed between the Choice and the Group, revealing that the frequency of punishment inhibits the choice response in RE, independent of its advantage/disadvantage. Although complementary studies are required, the data represent preliminary evidence that RE are sensitive to stress. The clinical implications of these findings are discussed.

KEY WORDS: restrained eaters, affective style, stress sensitivity, Iowa gambling task, motivational system.

RIASSUNTO. Introduzione. Coloro che praticano la restrizione alimentare (RE) mostrano un'alternanza ricorrente di restrizione/eccesso nei confronti del cibo. Questo comportamento altalenante è stato recentemente messo in relazione con l'umore e il modello affettivo in generale. In questo contesto, si sostiene che la RE possa essere sensibile allo stress. Tuttavia, non ci sono prove sostanziali che dimostrino che la RE presenti modelli comportamentali o psicofisiologici che rivelano questa percezione. **Scopo.** Verificare se esiste una relazione nel comportamento da RE con all'interno di un paradigma empirico che influenzi l'alternanza premio/punizione. **Metodo.** 104 studentesse universitarie (31 RE e 73 di controllo) hanno costituito un gruppo sperimentale in cui, a seguito di alternanze premio/punizione, hanno scelto una opzione vantaggiosa. **Risultati.** È stata osservata un'interazione significativa tra la Scelta e il Gruppo A, rivelando che la frequenza di punizione inibisce l'opzione di risposta nella RE, indipendentemente dal vantaggio/svantaggio. Sebbene siano necessari ulteriori studi, i risultati rappresentano una prova preliminare che gli RE sono sensibili allo stress. Sono state discusse le implicazioni cliniche di questa scoperta.

PAROLE CHIAVE: restrizione alimentare, modello affettivo, stress, sistema motivazionale.

INTRODUCTION

Chronic restraint eating has paradoxically been linked to overeating and weight gain (1). Indeed, several experimental paradigms and field studies have shown that restrained eaters (RE) overeat under varied conditions (2). In the long term, this fluctuating pattern of restraint/overeating is an important predictor in the development of eating disorders (3) and obesity (4).

In this broader context, a model derived from affective neuroscience has been proposed that includes restraint eating as a mechanism of emotional regulation that emerges in a particular affective style (5). According to this model, the variations in the sensitivity of the motivational systems would give rise to heightened levels of emotional reactivity which, modulated by familial and sociocultural factors, would be regulated by the continuous alternation of restraint and overeating.

E-mail: jaimesilva@ufro.cl

Restraint eating and sensitivity to stress: preliminary experimental evidence

From both the psychophysiological (5) and behavioral (6) points of view, it has been observed that the sensitivity of the motivational systems is related to chronic restraint eating. In addition, a field study showed that the variations in the affective style and motivational systems can also be expressed in different clinical syndromes (7).

A complementary hypothesis of this model is the argument that RE are people with greater emotional sensitivity, and are particularly more sensitive to stress (8,9). The RE would present a more active motivational system of avoidance that favors the emotional experience of anxiety and the development of mood disorders (10). Furthermore, individuals with this hyperactive system display a low activation threshold of the physiological systems responsible for the stress response (11,12). Although the loss of restraint in RE is observed particularly in response to stressful situations, there is no systematic experimental evidence to indicate that (a) the emotional responses of RE in any one parameter (behavioral, self-reporting, psychophysiological) are more intense, or that (b) their physiological system presents responses exacerbated by contexts of induced anxiety (9).

Mixed punishment and reward contingencies: the present study

A partial and preliminary way to examine the previously proposed hypothesis is to investigate experimentally whether differences exist between RE and unrestrained eaters (UR) when they respond to differential contingencies of reward and punishment. If the RE have a stress-sensitive affective style, a significant modulation in their behavior is to be expected when facing punishment, independent of the reward contingencies.

In behavioral sciences, the Iowa Gambling Task is a frequently used method to ascertain decision-making in the context of systematic variations of reward/punishment (13). Basically, in this task the subjects must choose one of four cards, with the aim of obtaining a sum of money. A probability of reward (earn money) and a probability of punishment (lose money) are associated with each card. Overall, two cards are “advantageous” (produce a total gain) and two “disadvantageous” (they produce a loss). It has been seen that subjects with various pathologies, especially those that affect the executive function of the prefrontal cortex, have difficulty in modulating their behavior on the basis of a long-term strategy that favors gain (14-17).

This test has been used in experiments on subjects with eating disorders (18-20) and RE (21). These studies have generally focused on the effectiveness of par-

ticipants’ decision-making ability. Recently, however, it has been questioned experimentally whether people with eating disorders exhibit patterns of altered decision-making (20).

In the present study, we will use a modified version of the Iowa Gambling Task, evaluating the effect of the punishment/reward in motivated choice behavior. The fundamental hypothesis is that, unlike the UR, the frequency of punishment will exert an inhibiting effect on the choice behavior of the RE, independent of whether this choice is advantageous in the long term.

METHOD

Participants

104 female university students participated in the study after signing an informed consent form. The average age was 20.69 years (SD=2.1), and the self-reported body mass index (BMI) was 22.11 kg/m² (SD=2.79). Each participant received a cash bonus for performing the experimental task (US\$ 10). This study received ethical approval from the Universidad de La Frontera Ethics Committee.

Instruments

Revised Restraint Scale (RRS) (1). To measure the Restrictive Eating variable, the Spanish-language version of the RRS was used, which evaluates attitudes towards eating, dieting frequency and weight fluctuation. It must be noted that high RRS scores are fundamentally associated with restraint/overeating patterns and not with pure restraint (22). In addition, this instrument allows the sample to be classified into chronic dieters and non-dieters based on a cut-off point. In international studies, this scale has shown acceptable levels of test-retest reliability and concurrent criterion and construct validity (23-25).

Eating Disorder Diagnostic Scale (EDDS) (26). The EDDS is a brief evaluation containing 22 items that investigates the symptoms of the three most important eating disorders: anorexia nervosa, bulimia nervosa and binge-eating disorder. In this study, the factor “concern for diet” from this instrument will be used (27).

Positive and Negative Affect Schedules (PANAS) (28). This questionnaire yields one score for positive affect (PA subscale) and another for negative affect (NA subscale). The “most of the time” version of the scale was used, which consists of 20 items describing different sentiments and emotions presented with a five-point Likert-type scoring scale indicating the respondent’s degree of acceptance.

Experimental Task

Iowa Gambling Task (IGT)(13). The experimental task consisted of selecting one of four card decks labeled with symbols (diamonds, clubs, hearts, and spades). The aim was to accumulate the maximum amount of money possible in 300

tries. Each card had a frequency and differential magnitude of reward/punishment, with two advantageous and two disadvantageous (**Figure 1**). Traditionally, to ascertain the subjects' performance, the IGT net score is obtained, which is derived by subtracting the number of disadvantageous choices from the advantageous ones. This way, higher scores indicate better performance. The experimental task was implemented using E-Prime 1.2 (Psychology Software Tools, Inc.), and the responses were recorded using a Serial Response Box (Psychology Software Tools Inc).

Procedure

The participants went to the laboratory individually, signed the informed consent form and received general instructions. Then they carried out the IGT on a computer where the cards appeared, and responded on a response pad in front of them. Once the task had concluded, they completed a set of self-reports in another room.

Analysis strategy

As a general strategy, the IGT net score (NS) was calculated, which shows the subject's overall performance and the quality of their decision-making. Second, to prove the hypothesis of the study, the cards were grouped based on the frequency of the punishment; infrequent (B and D) versus frequent (cards A and C) (**Figure 1**). Using these frequencies, a punishment aversion score (PAS) was calculated for each subject using the following function: $PAS = S(A+C) - S(B+D)$.

Higher PAS scores indicate an "aversion to punishment" associated with an inhibition of the behavior of choice based on the punishment frequency, independent of card desks' advantage/disadvantage. Through this strategy, it is expected that the differential effect of the advantage of the choice (NS) versus the frequency of the punishment (PAS) on the modulation of motivated choice in RE and UR will be evaluated.

RESULTS

Based on the traditional cut-off point applied to the RRS scores (12 points) (23,24), 31 subjects were classified RE and 74 UR. The groups differed in several parameters (**Table 1**).

Correlation of the variables of interest

In a primary analysis, partial correlations between restraint eating, concern for diet, BMI, the NS and the PAS were performed, controlling for negative affect (due to its effect on NS). As in previous studies, restrictive eating ($r_{YX,W}=0.55; p<0.001$) and concern for diet ($r_{YX,W}=0.52; p<0.001$) correlate significantly with BMI. Moreover, according to the study hypothesis, on-

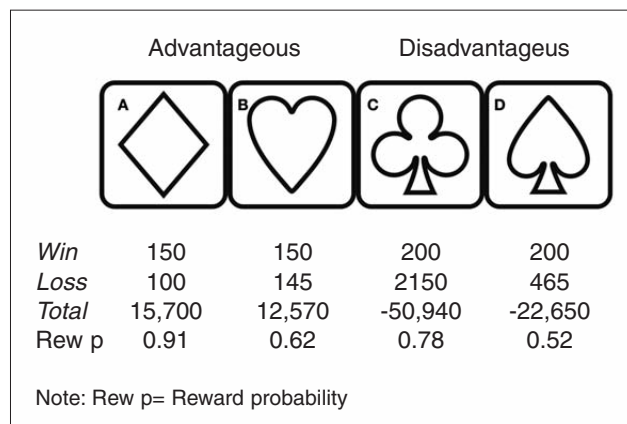


Figure 1. Magnitude of reward/punishment, probability of reward and total gain, associated with cards in the experimental task.

Table 1. Descriptive statistics. Differences in parameters of interest between restrained eaters (RE) and unrestrained eaters (UR)

	UR (n=73)	RE (n=31)	Total (n=104)	RE/UR <i>t</i> test	<i>p</i>
Age (years)	20.55 (1.99)	21.03 (2.53)	20.69 (2.17)	-1.042	>0.30
BMI (kg/m ²)	21.28 (1.98)	24.04 (3.45)	22.11 (2.79)	-5.130	<0.001
RRS	8.18 (3.65)	19.13 (3.57)	11.44 (6.19)	-14.082	<0.001
DC	8.29 (5.40)	17.90 (4.41)	11.15 (6.75)	-8.748	<0.001
PA	35.32 (4.97)	35.67 (5.62)	35.43 (5.15)	-0.322	>0.75
NA	20.79 (6.10)	22.32 (6.79)	21.25 (6.32)	-1.119	>0.26

Note: BMI=Body mass index; RRS=Revised restraint scale score; DC=Diet concern; PA=Positive Affect; NA=Negative affect. The standard deviation in parenthesis.

ly the PAS obtained a marginally significant correlation with restrictive eating ($r_{YX,W}=0.18; p<0.071$). There was no association between the NS and the variables of interest (all $ps>0.70$).

Effect of the reward/punishment contingencies on choice behavior

In order to test the effect of reward/punishment contingencies on the choice behavior according to the eating categories, a mixed ANOVA with a within-subject factor of Choice (NS versus PAS) and a between-subject factor of Group (RE versus UR), was performed on the response frequencies. In this context, there was no violation of the supposition of variance

Restraint eating and sensitivity to stress: preliminary experimental evidence

homogeneity (Box's M Test=31.64; $p=0.38$), at the same time that Levene's test was not significant for the dependent variables (all $ps>0.56$). The test of within-subject effects revealed effect of Choice ($F_{(1,104)}=88.53$; $p<0.001$), qualified by a significant Choice X Group interaction ($F_{(1,104)}=6.509$; $p<0.01$). As illustrated in **Figure 2**, *post-hoc t* tests reveal that RE have a greater PAS ($p<0.05$), reflecting an inhibition to choose when the punishment is frequent, independent of the advantage/disadvantage of the choice. With respect to the NS, the response frequency between RE and UR did not show any significant differences ($p>0.50$).

The effect of each card on the frequency of choice was also analyzed according to eating categories. This was done by performing a mixed ANOVA with a within-subject factor of Card (A, B, C and D) and a between-subject factor of Group (RE versus UR), on the response frequencies. Levene's test was not significant for the dependent variables (all $ps>0.29$). The test of within-subject effects revealed a significant Card X Group interaction ($F_{(1,104)}=26.88$; $p<0.05$), showing a lower choice frequency of card B in the RE versus UR (*post-hoc t* test: $p<0.001$). There were no differences in the response frequency between RE and UR for the other cards (all $p>0.18$).

DISCUSSION

The results confirmed the hypothesis of the study. In an experimental task that varies the reward/punishment contingencies, the frequency of the punishment

inhibits the choice response in RE, independent of its advantage/disadvantage. This observation can be interpreted as a reflex of RE hypothetical sensitivity to stress. As was argued previously, RE may be subjects whose system of behavioral avoidance is predominant in the organization of their behavior. This predominance would generate a condition of sensitivity (and of diathesis in the long term) that would be expressed in a heightened emotional reactivity against aversive and/or novel stimuli. In that context, and as is partially observed in the data of this research, it is expected that RE significantly modulate their behavior and physiology when the avoidance system is recruited (for example, through reward/punishment contingencies). It is important to note that, as demonstrated recently in the area of eating disorders (20), no group differences were found in decision-making (NS) between RE and UR. This means that although the strategy of choice in the RE favored avoidance of punishment, overall it was not detrimental to their performance in the IGT.

There may be several clinical implications. On the one hand, consolidating an explanatory model that emphasizes differences in the activation of the motivational systems would orient the psychiatric diagnosis towards the definition of specific development paths for certain eating disorders and certain cases of overweight/obesity. For example, stages of obesity development could be established, which, starting with stress sensitivity, would be followed by overeating (in the context of chronic stress) and then by endocrinal-metabolic changes that lead to weight gain (i.e dyslipidemia, insulin resistance, hypertension) (2). On the other hand, psychotherapeutic and psychopharmacological intervention could center on the development of mechanisms for handling stress sensitivity as the focal point for treatment, rather than on the eating behavior itself (8). Thus, the differentiation between sensitivity to stress and sensitivity to reward, which is gaining ground in the field of psychopathology (29) and psychopharmacology (30), would have eating disorders (as well as certain cases of overweight/obesity) as one of its scopes of application.

This study must be considered preliminary evidence that needs to be replicated and complemented with data that includes not only behavioral, but also psychophysiological parameters. It is also necessary to conduct more ecological experimental tasks that include various situations capable of recruit the system of behavioral avoidance. In that context, future studies will be able to resolve whether the pattern of sensitivity to stress indeed underlies certain eating disorders.

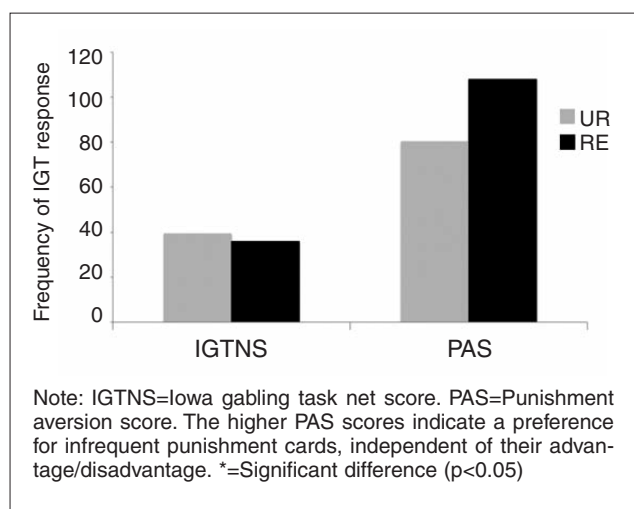


Figure 2. Frequency of choice of advantageous/disadvantageous cards versus choice of cards of infrequent/frequent punishment.

Acknowledgements

This research was financed by Dirección de Investigación de la Universidad de La Frontera (DIUFRO), la Dirección de Cooperación Internacional de la Universidad de La Frontera and FONDECYT 11090162.

REFERENCES

1. Herman CP, Polivy J. Restrained eating. In: Stunkard A (ed). Obesity. Philadelphia: Saunders, 1980.
2. Silva JR. Sobrealimentación inducida por la ansiedad, Parte I: Evidencia conductual, afectiva, metabólica y endocrina. *Ter Psicol* 2007; 25: 112-34.
3. Keel PK, Baxter MG, Heatherton TF, Joiner TE Jr. A 20-year longitudinal study of body weight, dieting, and eating disorder symptoms. *J Abnorm Psychol* 2007; 116: 422-32.
4. Rennie KL, Johnson L, Jebb SA. Behavioural determinants of obesity. *Best Pract Res Clin Endocrinol Metab* 2005; 19: 343-58.
5. Silva JR, Pizzagalli DA, Larson CL, Jackson DC, Davidson RJ. Frontal brain asymmetry in restrained eaters. *J Abnorm Psychol* 2002; 111: 676-81.
6. Silva JR, Livacic-Rojas P, Slachevsky A. [Differences among chronic restrained eaters: the influence of motivational systems]. *Rev Med Chil* 2006; 134: 735-42.
7. Silva JR, Ortiz M, Quiñones A, Vera-Villaruel P, Slachevsky A. Affective style and eating disorders: a field study. *Eat Weight Disord* 2010 Oct 21 [Epub ahead of print].
8. Silva JR. Sobrealimentación inducida por la ansiedad, Parte II: Un marco de referencia neurocientífico para el desarrollo de técnicas psicoterapéuticas. *Ter Psicol* 2008; 3: 99-115.
9. Silva JR. Un modelo psicobiológico de la sobrealimentación inducida por estrés. *Revista de Psicología* 2009; 18: 43-63.
10. Davidson RJ, Lewis DA, Alloy LB, et al. Neural and behavioral substrates of mood and mood regulation. *Biol Psychiatry* 2002; 52: 478-502.
11. Amodio DM, Master SL, Yee CM, Taylor SE. Neurocognitive components of the behavioral inhibition and activation systems: implications for theories of self-regulation. *Psychophysiology* 2008; 45: 11-9.
12. Davidson RJ. What does the prefrontal cortex "do" in affect: perspectives on frontal EEG asymmetry research. *Biol Psychol* 2004; 67: 219-33.
13. Bechara A, Tranel D, Damasio H. Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. *Brain* 2000; 123: 2189-202.
14. van der Plas EA, Crone EA, van den Wildenberg WP, Tranel D, Bechara A. Executive control deficits in substance-dependent individuals: a comparison of alcohol, cocaine, and methamphetamine and of men and women. *J Clin Exp Neuropsychol* 2009; 31: 706-19.
15. Malloy-Diniz L, Fuentes D, Leite WB, Correa H, Bechara A. Impulsive behavior in adults with attention deficit/hyperactivity disorder: characterization of attentional, motor and cognitive impulsiveness. *J Int Neuropsychol Soc* 2007; 13: 693-8.
16. Sevy S, Burdick KE, Visweswarajah H, et al. Iowa gambling task in schizophrenia: a review and new data in patients with schizophrenia and co-occurring cannabis use disorders. *Schizophr Res* 2007; 92: 74-84.
17. Clark L, Bechara A, Damasio H, Aitken MR, Sahakian BJ, Robbins TW. Differential effects of insular and ventromedial prefrontal cortex lesions on risky decision-making. *Brain* 2008; 131: 1311-22.
18. Davis C, Patte K, Curtis C, Reid C. Immediate pleasures and future consequences. A neuropsychological study of binge eating and obesity. *Appetite* 2010; 54: 208-13.
19. Liao PC, Uher R, Lawrence N, et al. An examination of decision making in bulimia nervosa. *J Clin Exp Neuropsychol* 2009; 31: 455-61.
20. Guillaume S, Sang CN, Jaussent I, et al. Is decision making really impaired in eating disorders? *Neuropsychology* 2010; 24: 808-12.
21. Kuijter R, de Ridder D, Ouweland C, Houx B, van den Bos R. Dieting as a case of behavioural decision making. Does self-control matter? *Appetite* 2008; 51: 506-11.
22. van Strien T. The concurrent validity of a classification of dieters with low versus high susceptibility toward failure of restraint. *Addict Behav* 1997; 22: 587-97.
23. Silva JR, Urzúa A. Propiedades psicométricas de la versión en español de la escala revisada de restricción alimentaria en una muestra de adolescentes. *Univ Psychol* 2010; 9: 535-44.
24. Silva JR. Consistencia interna y validez factorial de la versión en español de la escala revisada de restricción alimentaria. *Rev Chil Nutr* 2010; 37: 41-9.
25. Heatherton TF, Herman CP, Polivy J, King GA, McGree ST. The (mis)measurement of restraint: an analysis of conceptual and psychometric issues. *J Abnorm Psychol* 1988; 97: 19-28.
26. Stice E, Telch CF, Rizvi SL. Development and validation of the Eating Disorder Diagnostic Scale: a brief self-report measure of anorexia, bulimia, and binge-eating disorder. *Psychol Assess* 2000; 12: 123-31.
27. Lee SW, Stewart SM, Striegel-Moore RH, et al. Validation of the eating disorder diagnostic scale for use with Hong Kong adolescents. *Int J Eat Disord* 2007; 40: 569-74.
28. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol* 1988; 54: 1063-70.
29. Bale TL. Stress sensitivity and the development of affective disorders. *Horm Behav* 2006; 50: 529-33.
30. Wichers MC, Barge-Schaapveld DQ, Nicolson NA, et al. Reduced stress-sensitivity or increased reward experience: the psychological mechanism of response to antidepressant medication. *Neuropsychopharmacol* 2009; 4: 923-31.