



## BRIEF REPORT

# The usefulness of an intervention with a serious video game as a complementary approach to cognitive behavioural therapy in eating disorders: A pilot randomized clinical trial for impulsivity management

Cristina Vintró-Alcaraz<sup>1,2,3</sup> | Núria Mallorquí-Bagué<sup>4,5</sup>  |  
 María Lozano-Madrid<sup>1,3</sup> | Giulia Testa<sup>6</sup> | Roser Granero<sup>2,3,7</sup> | Isabel Sánchez<sup>1,2,3</sup> |  
 Janet Treasure<sup>8</sup>  | Susana Jiménez-Murcia<sup>1,2,3,9</sup> | Fernando Fernández-Aranda<sup>1,2,3,9</sup>

<sup>1</sup>Clinical Psychology Unit, Bellvitge University Hospital, Hospitalet del Llobregat, Spain

<sup>2</sup>Psychoneurobiology of Eating and Addictive Behaviours Group, Bellvitge Biomedical Research Institute (IDIBELL), Hospitalet del Llobregat, Spain

<sup>3</sup>CIBER de Fisiopatología de la Obesidad y Nutrición (CIBERobn), Instituto de Salud Carlos III, Barcelona, Spain

<sup>4</sup>Department of Psychiatry, Hospital de Mataró, Consorci Sanitari del Maresme, Mataró, Spain

<sup>5</sup>Department of Psychology, University of Girona, Girona, Spain

<sup>6</sup>Universidad Internacional de la Rioja, La Rioja, Spain

<sup>7</sup>Departament de Psicobiologia i Metodologia, Universitat Autònoma de Barcelona, Barcelona, Spain

<sup>8</sup>Department of Psychological Medicine, King's College London, Institute of Psychiatry and Neuroscience, Section of Eating Disorders, London, UK

<sup>9</sup>Department of Clinical Sciences, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain

## Correspondence

Susana Jiménez-Murcia and Fernando Fernández-Aranda, Clinical Psychology

## Abstract

**Objective:** The aim of the present study was to test the usefulness of an add-on serious video game approach (i.e., Playmancer) to treatment as usual (TAU) on reducing impulsive behaviours and psychopathology in individuals diagnosed with an eating disorder (ED).

**Method:** Thirty-seven patients diagnosed with an ED according to the DSM-5 were included in the present randomized clinical trial (RCT; study record 35,405 in [ClinicalTrials.gov](https://clinicaltrials.gov)) and were randomly assigned to either the TAU or TAU + Playmancer group. All participants completed a clinical interview. Impulsivity (UPPS-P self reported questionnaire and Stroop task) and general psychopathology (SCL-90-R) measures were assessed at: baseline, 4 weeks into treatment, at the end of TAU (after 16 weeks), and follow-up (2 years). In addition, patients in the experimental group underwent a total of nine sessions with Playmancer over the span of 3 weeks.

**Results:** Patients in both treatment groups (TAU + Playmancer or TAU) improved on Stroop task performance and psychological distress. Additionally, patients in TAU-Playmancer improved on the impulsive trait domain of lack of perseverance. No statistical differences were found regarding treatment outcomes (i.e., treatment adherence and remission of eating symptomatology) when comparing the two treatment groups.

**Conclusion:** Our results suggest that the impulsivity associated with EDs should be addressed and could be modified, as some facets of trait impulsivity

Cristina Vintró-Alcaraz and Núria Mallorquí-Bag share first authorship.

[Corrections made on 8 July 2023, after first online publication: In this version, this statement has been added to clarify authorship.]

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial](https://creativecommons.org/licenses/by-nc/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2023 The Authors. European Eating Disorders Review published by Eating Disorders Association and John Wiley & Sons Ltd.

Unit, University Hospital Bellvitge-IDIBELL and CIBERobn, Feixa Llarga s/n 08907 L'Hospitalet del Llobregat, Barcelona, Spain.  
Email: [sjimenez@bellvitgehospital.cat](mailto:sjimenez@bellvitgehospital.cat) and [ffernandez@bellvitgehospital.cat](mailto:ffernandez@bellvitgehospital.cat)

**Handling editor:** Micali, Nadia

#### Funding information

Institució Catalana de Recerca i Estudis Avançats; Instituto de Salud Carlos III, Grant/Award Numbers: PI14/00290, PI17/01167; FEDER funds/European Regional Development Fund; Ministerio de Educación, Cultura y Deporte, Grant/Award Numbers: FPU16/01453, FPU15/0291

improved after Playmancer add-on treatment. Yet, there were no significant differences in treatment outcomes when comparing the two groups and further research needs to be conducted.

#### KEYWORDS

eating disorders, impulsivity, psychopathology, randomized clinical trial, serious videogame

#### Highlights

- Certain eating disorders (EDs) are characterised by high levels of impulsivity.
- Serious video games may enhance standard treatments (such as cognitive-behavioural therapy).
- Playmancer sessions, along with standard treatment, are useful in reducing certain impulsive traits in patients with EDs.

## 1 | INTRODUCTION

Impulsivity and emotional instability are broad transdiagnostic constructs that have been described in association with different mental disorders (Amlung et al., 2017; Griffin et al., 2018; Lee et al., 2019; Munguía, Jiménez-Murcia, et al., 2021) and physical conditions (Jorge et al., 2022; Testa et al., 2021). Impulsivity includes behavioural and cognitive facets characterised by the tendency to act quickly without prior reflection, possibly leading to undesirable consequences (Evenden, 1999) such as harmful or suicidal behaviours (Valenciano-Mendoza et al., 2021), adverse emotional consequences (e.g., more depression, anxiety; Aldao et al., 2016), as well as poorer treatment adherence (Mallorquí-Bagué et al., 2021; Mena-Moreno et al., 2022) and outcomes (Vintró-Alcaraz et al., 2022).

In eating disorders (EDs), particularly those on the bulimic spectrum, impulsive personality traits are present. They include negative urgency (i.e., the propensity to act impulsively when experiencing negative affect), sensation seeking (i.e., the disposition to seek exciting experiences), low premeditation (i.e., the tendency to act without considering the consequences of an action) and poor perseverance (i.e., the tendency to not persist in an activity that can be arduous or boring; Carr et al., 2021; Claes et al., 2005, 2015; Mallorquí-Bagué et al., 2020; Steward et al., 2017). Higher negative urgency has been reported in the binge/purging subtype of anorexia nervosa (AN; Claes et al., 2005) and has been related to the frequency of binge eating and/or purging episodes (Culbert et al., 2016). Higher scores on impulsivity in EDs have been associated with both higher eating symptomatology (Racine et al., 2015) and general psychopathology (Boswell & Grilo, 2021), in addition to increased comorbidity with

impulse related disorders (Fernández-Aranda et al., 2006, 2008; Lucas et al., 2021), namely compulsive buying (Munguía, Lucas, et al., 2021) and dysfunctional personality traits (Atiye et al., 2015) along with a poorer treatment outcome (Bardone-Cone et al., 2016).

The lack of inhibitory control (i.e., inability to suppress or interrupt behavioural or cognitive responses; Bari & Robbins, 2013), has been described regarding the bulimic spectrum of EDs (Wu et al., 2013). The Color-Word Stroop task has been widely adopted to assess the cognitive component of inhibition, namely interference control (i.e., the ability to maintain response performance despite the presence of distracting or competing stimuli; Nigg, 2000). People with binge/purging EDs and obesity (OB) show evidence for poor interference control (Claes et al., 2012).

Impulsivity has been implicated in the development and maintenance of EDs (Lavender & Mitchell, 2015; Wonderlich et al., 2004), with an impact on treatment outcome (Manasse et al., 2016; Sohlberg et al., 1989). For instance, high scores on negative urgency have been associated with a worse response to treatment in patients with binge eating disorder (BED; Manasse et al., 2016). Although cognitive-behavioral therapy (CBT) is recommended as the first line of treatment for EDs (Fairburn et al., 2003; Galsworthy-Francis & Allan, 2014; Hay, 2013; National Institute for Clinical Excellence, 2017; Wilson et al., 2007), it has shown limited impact on reducing impulsivity. The few attempts known to manage impulsivity in EDs, by using enhanced CBT (including specific modules; Schag et al., 2019), dialectical-behavioural therapy (Bankoff et al., 2012), pharmacotherapy, or non-invasive brain stimulation (Nourredine et al., 2021; Yang et al., 2020), have shown limited or inconclusive results.

Serious video games, which are games designed with a primary purpose (e.g., education, health care, etc.),

other than just entertainment, have been introduced as an additional therapeutic strategy to manage impulsivity, and have shown promise in several disorders (Charlier et al., 2016; Fernández-Aranda et al., 2012, 2015; Tárrega et al., 2015). Uncontrolled studies have shown symptom reduction and improved therapy adherence when augmented with an element targeting impulsivity (Fagundo et al., 2013; Fernández-Aranda et al., 2015; Mena-Moreno et al., 2021). As yet, there are few controlled studies.

The goal of the present study was to assess the usefulness of augmenting treatment as usual (TAU) with a serious video game, Playmancer, which has a reported usability of over 85% (Fernández-Aranda et al., 2012), to target impulsive behaviours, as well as general psychopathology, in patients with EDs. With this aim, we analysed the levels of impulsivity and general psychopathology before and after TAU compared to TAU combined with the therapeutic video game. Our hypothesis was that patients receiving TAU + serious videogame sessions would show improvements in impulsivity-related and other clinical variables. A secondary aim was to examine the effect of adding Playmancer to TAU on treatment outcome (i.e., treatment adherence and remission from EDs symptomatology). Our hypothesis was that patients would benefit from this combined treatment showing lower dropout rates and a better remission from ED symptomatology. To our knowledge, this is the first controlled study using a serious videogame to manage impulsivity in EDs.

## 2 | METHODS

### 2.1 | Participants and procedure

A sample of 37 patients diagnosed with an ED (20 AN [14 AN-R; 6 AN-BP]; 12 BED and 5 BN) were recruited. The inclusion criteria were the following: female, meeting DSM-5 criteria for a specific ED (i.e., AN, BN, and BED), and engaging in either day or outpatient treatment for EDs. The exclusion criteria were: patients less than 18 years of age, and having an additional lifetime diagnosis of a severe mental condition (e.g., psychosis and borderline personality disorder) or current substance dependence. Both EDs and psychiatric comorbidity were assessed by means of a semi-structured clinical interview (First et al., 2002) conducted by psychologists and psychiatrists with wide experience in the field. They all gave written informed consent for being part of the study and the study protocol and procedures were approved by the Ethics Committee of the XXX (institution name) (CEIC-Ref: PR146/14) in accordance with the Helsinki

Declaration of 1975 as revised in 1983. Participants received no compensation for taking part in the study.

#### 2.1.1 | Randomized control trial

Experienced psychologists and psychiatrists conducted two face-to-face clinical interviews and patients were diagnosed according to DSM-5 criteria (American Psychiatric Association, 2013). Additional sociodemographic and clinical information was taken before initiating treatment. All patients received outpatient treatment at the EDs Unit within the Department of Psychiatry at XXX Hospital.

Patients were randomly assigned to TAU alone (21 patients) or TAU supplemented with the therapeutic video game Playmancer (16 patients). TAU consisted of a day-hospital treatment programme that included daily group CBT sessions for an average of 3 months for AN patients; and 16 weekly outpatient group sessions lasting 90 min each for BN and BED patients. The key topics addressed during the intervention were the following: psychoeducation (ED definition, triggering and maintaining factors, and course of the ED), problem-solving and emotion regulation strategies (including cognitive restructuring), improving self-esteem, body image and social skills, and relapse prevention. Follow-up sessions were continued for 2 years or more, as needed. More detailed information about the treatments conducted in this Eating Disorders Unit can be found in Agüera et al. (2017).

Patients were reassessed at week 4 and week 16 (end of the TAU). A total of 19 patients (51.3%) dropped out of treatment or dropped out of the randomized clinical trial (RCT) so the final sample was composed of 13 patients receiving TAU and six patients with the TAU + Playmancer (see Figure 1).

The study protocol was registered in June 2018 at ISRCTN registry with the reference number ISRCTN30788922 (<https://www.isrctn.com/ISRCTN30788922>).

### 2.2 | Measures

**UPPS-P Impulsive Behavior Scale** (Whiteside et al., 2005) is a 59-item self-report questionnaire developed to assess different features of impulsive traits: lack of perseverance, lack of premeditation, sensation seeking, negative urgency, and positive urgency. This instrument has satisfactory psychometric properties in the original version and in the Spanish adaptation (Verdejo-García

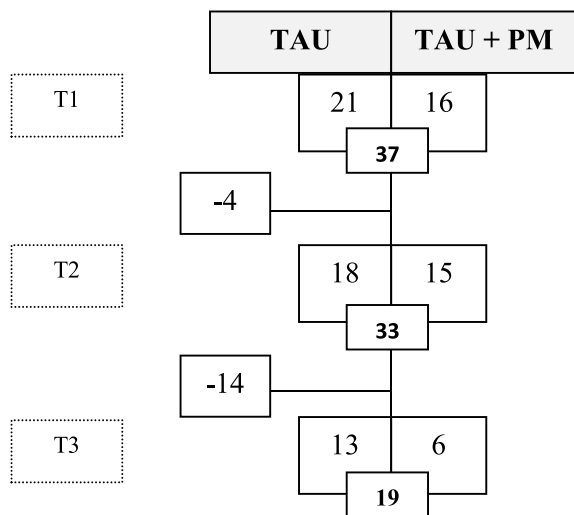


FIGURE 1 Flowchart. PM, Playmancer; T1, time 1; T2, time 2; T3, time 3; TAU, treatment as usual.

et al., 2010). The  $\alpha$  values for the different UPPS-P scales in our sample ranged from 0.827 to 0.911.

**The Stroop Color and Word Test (SCWT;** Golden, 1978) is a paper and pencil neuropsychological test that assesses inhibitory control, specifically interference control, flexibility, and attention. This task includes three lists: (1) a word list of names of colours printed in black ink, (2) a list with 'Xs' printed in colour (the same colours written in the first list), and (3) a list with names of colours printed in an incongruent colour (i.e., word 'red' printed in blue ink). A score is obtained from each of these lists and also a fourth score, the interference score, is computed based on the above ones. Higher scores in this last variable indicate a better capacity for inhibition response.

**Symptom Checklist-Revised (SCL-90-R;** Derogatis, 1990) is a self-report questionnaire consisting of 90 items that evaluates psychological problems and symptoms of psychopathology subdivided into nine primary symptom dimensions: somatisation, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. It also yields three global indices: the global severity index (GSI), designed to measure overall psychological distress; the positive symptom distress index, designed to measure symptom intensity; and the positive symptom total, which reflects the number of self-reported symptoms. The SCL-90 has been validated in a Spanish population obtaining a mean internal consistency of  $\alpha = 0.75$  (Derogatis, 2002). Internal consistency for the global indices in this sample was 0.97 ( $\alpha$  value). For the present study, only the GSI global index was explored.

**Eating Disorder Inventory (EDI-2;** Garner, 1991; Spanish validation by Garner, 1998) is a self-report questionnaire looking at psychological characteristics and behavioural patterns associated with EDs. It consists of 91 items divided into 11 subscales: drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. The EDI-2 also provides a global measure of ED severity. Internal consistency for the global indices in this sample ranged from adequate ( $\alpha = 0.73$  for interoceptive awareness) to excellent ( $\alpha = 0.93$  for the total scale).

**Treatment outcome:** Treatment outcome is codified according to the following: bad outcome, when the patients dropout of treatment or end treatment with non-remission, and good outcome, when the patients present partial or full remission at the end of treatment. Dropout was considered as participants missing three consecutive CBT sessions. Following the DSM-5 (American Psychiatric Association, 2013) approach, full remission implied a total absence of ED symptoms for a sustained period of time, partial-remission was considered when patients presented a substantial symptomatic improvement but with residual symptoms, and non-remission meant still meeting full criteria for an ED.

### 2.3 | Serious videogame: Playmancer

As described elsewhere (Fernández-Aranda et al., 2012; Jiménez-Murcia et al., 2009), Playmancer is a therapeutic video game that uses biofeedback techniques to improve aspects such as self-control, impulsive behaviours, and emotional skills. A secondary aim of this game is to increase motivation and adherence to treatment. The Playmancer intervention consists of nine 20-min sessions implemented over 3 weeks (3 sessions per week). A multidisciplinary team of clinicians, engineers, and programmers have developed this video game, by considering user requirements and emotional reactions as well as personality profiles of the targeted patients.

### 2.4 | Statistical analysis

Statistical analysis was done with Stata16 for Windows (StataCorp, 2019). Comparisons between the groups regarding the sociodemographic data were based on chi-square tests ( $\chi^2$ ). Comparisons for chronological age, age of onset, and duration of the disorder were based on *T*-test measures.

Mixed analysis of variance ( $2 \times 3$  ANOVA) assessed the changes in the impulsivity construct during treatment. The treatment group was defined as the between-subjects factor (with 2 levels: TAU vs. TAU + Playmancer). The assessment time was defined as the within-subjects factor (with 3 levels: baseline, week-4 and, post-treatment).

The effect size was assessed through partial eta-square ( $\eta^2$ ) for mean comparison tests ( $T$ -test and mixed ANOVA), and through Cramer's V coefficient ( $\phi_c$ ) for proportion comparison tests ( $\chi^2$ ) (values of 0.06, 0.10, and 0.25 were interpreted as low-poor, moderate-medium, and large-high effect sizes; Levine & Hullett, 2002).

This study used Finner-method to control the increase in Type-I error due to the multiple significance tests (this procedure is included in the family-wise error rate stepwise methods, which has proved more powerful than the classical Bonferroni-correction; Finner & Roters, 2001).

### 3 | RESULTS

#### 3.1 | Sociodemographics

Table 1 displays the description of the sociodemographic and clinical profile at baseline, and the comparison between the groups. The only statistical difference was found for education (higher levels among the TAU + playmancer condition).

#### 3.2 | Progression of the measures during treatment

Table 2 shows the pretreatment levels of impulsivity and psychopathology, as well as the results obtained in the mixed ANOVA exploring the progression in the Stroop task, impulsive trait levels (UPPS-P scales), and psychological distress (SCL-90-R GSI; see also Figures S1–S3). Within the TAU group, better performance in the Stroop task was registered during treatment, and a significant improvement in the patient's psychopathological state. Within the TAU + Playmancer group, performance in the Stroop task also improved, psychological distress was reduced and impulsivity level decreased for the lack of perseverance domain.

#### 3.3 | Comparison of the outcomes

Table 3 shows the comparison of treatment efficacy (bad vs. good outcome) at post-treatment and at the 2-year

follow-up. No statistical differences between the groups were found.

## 4 | DISCUSSION

The present study first examined whether impulsivity in patients with EDs could be improved after adding a serious videogame (Playmancer) as a complementary therapy to TAU, by means of a RCT. We observed that Playmancer might be a helpful tool to target some impulsivity aspects. Specifically, patients that completed the serious videogame exhibited a marked level of reduction in the lack of perseverance subscale, meaning an improvement in their ability to stay focused on a long, boring, or difficult task (Cándido et al., 2012). Moreover, a trend to lower negative urgency was also displayed by patients who received CBT and Playmancer, which might reflect a lower inclination to behave impulsively when experiencing extremely negative emotions (Cándido et al., 2012). Lack of perseverance and negative urgency are impulsive personality traits frequently related to binge eating and other ED symptoms and seem to be involved in the maintenance of the disorder and later relapses (Claes et al., 2015; Culbert et al., 2016; Fischer et al., 2018; Mallorquí-Bagué et al., 2020).

By contrast, cognitive measures of impulsivity did not show significant improvement either in the TAU group or the TAU + Playmancer patients. As suggested by a previous single case study, Playmancer may have a positive effect on risky decision making, impulsive motor responses, and sustained attention (Giner-Bartolomé et al., 2015). However, no extra benefits on interference control abilities seem to be driven by the adoption of a therapeutic video game. Most of the therapies commonly used in ED treatment, such as CBT, do not contemplate these difficulties, whereas Playmancer was developed as a complementary tool to specifically target, among other deficits, impulsivity in mental disorders (Fernández-Aranda et al., 2012). Other types of training focused on executive functions, such as cognitive remediation therapy, may be more effective for the reduction of cognitive difficulties in patients with EDs (Danner et al., 2015; Davies et al., 2012; Genders & Tchanturia, 2010; Pretorius et al., 2012; Tchanturia et al., 2014).

As for the second aim, a similar dropout rate and remission of EDs symptoms were present in the experimental and the control group. Overall, a high rate of full or partial remission from ED symptoms was shown in both interventions, which can be primarily related to CBT therapy. In regard to this, previous literature supports the efficacy of CBT therapy approaches in ED treatment, reducing ED behaviours and core psychopathology

TABLE 1 Comparison between groups for sociodemographic and clinical profiles at baseline.

	TAU ( <i>n</i> = 21)		TAU + Playmancer ( <i>n</i> = 16)		$\chi^2$ (df)	<i>p</i>	<i>C-V</i>
	<i>n</i>	%	<i>n</i>	%			
Marital status							
Single	14	66.7	10	62.5	0.08 (2)	0.959	0.05
Married	6	28.6	5	31.3			
Divorced	1	4.8	1	6.3			
Education							
Primary	9	42.9	2	12.5	6.50 (2)	0.039	0.419
Secondary	7	33.3	12	75.0			
University	5	23.8	2	12.5			
Social position							
Mean-high	3	14.3	3	18.8	2.39 (3)	0.495	0.254
Mean	1	4.8	2	12.5			
Mean-low	4	19.0	5	31.3			
Low	13	61.9	6	37.5			
Employment							
Student-employed	15	71.4	9	56.3	0.92 (1)	0.338	0.158
Unemployed	6	28.6	7	43.8			
	Mean	SD	Mean	SD	<i>T</i> (df = 35)	<i>p</i>	$\eta^2$
Chronological age (years-old)	30.95	12.84	30.44	11.22	0.13	0.899	0.001
Onset of ED (years-old)	21.95	9.64	23.69	8.15	0.58	0.566	0.009
Duration of ED (years)	8.92	9.31	6.77	7.13	0.77	0.447	0.017
EDI-2 drive for thinness	30.95	12.84	30.44	11.22	1.19	0.242	0.040
EDI-2 body dissatisfaction	21.95	9.64	23.69	8.15	0.22	0.827	0.001
EDI-2 interoceptive awareness	8.92	9.31	6.77	7.13	0.72	0.475	0.015
EDI-2 bulimia	12.80	5.63	10.44	6.26	1.42	0.164	0.056
EDI-2 interpersonal distrust	16.60	7.38	16.06	7.19	0.80	0.427	0.019
EDI-2 ineffectiveness	11.90	7.01	10.38	5.25	1.35	0.187	0.051
EDI-2 maturity fears	7.45	5.67	5.00	4.35	1.16	0.254	0.038
EDI-2 perfectionism	5.15	4.68	6.50	5.39	0.02	0.981	0.000
EDI-2 impulse regulation	11.95	6.62	9.13	5.76	0.97	0.340	0.027
EDI-2 ascetic	7.20	6.01	9.50	5.80	0.59	0.557	0.010
EDI-2 social insecurity	5.90	5.06	5.94	3.99	0.97	0.338	0.027
EDI-2 total score	3.80	4.71	5.31	4.60	0.55	0.585	0.009
Body mass index (kg/m <sup>2</sup> )	6.25	2.97	5.56	3.98	0.16	0.878	0.001

Note: Duration of ED is measured as the difference between the chronological age at the arrival to the treatment unit and the onset of the ED related problems.

Abbreviations: *C-V*, Cramer's-*V*; *df*, degrees of freedom; ED, eating disorder; EDI-2, Eating disorder inventory; SD, standard deviation;  $\eta^2$ , Partial eta-squared.

(Linardon et al., 2017). What is particularly striking about our findings is that our whole sample reported better treatment outcome variables compared to other studies

(Fernández-Aranda et al., 2021; Keel & Brown, 2010). This is in contrast with our hypothesis of an additional beneficial effect of Playmancer when combined with CBT, in

TABLE 2 Longitudinal comparison of the measures in the study.

	TAU (n = 21)			TAU + Playmancer (n = 16)			Interaction term group-by-time			Factor time (within TAU)			Factor time (within TAU + Playmancer)			Power										
	Pre (T1)		Mean SD	Post (T3)		Mean SD	Week-4 (T2)		Mean SD	Post (T3)	F	df	p	T1-T2	T1-T3	T2-T3	p	p	η <sup>2</sup>	Group	Time	Interac.				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD				p	p	p	p	p	η <sup>2</sup>							
Stroop																										
A raw score	96.1	23.0	107.0	16.4	109.0	16.5	105.3	13.6	111.3	15.0	111.4	14.0	0.92	2/35	0.402	<b>0.010*</b>	<b>0.004*</b>	<b>0.024*</b>	.238 <sup>†</sup>	0.194	0.213	0.903	0.048	0.185	0.953	0.203
B raw score	66.5	14.3	68.7	15.2	72.4	11.1	70.4	12.2	73.1	10.3	72.9	10.3	0.83	2/35	0.440	<b>0.016*</b>	<b>0.035*</b>	.201 <sup>†</sup>	0.346	0.365	0.897	<b>0.375<sup>†</sup></b>	0.120	0.590	0.187	
C raw score	45.8	11.1	49.6	11.0	52.9	12.1	42.3	10.6	47.8	9.4	47.8	10.5	1.26	2/35	0.289	<b>0.008*</b>	<b>0.001*</b>	<b>0.004*</b>	<b>0.375<sup>†</sup></b>	<b>0.001*</b>	<b>0.005*</b>	0.960	<b>0.267<sup>†</sup></b>	0.166	0.992	0.266
Interference	6.1	14.2	8.1	8.6	9.5	7.7	0.4	10.0	3.7	5.4	3.8	7.1	0.11	2/35	0.894	0.449	0.164	0.301	0.072	0.262	0.214	0.938	0.044	0.534	0.465	0.066
UPPS-P																										
Premedita.	22.0	6.7	21.3	5.8	21.8	6.2	22.1	6.2	22.4	6.9	21.9	6.9	0.35	2/35	0.703	0.472	0.852	0.375	0.040	0.750	0.915	0.429	0.022	0.055	0.056	0.105
Persevera.	23.2	6.4	22.7	6.3	22.8	6.3	22.0	6.5	19.9	7.4	19.8	7.4	2.00	2/35	0.142	0.472	0.657	0.832	0.018	<b>0.008*</b>	<b>0.027*</b>	0.808	<b>0.188<sup>†</sup></b>	0.190	0.740	0.401
Sensation	24.2	7.8	24.2	7.6	24.9	8.2	26.1	6.9	24.9	7.3	24.6	7.5	0.82	2/35	0.446	1.000	0.582	0.568	0.010	0.262	0.303	0.815	0.046	0.061	0.087	0.184
Positive urg.	24.9	9.1	24.8	8.9	25.7	9.0	28.8	11.1	28.2	12.6	27.8	12.8	0.33	2/35	0.717	0.948	0.669	0.423	0.019	0.736	0.644	0.734	0.006	0.158	0.056	0.101
Negative urg.	33.8	7.3	32.6	8.1	31.6	6.4	32.9	7.9	32.1	8.8	30.6	9.5	0.04	2/35	0.958	0.352	0.087	0.237	0.093	0.549	0.104	0.124	<b>0.103<sup>†</sup></b>	0.061	0.641	0.056
Total	128.0	19.6	125.6	21.5	126.7	21.4	131.8	27.9	127.4	32.0	124.6	32.7	0.66	2/35	0.521	0.450	0.769	0.679	0.024	0.229	0.158	0.357	0.057	0.052	0.303	0.156
Psychology																										
SCL GSI	1.67	0.63	1.55	0.56	1.27	0.64	1.59	0.70	1.40	0.72	1.22	0.73	0.25	2/35	0.776	0.185	<b>0.002*</b>	<b>0.007*</b>	<b>0.251<sup>†</sup></b>	0.068	<b>0.013*</b>	0.139	<b>0.167<sup>†</sup></b>	0.071	0.993	0.089

Note: \*Bold: significant comparison (0.05 level). †Bold: effect size into the range mild-moderate ( $\eta^2 > 0.10$ ) to high-large ( $\eta^2 > 0.25$ ).

Abbreviations: df, degrees of freedom; GSI, global severity index; SCL, Symptom Checklist-Revised; SD, standard deviation; T1, time 1; T2, time 2; T3, time 3; TAU, treatment as usual;  $\eta^2$ , partial eta-squared.

TABLE 3 Comparison of the treatment outcomes at post-treatment and 2-year follow-up.

	TAU ( <i>n</i> = 21)		TAU + Playmancer ( <i>n</i> = 16)		$\chi^2$ ( <i>df</i> = 1)	<i>p</i>	$\varphi_c$
	<i>n</i>	%	<i>n</i>	%			
Post-treatment							
Bad outcome	2	9.5	3	18.8	0.66	0.416	<b>0.134<sup>†</sup></b>
Good outcome	19	90.5	13	81.3			
2-year follow-up							
Bad outcome	10	47.6	11	68.8	1.65	0.199	<b>0.211<sup>†</sup></b>
Good outcome	11	52.4	5	31.3			

Note: Bad outcome: dropout or non-remission. Good outcome: partial remission or good remission. <sup>†</sup>Bold: effect size into the range mild-moderate ( $\varphi_c > 0.10$ ) to high-large ( $\varphi_c > 0.25$ ).

Abbreviation:  $\varphi_c$ , Cramer's-V coefficient.

improving treatment adherence and reducing ED symptomatology.

However, better benefits are likely to be obtained with some changes regarding the frequency, duration, and number of sessions provided. When applied in the first 3 weeks of treatment, patients may still be ambivalent about the therapy and may not be fully aware of the aspects that are altered by suffering from an ED. Brief psychoeducation on the role of impulsivity in eating symptomatology before starting treatment with Playmancer may also be a good approach.

#### 4.1 | Limitations

The results of this study should be considered in light of its limitations. The main weakness is the sample size, especially at post-treatment. This is due to the high dropout rate from treatment, which diminishes the statistical power analyses as well as the external validity of the present study; for instance, those participants scoring higher on impulsivity might have dropped out. Larger sample sizes would have allowed the results to be separated according to the specific ED. Furthermore, the dichotomous classification of treatment response may be a limitation of the present study. Future research should also examine the reason for treatment dropout. Moreover, it should be noted that the sample consisted exclusively of female patients. Therefore, it would be of interest for future studies to include the male population. It would also have been ideal if the underweight group had had the same number of patients with restricting AN and binge-purging AN. Also, the self-report nature of the trait-impulsivity and psychopathology questionnaires may lead to certain biases. Finally, patients are randomly allocated to TAU or TAU + Playmancer and it has to be

noted that although the duration of the treatments are similar, the frequency of session in TAU treatment differ between disorders: the treatment of AN patients is via day hospital, while patients suffering from BN and BED follow outpatient treatment.

## 5 | CONCLUSIONS

There is a growing interest in addressing impulsivity and other altered features in EDs that are not usually targeted in the most commonly used treatments for these disorders. Our results provide support of previous research and highlight the need to complementary treat impulsivity during ED intervention. Some aspects of trait impulsivity have been improved after Playmancer treatment. However, the present study found no significant differences in treatment outcomes when comparing the TAU group and the group that additionally performed a serious videogame. Keeping this limitation in mind, our study provides some support and additional information on how new technological approaches could complement the standard treatments.

### ACKNOWLEDGEMENTS

We thank CERCA Programme/Generalitat de Catalunya for institutional support. This manuscript and research were also supported by grants from the Instituto de Salud Carlos III (ISCIII) (FIS PI14/00290, PI17/01167 and cofunded by FEDER funds/European Regional Development Fund [ERDF], a way to build Europe). CIBER Fisiopatología de la Obesidad y Nutrición (CIBERObn) is an initiative of ISCIII. CVA and MLM were supported each one by a predoctoral Grant of the Ministerio de Educación, Cultura y Deporte (FPU16/01453 and FPU15/0291). RG is supported by the Catalan Institution for



Research and Advanced Studies (ICREA-Academia, 2021-Programme). The funders had no role in the study design, data collection, and analysis, decision to publish, or preparation of the manuscript. Finally, we would like to thank Magda Rosińska for her support with the English editing.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## ORCID

Núria Mallorquí-Bagué  <https://orcid.org/0000-0003-1434-3162>

Janet Treasure  <https://orcid.org/0000-0003-0871-4596>

## REFERENCES

- Agüera, Z., Sánchez, I., Granero, R., Riesco, N., Steward, T., Martín-Romera, V., Jiménez-Murcia, S., Romero, X., Caroleo, M., Segura-García, C., Menchon, J. M., & Fernández-Aranda, F. (2017). Short-term treatment outcomes and dropout risk in men and women with eating disorders. *European Eating Disorders Review*, 25(4), 293–301. <https://doi.org/10.1002/erv.2519>
- Aldao, A., Gee, D. G., De Los Reyes, A., & Seager, I. (2016). Emotion regulation as a transdiagnostic factor in the development of internalizing and externalizing psychopathology: Current and future directions. *Development and Psychopathology*, 28(4), 927–946. <https://doi.org/10.1017/S0954579416000638>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. American Psychiatric Association.
- Amlung, M., Vedelago, L., Acker, J., Balodis, I., & MacKillop, J. (2017). Steep delay discounting and addictive behavior: A meta-analysis of continuous associations. *Addiction*, 112(1), 51–62. <https://doi.org/10.1111/add.13535>
- Atiye, M., Miettunen, J., & Raevuori-Helkamaa, A. (2015). A meta-analysis of temperament in eating disorders. *European Eating Disorders Review*, 23(2), 89–99. <https://doi.org/10.1002/ERV.2342>
- Bankoff, S. M., Karpel, M. G., Forbes, H. E., & Pantalone, D. W. (2012). A systematic review of dialectical behavior therapy for the treatment of eating disorders. *The Journal of Treatment and Prevention*, 20(3), 196–215. <https://doi.org/10.1080/10640266.2012.668478>
- Bardone-Cone, A. M., Butler, R. M., Balk, M. R., & Koller, K. A. (2016). Dimensions of impulsivity in relation to eating disorder recovery. *International Journal of Eating Disorders*, 49(11), 1027–1031. <https://doi.org/10.1002/eat.22579>
- Bari, A., & Robbins, T. W. (2013). Inhibition and impulsivity: Behavioral and neural basis of response control. *Progress in Neurobiology*, 108, 44–79. <https://doi.org/10.1016/j.pneurobio.2013.06.005>
- Boswell, R. G., & Grilo, C. M. (2021). General impulsivity in binge-eating disorder. *CNS Spectrums*, 26(5), 538–544. <https://doi.org/10.1017/S1092852920001674>
- Cándido, A., Orduña, E., Perales, J. C., Verdejo-García, A., & Billieux, J. (2012). Validation of a short Spanish version of the UPPS-P impulsive behaviour scale. *Trastornos Adictivos*, 14(3), 73–78. [https://doi.org/10.1016/S1575-0973\(12\)70048-X](https://doi.org/10.1016/S1575-0973(12)70048-X)
- Carr, M. M., Wiedemann, A. A., Macdonald-Gagnon, G., & Potenza, M. N. (2021). Impulsivity and compulsivity in binge eating disorder: A systematic review of behavioral studies. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 110, 110318. <https://doi.org/10.1016/J.PNPBP.2021.110318>
- Charlier, N., Zupancic, N., Fieuws, S., Denhaerynck, K., Zaman, B., & Moons, P. (2016). Serious games for improving knowledge and self-management in young people with chronic conditions: A systematic review and meta-analysis. *Journal of the American Medical Informatics Association*, 23(1), 230–239. <https://doi.org/10.1093/jamia/ocv100>
- Claes, L., Islam, M. A., Fagundo, A. B., Jimenez-Murcia, S., Granero, R., Agüera, Z., Rossi, E., Menchón, J. M., & Fernández-Aranda, F. (2015). The relationship between non-suicidal self-injury and the UPPS-P impulsivity facets in eating disorders and healthy controls. *PLoS One*, 10(5), e0126083. <https://doi.org/10.1371/journal.pone.0126083>
- Claes, L., Mitchell, J. E., & Vandereycken, W. (2012). Out of control?: Inhibition processes in eating disorders from a personality and cognitive perspective. *International Journal of Eating Disorders*, 45(3), 407–414. <https://doi.org/10.1002/eat.20966>
- Claes, L., Vandereycken, W., & Vertommen, H. (2005). Impulsivity-related traits in eating disorder patients. *Personality and Individual Differences*, 39(4), 739–749. <https://doi.org/10.1016/J.PAID.2005.02.022>
- Culbert, K. M., Lavender, J. M., Crosby, R. D., Wonderlich, S. A., Engel, S. G., Peterson, C. B., Mitchell, J. E., Crow, S. J., Le Grange, D., Cao, L., & Fischer, S. (2016). Associations between negative affect and binge/purge behaviors in women with anorexia nervosa: Considering the role of negative urgency. *Comprehensive Psychiatry*, 66, 104–112. <https://doi.org/10.1016/j.comppsy.2016.01.010>
- Danner, U. N., Dingemans, A. E., & Steinglass, J. (2015). Cognitive remediation therapy for eating disorders. *Current Opinion in Psychiatry*, 28(6), 468–472. <https://doi.org/10.1097/YCO.0000000000000192>
- Davies, H., Fox, J., Naumann, U., Treasure, J., Schmidt, U., & Tchanturia, K. (2012). Cognitive remediation and emotion skills training for anorexia nervosa: An observational study using neuropsychological outcomes. *European Eating Disorders Review*, 20(3), 211–217. <https://doi.org/10.1002/erv.2170>
- Derogatis, L. (1990). *SCL-90-R. Administration, scoring and procedures manual*. Clinical Psychometric Research.
- Derogatis, L. R. (2002). *SCL-90-R. Cuestionario de 90 síntomas-Manual*. TEA Editorial.
- Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology*, 146(4), 348–361. <https://doi.org/10.1007/PL00005481>
- Fagundo, A. B., Santamaría, J. J., Forcano, L., Giner-Bartolomé, C., Jiménez-Murcia, S., Sánchez, I., Granero, R., Ben-Moussa, M., Magnenat-Thalmann, N., Konstantas, D., Lam, T., Lucas, M., Nielsen, J., Bults, R. G. A., Tarrega, S., Menchón, J. M., de la Torre, R., Cardi, V., Treasure, J., & Fernández-Aranda, F. (2013). Video game therapy for emotional regulation and impulsivity control in a series of treated cases with bulimia

- nervosa. *European Eating Disorders Review*, 21(6), 493–499. <https://doi.org/10.1002/erv.2259>
- Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: A “transdiagnostic” theory and treatment. *Behaviour Research and Therapy*, 41(5), 509–528. [https://doi.org/10.1016/S0005-7967\(02\)00088-8](https://doi.org/10.1016/S0005-7967(02)00088-8)
- Fernández-Aranda, F., Jiménez-Murcia, S., Álvarez-Moya, E. M., Granero, R., Vallejo, J., & Bulik, C. M. (2006). Impulse control disorders in eating disorders: Clinical and therapeutic implications. *Comprehensive Psychiatry*, 47(6), 482–488. <https://doi.org/10.1016/j.comppsy.2006.03.002>
- Fernández-Aranda, F., Jiménez-Murcia, S., Santamaría, J. J., Giner-Bartolomé, C., Mestre-Bach, G., Granero, R., Sánchez, I., Agüera, Z., Moussa, M. H., Magnenat-Thalmann, N., Konstantas, D., Lam, T., Lucas, M., Nielsen, J., Lems, P., Tarrega, S., & Menchón, J. M. (2015). The use of videogames as complementary therapeutic tool for cognitive behavioral therapy in bulimia nervosa patients. *Cyberpsychology, Behavior, and Social Networking*, 18(12), 744–751. <https://doi.org/10.1089/cyber.2015.0265>
- Fernández-Aranda, F., Jiménez-Murcia, S., Santamaría, J. J., Gunnard, K., Soto, A., Kalapanidas, E., Bults, R. G. A., Davarakis, C., Ganchev, T., Granero, R., Konstantas, D., Kostoulas, T. P., Lam, T., Lucas, M., Masuet-Aumatell, C., Moussa, M. H., Nielsen, J., & Penelo, E. (2012). Video games as a complementary therapy tool in mental disorders: PlayMancer, a European multicentre study. *Journal of Mental Health*, 21(4), 364–374. <https://doi.org/10.3109/09638237.2012.664302>
- Fernández-Aranda, F., Pinheiro, A. P., Thornton, L. M., Berrettini, W. H., Crow, S., Fichter, M. M., Halmi, K. A., Kaplan, A. S., Keel, P., Mitchell, J., Rotondo, A., Strober, M., Woodside, D. B., Kaye, W. H., & Bulik, C. M. (2008). Impulse control disorders in women with eating disorders. *Psychiatry Research*, 157(1–3), 147–157. <https://doi.org/10.1016/J.PSYCHRES.2007.02.011>
- Fernández-Aranda, F., Treasure, J., Paslakis, G., Agüera, Z., Giménez, M., Granero, R., Sánchez, I., Serrano-Troncoso, E., Gorwood, P., Herpertz-Dahlmann, B., Bonin, E., Monteleone, P., & Jiménez-Murcia, S. (2021). The impact of duration of illness on treatment nonresponse and drop-out: Exploring the relevance of enduring eating disorder concept. *European Eating Disorders Review*, 29(3), erv.2822. <https://doi.org/10.1002/erv.2822>
- Finner, H., & Roters, M. (2001). On the false discovery rate and expected type I errors. *Journal of the American Statistical Association*, 88(8), 920–923. [https://doi.org/10.1002/1521-4036\(200112\)43:8<985::aid-bimj985>3.0.co;2-4](https://doi.org/10.1002/1521-4036(200112)43:8<985::aid-bimj985>3.0.co;2-4)
- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. (2002). *Structured clinical interview for DSM-IV-TR Axis I disorders, research version, patient edition (SCID-I/P)*. Biometrics Research Department, New York State Psychiatric Institute.
- Fischer, S., Wonderlich, J., & Becker, K. D. (2018). Impulsivity, stress reactivity, and eating disorders. In *Neurobiology of abnormal emotion and motivated behaviors: Integrating animal and human research* (pp. 42–58). Elsevier. <https://doi.org/10.1016/B978-0-12-813693-5.00003-4>
- Galsworthy-Francis, L., & Allan, S. (2014). Cognitive behavioural therapy for anorexia nervosa: A systematic review – ScienceDirect. *Clinical Psychology Review*, 34(1), 54–72. <https://doi.org/10.1016/j.cpr.2013.11.001>
- Garner, D. (1991). *Eating disorder inventory-2*. Psychological-Assessment Resources.
- Garner, D. M. (1998). *Inventario de Trastornos de la Conducta Alimentaria (EDI-2)-Manual*. TEA ediciones.
- Genders, R., & Tchanturia, K. (2010). Cognitive remediation therapy (CRT) for anorexia in group format: A pilot study. *Eating and Weight Disorders*, 15(4), e234–e239. <https://doi.org/10.1007/BF03325304>
- Giner-Bartolomé, C., Fagundo, A. B., Sánchez, I., Jiménez-Murcia, S., Santamaría, J. J., Ladouceur, R., Menchón, J. M., & Fernández-Aranda, F. (2015). Can an intervention based on a serious videogame prior to cognitive behavioral therapy be helpful in bulimia nervosa? A clinical case study. *Frontiers in Psychology*, 6(JUL), 14. <https://doi.org/10.3389/fpsyg.2015.00982>
- Golden, C. J. (1978). *Stroop color and word test: A manual for clinical and experimental uses*. Stoelting.
- Griffin, S. A., Lynam, D. R., & Samuel, D. B. (2018). Dimensional conceptualizations of impulsivity. *Personality Disorders: Theory, Research, and Treatment*, 9(4), 333–345. <https://doi.org/10.1037/PER0000253>
- Hay, P. (2013). A systematic review of evidence for psychological treatments in eating disorders: 2005–2012. *International Journal of Eating Disorders*, 46(5), 462–469. <https://doi.org/10.1002/eat.22103>
- Jiménez-Murcia, S., Fernández-Aranda, F., Kalapanidas, E., Konstantas, D., Ganchev, T., Kocsis, O., Lam, T., Santamaría, J., Raguin, T., Breiteneder, C., Kaufmann, H., & Davarakis, C. (2009). Playmancer project: A serious videogame as an additional therapy tool for eating and impulse control disorders. *Annual Review of Cybertherapy and Telemedicine*, 163–166. <https://doi.org/10.3233/978-1-60750-017-9-163>
- Jorge, H., Duarte, I. C., Paiva, S., Relvas, A. P., & Castelo-Branco, M. (2022). Abnormal responses in cognitive impulsivity circuits are associated with glycosylated hemoglobin trajectories in type 1 diabetes mellitus and impaired metabolic control. *Diabetes and Metabolism Journal*, 46(6), 1–13. <https://doi.org/10.4093/DMJ.2021.0307>
- Keel, P. K., & Brown, T. A. (2010). Update on course and outcome in eating disorders. *International Journal of Eating Disorders*, 43(3), 195–204. <https://doi.org/10.1002/eat.20810>
- Lavender, J. M., & Mitchell, J. E. (2015). Eating disorders and their relationship to impulsivity. *Current Treatment Options in Psychiatry*, 2(4), 394–401. <https://doi.org/10.1007/s40501-015-0061-6>
- Lee, R. S. C., Hoppenbrouwers, S., & Franken, I. (2019). A systematic meta-review of impulsivity and compulsivity in addictive behaviors. *Neuropsychology Review*, 29(1), 14–26. <https://doi.org/10.1007/s11065-019-09402-x>
- Levine, T. R., & Hullett, C. R. (2002). Eta squared, partial eta squared, and misreporting of effect size in communication research. *Human Communication Research*, 28(4), 612–625. <https://doi.org/10.1111/j.1468-2958.2002.tb00828.x>
- Linardon, J., Wade, T. D., De la Piedad Garcia, X., & Brennan, L. (2017). The efficacy of cognitive-behavioral therapy for eating disorders: A systematic review and meta-analysis. *Journal of*

- Consulting and Clinical Psychology*, 85(11), 1080–1094. <https://doi.org/10.1037/ccp0000245>
- Lucas, I., Miranda-Olivos, R., Testa, G., Granero, R., Sánchez, I., Sánchez-González, J., Jiménez-Murcia, S., Fernández-Aranda, F., & Erzegovesi, S. (2021). Neuropsychological learning deficits as predictors of treatment outcome in patients with eating disorders. *Nutrients*, 13(7):2145. <https://doi.org/10.3390/nu13072145>
- Mallorquí-Bagué, N., Lozano-Madrid, M., Vintró-Alcaraz, C., Forcano, L., Díaz-López, A., Galera, A., Fernández-Carrión, R., Granero, R., Jiménez-Murcia, S., Corella, D., Pintó, X., Cuenca-Royo, A., Bulló, M., Salas-Salvadó, J., de la Torre, R., & Fernández-Aranda, F. (2021). Effects of a psychosocial intervention at one-year follow-up in a PREDIMED-plus sample with obesity and metabolic syndrome. *Scientific Reports*, 11(1), 1–12. <https://doi.org/10.1038/s41598-021-88298-1>
- Mallorquí-Bagué, N., Testa, G., Lozano-Madrid, M., Vintró-Alcaraz, C., Sánchez, I., Riesco, N., Granero, R., Perales, J. C., Navas, J. F., Megías-Robles, A., Martínez-Zalacain, I., Veciana de las Heras, M., Jiménez-Murcia, S., & Fernández-Aranda, F. (2020). Emotional and non-emotional facets of impulsivity in eating disorders: From anorexia nervosa to bulimic spectrum disorders. *European Eating Disorders Review*, 28(4), 410–422. <https://doi.org/10.1002/erv.2734>
- Manasse, S. M., Espel, H. M., Schumacher, L. M., Kerrigan, S. G., Zhang, F., Forman, E. M., & Juarascio, A. S. (2016). Does impulsivity predict outcome in treatment for binge eating disorder? A multimodal investigation. *Appetite*, 105, 172–179. <https://doi.org/10.1016/j.appet.2016.05.026>
- Mena-Moreno, T., Testa, G., Mestre-Bach, G., Miranda-Olivos, R., Granero, R., Fernández-Aranda, F., Menchón, J. M., & Jiménez-Murcia, S. (2022). Delay discounting in gambling disorder: Implications in treatment outcome. *Journal of Clinical Medicine*, 11(6), 1611. <https://doi.org/10.3390/JCM11061611>
- Mena-Moreno, T., Fernández-Aranda, F., Granero, R., Munguía, L., Steward, T., López-González, H., del Pino-Gutiérrez, A., Lozano-Madrid, M., Gómez-Peña, M., Moragas, L., Giroux, I., Grall-Bronnec, M., Sauvaget, A., Mora-Maltas, B., Valenciano-Mendoza, E., Menchón, J. M., & Jiménez-Murcia, S. (2021). A serious game to improve emotion regulation in treatment-seeking individuals with gambling disorder: A usability study. *Frontiers in Psychology*, 12, 621953. <https://doi.org/10.3389/fpsyg.2021.621953>
- Munguía, L., Jiménez-Murcia, S., Granero, R., Baenas, I., Agüera, Z., Sánchez, I., Codina, E., del Pino-Gutiérrez, A., Testa, G., Treasure, J., & Fernández-Aranda, F. (2021). Emotional regulation in eating disorders and gambling disorder: A transdiagnostic approach. *Journal of Behavioral Addictions*, 10(3), 508–523. <https://doi.org/10.1556/2006.2021.00017>
- Munguía, L., Lucas, I., Jiménez-Murcia, S., Mora-Maltas, B., Granero, R., Miranda-Olivos, R., Sánchez, I., Testa, G., Lozano-Madrid, M., Turton, R., Menchon, J. M., & Fernández-Aranda, F. (2021). Executive functions in binge spectrum eating disorders with comorbid compulsive buying. *European Eating Disorders Review*, 29(6), 854–867. <https://doi.org/10.1002/ERV.2855>
- National Institute for Clinical Excellence. (2017). Eating disorders: Recognition and treatment NICE guideline. [www.nice.org.uk/guidance/ng69](http://www.nice.org.uk/guidance/ng69)
- Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin*, 126(2), 220–246. <https://doi.org/10.1037/0033-2909.126.2.220>
- Nourredine, M., Jurek, L., Angerville, B., Longuet, Y., de Ternay, J., Derveaux, A., & Rolland, B. (2021). Use of topiramate in the spectrum of addictive and eating disorders: A systematic review comparing treatment schemes, efficacy, and safety features. *CNS Drugs*, 35(2), 177–213. <https://doi.org/10.1007/S40263-020-00780-Y/FIGURES/2>
- Pretorius, N., Dimmer, M., Power, E., Eisler, I., Simic, M., & Tchanturia, K. (2012). Evaluation of a cognitive remediation therapy group for adolescents with anorexia nervosa: Pilot study. *European Eating Disorders Review*, 20(4), 321–325. <https://doi.org/10.1002/erv.2176>
- Racine, S. E., Burt, S. A., Keel, P. K., Sisk, C. L., Neale, M. C., Boker, S., & Klump, K. L. (2015). Examining associations between negative urgency and key components of objective binge episodes. *International Journal of Eating Disorders*, 48(5), 527–531. <https://doi.org/10.1002/EAT.22412>
- Schag, K., Renhak, S. K., Leehr, E. J., Skoda, E. M., Becker, S., Bethge, W., Martus, P., Zipfel, S., & Giel, K. E. (2019). IMPULS: Impulsivity-focused group intervention to reduce binge eating episodes in patients with binge eating disorder – A randomised controlled trial. *Psychotherapy and Psychosomatics*, 88(3), 141–153. <https://doi.org/10.1159/000499696>
- Sohlberg, S., Norring, C., Holmgren, S., & Rosmark, B. (1989). Impulsivity and long-term prognosis of psychiatric patients with anorexia nervosa/bulimia nervosa. *The Journal of Nervous and Mental Disease*, 177(5), 249–258. <https://doi.org/10.1097/00005053-198905000-00001>
- StataCorp. (2019). *Stata statistical software: Release 16*. StataCorp LLC.
- Steward, T., Mestre-Bach, G., Vintró-Alcaraz, C., Agüera, Z., Jiménez-Murcia, S., Granero, R., & Fernández-Aranda, F. (2017). Delay discounting of reward and impulsivity in eating disorders: From anorexia nervosa to binge eating disorder. *European Eating Disorders Review*, 25(6), 601–606. <https://doi.org/10.1002/erv.2543>
- Tárrega, S., Castro-Carreras, L., Fernández-Aranda, F., Granero, R., Giner-Bartolomé, C., Aymamí, N., Gómez-Peña, M., Santamaría, J. J., Forcano, L., Steward, T., Menchón, J. M., & Jiménez-Murcia, S. (2015). A serious videogame as an additional therapy tool for training emotional regulation and impulsivity control in severe gambling disorder. *Frontiers in Psychology*, 6, 1721. <https://doi.org/10.3389/fpsyg.2015.01721>
- Tchanturia, K., Lounes, N., & Holtum, S. (2014). Cognitive remediation in anorexia nervosa and related conditions: A systematic review. *European Eating Disorders Review*, 22(6), 454–462. <https://doi.org/10.1002/erv.2326>
- Testa, G., Mora-Maltas, B., Camacho-Barcia, L., Granero, R., Lucas, I., Agüera, Z., Jiménez-Murcia, S., Baños, R., Bertaina-Anglade, V., Botella, C., Bulló, M., Casanueva, F. F., Dalsgaard, S., Fernández-Real, J. M., Franke, B., Frühbeck, G., Fitó, M., Gómez-Martínez, C., Pintó, X., ... Fernández-Aranda, F. (2021). Transdiagnostic perspective of impulsivity and compulsivity in obesity: From cognitive profile to self-

- reported dimensions in clinical samples with and without diabetes. *Nutrients*, *13*(12), 4426. <https://doi.org/10.3390/NU13124426>
- Valenciano-Mendoza, E., Fernández-Aranda, F., Granero, R., Gómez-peña, M., Moragas, L., Mora-Maltas, B., Håkansson, A., Menchón, J. M., & Jiménez-Murcia, S. (2021). Prevalence of suicidal behavior and associated clinical correlates in patients with behavioral addictions. *International Journal of Environmental Research and Public Health*, *18*(21), 11085. <https://doi.org/10.3390/IJERPH182111085>
- Verdejo-García, A., Lozano, Ó., Moya, M., Alcázar, M. Á., & Pérez-García, M. (2010). Psychometric properties of a Spanish version of the UPPS-P impulsive behavior scale: Reliability, validity and association with trait and cognitive impulsivity. *Journal of Personality Assessment*, *92*(1), 70–77. <https://doi.org/10.1080/00223890903382369>
- Vintró-Alcaraz, C., Munguía, L., Granero, R., Gaspar-Pérez, A., Solé-Morata, N., Sánchez, I., Sánchez-González, J., Menchón, J. M., Jiménez-Murcia, S., & Fernández-Aranda, F. (2022). Emotion regulation as a transdiagnostic factor in eating disorders and gambling disorder: Treatment outcome implications. *Journal of Behavioral Addictions*, *11*(1), 140–146. <https://doi.org/10.1556/2006.2022.00004>
- Whiteside, S. P., Lynam, D. R., Miller, J. D., & Reynolds, S. K. (2005). Validation of the UPPS impulsive behaviour scale: A four-factor model of impulsivity. *European Journal of Personality*, *19*(7), 559–574. <https://doi.org/10.1002/per.556>
- Wilson, G. T., Grilo, C. M., & Vitousek, K. M. (2007). Psychological treatment of eating disorders. *American Psychologist*, *62*(3), 199–216. <https://doi.org/10.1037/0003-066X.62.3.199>
- Wonderlich, S. A., Connolly, K. M., & Stice, E. (2004). Impulsivity as a risk factor for eating disorder behavior: Assessment implications with adolescents. *International Journal of Eating Disorders*, *36*(2), 172–182. <https://doi.org/10.1002/eat.20033>
- Wu, M., Hartmann, M., Skunde, M., Herzog, W., & Friederich, H.-C. (2013). Inhibitory control in bulimic-type eating disorders: A systematic review and meta-analysis. *PLoS One*, *8*(12), e83412. <https://doi.org/10.1371/journal.pone.0083412>
- Yang, C. C., Mauer, L., Völlm, B., & Khalifa, N. (2020). The effects of non-invasive brain stimulation on impulsivity in people with mental disorders: A systematic review and explanatory meta-analysis. *Neuropsychology Review*, *30*(4), 499–520. <https://doi.org/10.1007/S11065-020-09456-2>

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Vintró-Alcaraz, C., Mallorquí-Bagué, N., Lozano-Madrid, M., Testa, G., Granero, R., Sánchez, I., Treasure, J., Jiménez-Murcia, S., & Fernández-Aranda, F. (2023). The usefulness of an intervention with a serious video game as a complementary approach to cognitive behavioural therapy in eating disorders: A pilot randomized clinical trial for impulsivity management. *European Eating Disorders Review*, *31*(6), 781–792. <https://doi.org/10.1002/erv.3003>