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Getting even: chasing behavior, decision-making, and craving in habitual gamblers

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Abstract

Background Dysfunctional decision-making and intense craving represent pivotal aspects across all addictive behaviors, notably evident in gambling addiction where these factors significantly shape chasing behavior—continuing gambling to recoup losses—indicative of problematic gambling. This study explores the correlation between chasing behavior, craving, affective decision-making, decision-making styles, and gambling severity among habitual Italian gamblers.

Methods One hundred and sixty-six participants from diverse gambling venues completed assessments including the South Oaks Gambling Screen (SOGS), the Iowa Gambling Task (IGT), the General Decision-Making Style (GDMS), the Gambling Craving Scale (GACS), and a computerized task to measure chasing behavior. Participants were randomly assigned to Control and Loss chasing conditions.

Results Regression analyses revealed craving as a predictor of chasing behavior. Interestingly, individuals with a dependent decision-making style exhibited lower tendencies to chase. While IGT performance correlates with chasing frequency, it is not associated with the decision to continue or cease gambling. Intriguingly, gambling severity (SOGS total score) did not feature in the final models of both regression analyses.

Discussion These findings emphasize the significant role of craving in driving chasing behavior. Additionally, this study introduces, for the first time, the idea that a dependent decision-making style could potentially serve as a safeguard against chasing proneness.

Conclusions The study suggests a fundamental dichotomy between chasers and nonchasers among gamblers, irrespective of gambling severity. This distinction could be instrumental in tailoring more effective intervention strategies for gambling disorder treatment.

Keywords Gambling, Gambling disorder, Chasing, Craving, Iowa Gambling Task, Decision-making styles

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Introduction

Dysfunctional decision-making and intense cravings represent pivotal aspects across all addictive behaviors [1]. Within gambling addiction specifically, these elements significantly contribute to defining what is known as *chasing behavior*. Chasing is a behavioral marker and a core feature of problematic gambling that significantly contributes to the etiology and maintenance of gambling disorder (GD; for recent reviews, see [2, 3]). Listed among the diagnostic criteria for GD, chasing refers to the act of continuing gambling to regain gambling-related losses [4, 5]. Specifically, the Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR; [6]), defines "chasing losses" as follows: "After losing money gambling, often returns another day to get even ("chasing" one's losses)" (p. 661). Such a description assumes that there is a time interval ("another day") between "losing money gambling" and "getting even", leaving aside the possibility that this behavior may also occur during the same gambling session. To overcome this limitation and consistent with Lesieur [5], Breen and Zuckerman [7] have appropriately proposed to distinguish within-session from between-session chasing. Gambling excessively within a specific session refers to within-session chasing, whereas attempting to recover lost money on a subsequent day defines between-session chasing. In both cases, according to Breen and Zuckerman [7], chasing losses can be seen as a distinct form of persistence in gambling, specifically persistence in the face of losing. In addition, it is worth noting that the DSM-5 definition of loss-chasing overlooks the phenomenon of chasing wins, which can be equally detrimental to people struggling with this disorder [8, 9]. Since individuals may continue to gamble beyond their initial intentions, regardless of whether they have experienced a series of losses or wins, prolonged gambling typically results in greater financial losses over time. Empirical evidence supporting this notion can be found in studies conducted by Lister et al. [10–13].

Chasers typically do not realize they are caught in a vicious cycle until it is too late [14]. They often illusorily believe that luck will sooner or later turn in their favor or continue to assist them, and this hope encourages chasing (about the role of cognitive biases related to gambling, see [12]). The desire to get even or gain more appears to override concerns about losing money, possibly because withdrawing from the game when the challenge becomes more exciting could produce, among others, a state of cognitive tension like that generated by unfinished tasks (about the role of the so-called "Zeigarnik effect" in persistent gambling, see [15]).

Based on various surveys, it has been found that around 33–40% of individuals who engage in regular gambling acknowledge instances of chasing their losses on occasion and approximately 13% of these individuals admit to frequently or consistently pursuing their losses [16–19]. While not all gamblers are trapped in the chasing spiral, some people, namely compulsive gamblers, engage in such a seemingly "illogical behavior" [5]. Indeed, although chasing is frequently associated with greater gambling involvement [20], some empirical evidence [21–23] and the results of latent class analyses (e.g., [24–26]) have shown that chasers and nonchasers fall into distinct subtypes of problematic gamblers, even regardless of gambling severity.

Because "loss-chasing frequently involves a strong appetitive component, manifested in uncontrollable urges to continue gambling or increase the size of bets placed" ([9], p. 297), the decision to chase shares similarities with drug cravings observed in substance addicts.

Craving is a strong and often overwhelming desire to engage in harmful addictive behaviors, including gambling. The experience of craving has demonstrated connections with various dimensions of gambling, including GD severity, frequency of gambling episodes, and chasing proneness, among others [27]. Indeed, research on this topic has shown that gambling craving further abets GD symptoms and plays a significant role in triggering relapse (e.g., [8, 28, 29]). Even though people suffering from GD can experience stronger cravings than both alcoholic and substance addicts [30, 31] and craving is usually a focus of clinical treatments for GD [32, 33], craving is not declined among the diagnostic criteria for GD (about the role of craving in GD, see [21, 27, 34, 35]).

Research exploring the relationship between chasing and craving has revealed significant findings. For instance, it has been observed that the alleviation of negative emotions through gambling predicts continued engagement despite consistent losses [36], while the urge to gamble tends to intensify following positive gambling experiences [37]. Moreover, elevated levels of craving have been linked to both the inclination to chase losses and the frequency of chasing behaviors in both adult and adolescent populations [21, 38].

While neurobiological differences may be present in individuals with GD [39], recent research suggests that craving and chasing stem both from functional alterations in cerebellum-related connectivity that might underpin gambling severity [40–42]. However, chasing seems to depend mainly on dysfunctions in the cognitive mechanisms underpinning decision-making. As prior research demonstrated, problematic gamblers perform worse than normal controls in behavioral tasks, such as the Iowa Gambling Task (IGT; for reviews, see [43, 44]), with chasing contributing to impair decision-making among problematic gamblers [14, 22]. Not surprisingly,

Wyckmans et al. [45] assumed that behavioral addictions, including gambling, can be viewed as an aberrant decision process. Nevertheless, poor affective decision-making is not universally present in disordered gamblers, arguably because differences in performance may also be linked to relatively stable individual characteristics [46–50]. According to Buelow and Suhr [51], "the results of the few studies that have explored personality correlates of IGT performance in nonclinical samples suggest that underlying personality characteristics, independent of a psychological disorder, mental disorder, or frontal lobe dysfunction, may impact performance on the IGT" (p. 109).

Thus far, gambling research on decision-making has mainly focused on the functional or dysfunctional outcomes of the decisional process, neglecting the possible role of individual habitual response patterns when facing decisions. We are referring to the decisional style, which has been defined as "the learned habitual response pattern exhibited by an individual when confronted with a decision situation" ([52], p. 820). To the best of our knowledge, only two studies have examined the relationship between decisional styles and gambling [53, 54], with no investigation focusing on the role of decision habits in chasing behavior.

The present study aimed to first investigate the interplay between chasing behavior, craving, affective decision-making, as measured by the IGT, decision-making styles, and gambling severity among Italian habitual gamblers. Consistent with Breen and Zuckerman [7], we defined loss chasing in this study as persistence in gambling following prior losses. In line with the literature mentioned earlier and considering the pervasive role of craving in both gambling and chasing behavior (e.g., [33, 55]), we expected that high levels of craving, poor performance on the IGT, and dysfunctional decision-making styles (i.e., those that don't rely on a systematic and exhaustive information search and evaluation of alternatives), along with gambling severity, would contribute to the decision to continue playing and chasing proneness.

Methods

Participants and procedure

A convenience sample of one hundred and sixty-six Italian habitual gamblers (79.5% males) aged between 19 and 70 years (M_{age} = 36.96; SD = 12.39) were recruited from local gambling venues.

To be eligible for enrollment, participants needed to meet two criteria: they had to be habitual gamblers, meaning they reported gambling at least once a week, and they had to be 18 years of age or older. The refusal rate was about 26%. Regarding modal occupation status, 17.1% of the participants were unemployed, 27.7% manual workers, and 21.9% were office workers.

Participants were administered a set of measures to assess gambling severity, craving, affective decision-making, decision-making styles, and a computerized task developed to measure chasing behavior. The chasing task had two conditions, namely, control and loss, with half of the participants randomly assigned to each (between-subjects design). Participants were tested on-site, in a quiet room made available by the management. The order of the two behavioral tasks (IGT and ChasIT) was balanced between subjects, whereas paper-and-pencil measures were administered in the interval between the two computerized tasks. Participants did not receive any compensation in exchange for their participation. Each session lasted about 60 min.

Measures

Gambling severity was assessed using of the South Oaks Gambling Screen (SOGS; [56]; Italian translation: [57]), a self-report measure estimating the frequency and the severity of gambling problems where responses are dichotomous in nature (yes/no) or transformed into dummy variables according to the scoring procedure. It consists of twenty scored items and six unscored items. The unscored items request participants to indicate, among others, the frequency of participation in different gambling activities (not at all, less than once a week, or once a week or more). The SOGS total score ranges from 0 to 20. Scoring between 0 and 2 suggests an absence of gambling issues, while scores between 3 and 4 signal a potential risk for developing gambling problems. A score of 5 or higher indicates a likelihood of pathological gambling. In the current study, the internal consistency of the scale was high, with a Cronbach's α of 0.93.

Craving was assessed using the Gambling Craving Scale (GACS; [36]; Italian translation: [38]). The GACS is a comprehensive tool designed to measure different dimensions of craving related to gambling. It consists of 9 items that are grouped into three subscales: Anticipation, Desire, and Relief. Anticipation refers to the expectation that gambling will be enjoyable and fun, Desire refers to a strong and urgent desire to gamble, and Relief refers to the expectation that gambling will alleviate negative emotional states. Participants rate their agreement with each statement on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alphas for the three dimensions of the GACS were as follows: Anticipation: 0.84; Desire: 0.93; Relief: 0.81.

Inspired by the Somatic Marker Hypothesis (SMH; [58]), which suggests that emotions significantly influence the process of decision-making, the Iowa Gambling Task (IGT; [59, 60]) stands as a computerized evaluation

of affective decision-making. The IGT uses four card decks, varying in the amount of monetary reward and punishment and the frequency of losses throughout one hundred trials. The participants draw a series of cards from a set of four 'decks of cards' named A, B, C, and D, respectively. Decks A and B consistently yielded $100, while Decks C and D consistently yielded $50. With each card selection, there is a 50% chance of incurring a penalty. For Decks A and B, the penalty amounts to $250, whereas for Decks C and D, it is $50. At the beginning of the task, participants are given a loan of $2000 and asked to play to earn as much money as possible. Drawing cards from decks A and B (high-risk or disadvantageous decks) results in large immediate gains but larger losses in the long term, whereas choosing cards from decks C and D (low-risk or advantageous decks) yields small immediate monetary gains but smaller long-term losses. So, drawing cards more frequently from disadvantageous decks leads to an overall loss, while drawing from advantageous decks leads to an overall gain. Performance on the IGT (Net total score) is computed by subtracting the number of disadvantageous choices from the number of advantageous choices on the complete task, and for each block of twenty cards to evaluate changes in decision-making strategies. Higher scores, therefore, indicate better performance on the task. A global score below 10 (out of 100) is indicative of a decision-making deficit [61]. In the present version, we changed the currency symbol from U.S. dollars to Euros.

The General Decision-Making Scale (GDMS; [52]; Italian validation [62]) is a 25-item questionnaire used to assess five different decision-making styles. It assesses both rationality and intuitiveness, alongside three additional styles: avoidance, dependence, and spontaneity. Conceptually, these dimensions are considered independent yet not mutually exclusive. Cognitive scientists typically posit that decision-making styles characterized as "rational" or "intuitive" tend to yield favorable life outcomes, while those characterized as "avoidant" or "spontaneous" may have a negative impact. Conversely, the relationship between the dependent decision-making style and decision outcomes remains somewhat unclear.

Participants are asked to rate their agreement with statements on a 5-point Likert scale, which measures the following styles: Rational (systematic and exhaustive information search and evaluation of alternatives; e. g., I *make decisions in a logical and systematic way*), Intuitive (relying on intuitions, premonitions, and feelings; e. g., *When making decisions, I rely upon my instincts*), Dependent (searching for advice, support, and guidance from others; e. g., *I use the advice of other people in making my important decisions*), Avoidant (postponing or avoiding decision-making; e. g., *I avoid making important decisions until the pressure is on*), and Spontaneous (making impulsive and quick decisions; e. g., *I often make decisions on the spur of the moment*). Total scores for each style are calculated by summing participants' responses. Higher scores indicate a greater tendency to use a particular style. In the present study, Cronbach's alphas for the five dimensions of the GDMS were as follows: Rational: 0.80; Intuitive: 0.75; Dependent: 0.83; Avoidant: 0.71; Spontaneous: 0.78.

The ChasIT [22] is a computerized task measuring chasing that mimics a card game where players compete against the house with a starting budget of 10 Euros. Each card reports a number ranging from 1 to 9, and players either win or lose 1 Euro based on whether they have the highest card. Positive or negative feedback and sound cues are given via computer following each round. After the initial 30 rounds, players are informed of their savings or losses and given the choice to continue or stop the game. In the control condition, players save their entire budget, while in the loss condition, they lose 12 Euros, including the entire budget and an additional 2 Euros, but are still allowed to continue playing. In the second phase, players receive the appropriate feedback after each round and are informed of their remaining credit. They are given the option to continue or stop playing after each round. The maximum chasing score is 30, and the final budget in the control condition was 10 Euros, while it is minus 14 Euros in the loss condition. Participants who chose to continue playing in the second phase are classified as "chasers" (1), while those who stop are classified as "nonchasers" (0).

In the present study, the decision to continue playing or to quit and the number of rounds played were the two dependent variables of interest.

Statistical analyses

The data analysis was conducted using IBM SPSS version 28.0, with a significance level of $p < 0.05$. All variables were preliminarily screened for missing data, distribution abnormalities, and outliers [63]. Pearson correlation coefficients were used to examine the relationships among SOGS, GACS, and GDMS subscales, IGT, and chasing frequency. Categorical data were compared using the chi-square test, while continuous variables were analyzed for mean differences using an analysis of variance. Repeated measures analysis was conducted to compare the IGT profiles of nonchasers and chasers and to illustrate the learning curve of each group. Hierarchical logistic regression was performed to analyze the independent associations between gender, age, education, SOGS, GACS, GDMS subscales, IGT scores (Net total score), and the decision to chase. To determine potential predictors of chasing frequency, a hierarchical linear regression

Table 1 Means and standard deviations by experimental condition and gender

Condition	Control				Loss				Gender effects (univariate *F*)		
Gender	Men (*N* = 69)		Women (*N* = 14)		Men (*N* = 63)		Women (*N* = 20)				
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	$F_{1.164}$	*p*	η_p^2
Age	36.93	12.84	33.71	12,22	38.40	11.58	34.85	13.59	1.87	n.s	
Education	12.15	3.42	15.86	2.57	12.24	3.87	13.25	2.55	10.80	< .001	.062
SOGS[a] Total score	6.71	5.59	2.14	2.25	7.83	5.87	1.10	1.59	32.69	< .001	.166
GACS[b]											
Anticipation	4.61	1.98	3.55	1.67	4.50	1.98	3.05	1.56	12.64	< .001	.072
Desire	2.23	1.53	1.55	1.36	2.24	1.47	1.28	0.95	9.34	.003	.054
Relief	2.96	1.71	2.21	1.45	2.92	1.69	1.58	0.86	12.70	< .001	.072
IGT[c]											
NET Total score	-2.28	33.00	-3.71	21.50	-0.97	32.65	-3.10	24.22	.082	n.s	
GDMS[d]											
Rational	17.55	4.23	18.57	2.82	17.41	4.32	18.05	2.56	1.037	n.s	
Intuitive	18.38	3.48	18.00	2.88	18.73	3.79	17.55	2.44	1.501	n.s	
Dependent	16.22	4.62	15.00	4.69	14.56	4.75	16.15	4.63	.077	n.s	
Avoidant	13.72	3.80	14.07	3.43	13.13	4.04	12.95	4.11	.001	n.s	
Spontaneous	14.26	4.02	14.07	3.22	14.76	4.75	14.35	4.09	.105	n.s	
Chasing frequency	5.25	9.09	3.21	7.19	9.84	12.04	1.25	3.55	7.904	.006	.046

[a] South Oaks Gambling Screen

[b] Gambling Craving Scale

[c] Iowa Gambling Task

[d] General Decision-Making Style

analysis was carried out with ChasIT total score as the dependent variable and gender, age, education, SOGS, GACS, GDMS, and IGT scores as independent variables. Prior to interpreting the regression coefficients, variance inflation factors (VIF) were calculated to avoid multicollinearity. All VIF values were found to be below the recommended cut-off of 10 [64].

Ethics

The research obtained the ethics committee's approval from the first author's university. This study was performed in line with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants included in the study before enrolment.

Results

Means and standard deviations by experimental condition and gender are presented in Table 1.

According to the SOGS scoring system, the sample consisted of 39.8% non-problem gamblers, 12.3% problem gamblers, and 47% (probable) pathological gamblers. The most favored gambling activities among the participants included sports betting (80.7%), scratch cards (80.7%), lottery games (75.3%), card games (74.1%), and video poker and slot machines (60.2%).

Preliminarily, to ascertain whether participants assigned to the two experimental conditions differed in terms of gender, age, education, SOGS, GACS, IGT, and GDMS scores, data were submitted to $\chi 2$ test or univariate ANOVA. The results did not show any difference between the two groups (all *ps* ns).

Data were submitted to univariate ANOVA to test for gender differences. As Table 1 shows, on average, women have a higher level of education in terms of years of schooling compared to men. Differences due to gender were also observed on the SOGS, the three dimensions of the GACS, and chasing frequency, with men scoring higher than women in all cases.

To ascertain whether there were associations between age, years of education, SOGS, IGT, GACS, GDMS scores, and chasing frequency, Pearson's correlation coefficients were calculated. To control for false discovery rate (FDR) *p*-values for multiple testing were adjusted with the Benjamini and Hochberg method [65]. A significance level of $\alpha = 0.05$ was chosen. With only a few exceptions, the results showed strong to moderate significant associations between chasing frequency, gambling severity, craving, affective decision-making, and four of the five decision styles (see Table 2).

To establish whether the choice to chase after the first phase and the total number of trials played during the

Table 2 Pearson correlation coefficients among the study variables

	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-.171*	.255**	-.116	.114	.101	-.111	-.003	.130	.000	.025	.009	-.061
2. Education	-	-.330**	-.124	-.218*	-.296**	.130	.181*	-.087	-.037	-.190*	-.143	-.156
3. SOGS[a] Total score		-	.158	.420**	.385**	-.192*	-.243**	.263**	.004	.310**	.325**	.328**
4. GACS[b] Anticipation			-	.610**	.543**	-.040	-.335**	.238**	-.112	.273**	.249**	.416**
5. GACS Desire				-	.746**	-.208*	-.327**	.198*	-.071	.415**	.341**	.431**
6. GACS Relief					-	-.216*	-.254**	.216*	-.061	.394**	.283**	.493**
7. IGT[c] Net Total score						-	.269**	-.199*	.051	-.246**	-.187*	-.305**
8. GDMS[d] Rational							-	-.179*	.164	-.400**	-.400**	-.199*
9. GDMS Intuitive								-	-.203*	.203*	.511**	.222**
10. GDMS Dependent									-	.284**	-.194*	-.210*
11. GDMS Avoidant										-	.305**	.214*
12. GDMS Spontaneous											-	.122
13. Chasing frequency												-

* $p < .05$; ** $p < .01$ (Benjamini-Hochberg Adjusted p values)

[a] South Oaks Gambling Screen

[b] Gambling Craving Scale

[c] Iowa Gambling Task

[d] General Decision-Making Style

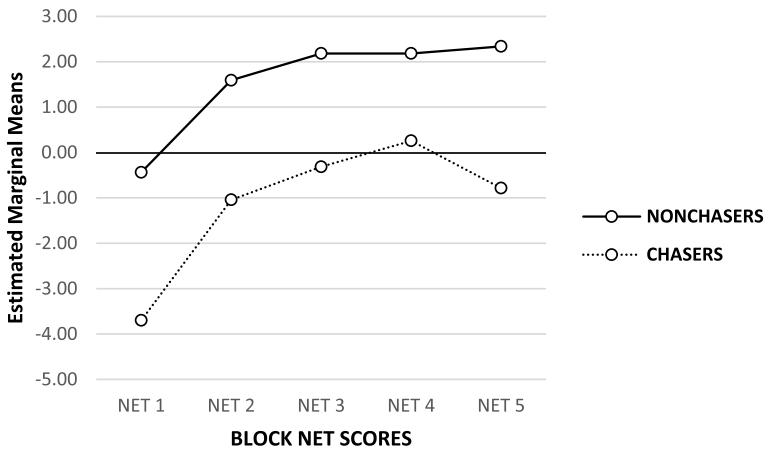

Fig. 1 IGT performance by block as a function of chasing decision

second phase varied according to the experimental condition, data were submitted to a chi-square test and univariate ANOVA.

The results indicated that the choice to play further did not vary as a function of the experimental condition (47.5% in the Control condition and 52.5% in the Loss condition; $\chi 2(1, N = 166) = 0.64$; ns). Univariate ANOVA did not show significant differences due to the experimental condition in chasing frequency ($F_{1,\ 164} = 3.36$; $p = 0.069$).

To compare the IGT performance profiles of chasers versus nonchasers, we conducted a repeated measures ANOVA, with group as the between-subjects factor and scores on the five subsequent IGT blocks as the dependent variables. The analysis yielded a significant within-subjects contrast effect of block ($F_{1,\ 139} = 7.36$; $p < 0.01$; $\eta_p^2 = 0.050$), reflecting the fact that task performance increased over time, and a significant main effect of group ($F_{1,\ 139} = 6.22$; $p < 0.01$; $\eta_p^2 = 0.043$), indicating that, relative to nonchasers, chasers performed poorer on the IGT (see Fig. 1). Interestingly, the between-subjects effect disappears after inserting the GACS scale scores as covariates in the analysis ($F_{1,\ 139} = 1.76$; $p = 0.186$).

Table 3 Summary of logistic regression analysis with the choice to continue or stop gambling as the dependent variable

	B	*SE*	Wald	*df*	*P*	Odds ratio (95% CI)
Step 1						
Gender	-0.373	0.460	0.659	1	0.417	.689 (.280–1.695)
GACS Relief	0.690	0.127	29.440	1	0.000	1.994 (1.554–2558)
Step 2						
Gender	-0.155	0.480	0.105	1	0.746	0.856 (.334–2.193)
GACS[a] Anticipation	0.298	0.111	7.151	1	0.007	1.347 (1.083–1.676)
GACS Relief	0.539	0.136	15.797	1	0.000	1.714 (1.314–2.236)
Step 3						
Gender	-.189	.489	.149	1	.700	.828 (.318–2.158)
GDMS[b] Dependent	-.102	.041	6.147	1	.013	.903(.833-.979)
GACS[a] Anticipation	.283	.114	6.132	1	.013	1.328 (1.061–1.662)
GACS Relief	.562	.140	16.131	1	.000	1.754 (1.333–2.307)

Dependent variable: Group (nonchasers/chasers); Model: $\chi^2 = 57.83$; Nagelkerke's $R^2 = .392$

Overall percentage accuracy rate = 74.7%

[a] Gambling Craving Scale

[b] General Decision-Making Style

To assess the relative contribution of gender, age, education, experimental condition, gambling severity (SOGS total score), craving (GACS scores), affective decision-making (Net scores), and decisional styles (GDMS scores; step 2) for the choice to chase, a hierarchical logistic regression analysis was conducted, using the two groups (chasers and nonchasers) as the criterion variable. For the regression, Hosmer and Lemeshow's test was not significant [$\chi^2(8, N = 166) = 6.99$; $p = 0.54$)], indicating an adequate model fit. The results of the final regression model showed that scores on both the GACS Anticipation and Relief scales and on the GDMS Dependent style were significant predictors of the choice to chase (see Table 3). Notably, gambling severity was not retained in the final model.

To identify the potential predictors of chasing frequency, gender, age, education (in years), experimental condition, and scores on SOGS, GACS, IGT, and GDMS were entered into a hierarchical regression analysis with chasing frequency as the dependent measure.[1]

Since typically, the first stage of regression analysis entails incorporating demographic variables, we included gender, age, and education in this initial step. Additionally, we introduced the experimental condition to assess its potential impact on the outcome variable independently of other factors. This allowed us to determine if the experimental manipulation had a significant effect before examining the influence of additional variables. In the subsequent step, we entered the scores from the SOGS, GACS, IGT, and GDMS. Variables were entered into the regression models in a hierarchical fashion, with each block of predictors added sequentially. This approach allowed us to assess the incremental contribution of each set of variables to the prediction of the outcome variable.

The results (see Table 4) showed that, along with the Loss condition, GACS Relief and Anticipation, IGT, and GDMS Dependent style scores were significant predictors of chasing frequency ($R^2_{adj} = 0.36$, $F_{6,\ 159} = 16.38$; $p < 0.001$). Again, SOGS total score was not included in the final regression model.

Finally, after defining loss chasing as the persistence in gambling following prior losses, distinguishing it from a general willingness to gamble, we focused on two dimensions of the Gambling Craving Scale (GACS): Anticipation and Relief. These dimensions were identified as significant predictors of both the decision to continue gambling and the frequency of chasing behavior. Our specific objective was to investigate whether these two facets of craving were uniquely related to loss chasing.

To accomplish this objective, we first constructed a composite craving index by summing the scores from the Anticipation and Relief subscales. Participants were then classified into two groups based on the median composite craving score (low/high craving). Subsequently, we conducted a 2 (condition) X 2 (low/high craving) ANOVA, using the number of rounds

[1] An a priori power analysis was conducted using G*Power version 3.1.9. [66] to determine the minimum sample size required to test the study hypothesis. Results indicated the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of $\alpha = 0.05$, was $N = 152$ for the regression analysis. Thus, the obtained sample size of $N = 166$ is adequate to test the study hypothesis.

Table 4 Summary of hierarchical linear regression analysis with chasing frequency as the dependent variable

Variable	B	R^2	ΔR^2	β	*t*	*P*	VIF
Step 1							
Gender	-5.381	.046	.046	-.214	-2.811	.006	1.000
Step 2							
Gender	-5.745	.072	.027	-.229	-3.022	.003	1.008
Exp. Cond. Loss	3.283			.162	2.140	.034	1.008
Step 3							
Gender	-2.580	.284	.212	-.103	-1.485	.139	1.083
Exp. Cond. Loss	3.737			.185	2.760	.006	1.010
GACS[a] Relief	2.933			.478	6.916	.000	1.080
Step 4							
Gender	-3.057	.329	.045	-.122	-1.806	.073	1.091
Exp. Cond. Loss	3.772			.186	2.869	.005	1.011
GACS Relief	2.613			.426	6.175	.000	1.140
IGT[b] Net Total score	-.072			-.219	-3.295	.001	1.057
Step 5							
Gender	-2.348	.365	.036	-.094	-1.407	.161	1.114
Exp. Cond. Loss	3.887			.192	3.028	.003	1.011
GACS Relief	1.878			.306	3.913	.000	1.541
IGT Net Total score	-.077			-.235	-3.612	.000	1.064
GACS Anticipation	1.181			.229	3.003	.003	1.462
Step 6							
Gender	-2.337	.382	.017	-.093	-1.416	.159	1.114
Exp. Cond. Loss	3.552			.175	2.775	.006	1.027
GACS Relief	1.885			.307	3.969	.000	1.541
IGT Net Total score	-.075			-.228	-3.544	.001	1.066
GACS Anticipation	1.096			.212	2.803	.006	1.478
GDMS Dependent	-.289			-.134	-2.112	.036	1.031

B Unstandardized coefficient, ΔR^2 *R* square change, *β* Standardized regression coefficient, *VIF* Variance Inflation Factor

[a] Gambling Craving Scale

[b] Iowa Gambling Task

[c] General Decision-Making Style

played (chasing frequency) as the dependent variable. The results indicated significant effects of craving ($F_{1, 162} = 36.6$; $p < 0.001$; $\eta_p^2 = 0.184$) and the experimental condition ($F_{1, 162} = 5.72$; $p < 0.05$; $\eta_p^2 = 0.034$), as well as an interaction effect between the experimental condition and the degree of craving ($F_{1, 162} = 9.8$; $p < 0.01$; $\eta_p^2 = 0.057$). Participants assigned to the loss condition who chosen to play further experienced higher levels of craving compared to those in the control condition. However, among participants who decided to stop gambling, craving scores were higher for those in the control condition compared to those in the loss condition.

Discussion and conclusions

This study examined the interconnections among chasing behavior, gambling severity, craving, affective decision-making, and decisional styles in a sample of Italian habitual gamblers. The results showed that craving significantly predicted chasing behavior. Moreover, the study revealed that individuals with a dependent decision-making style were less inclined to engage in chasing behavior. Interestingly, while affective decision-making contributed to chasing frequency, it was not associated with the decision to stop or continue playing.

It is not surprising that some facets of craving play a crucial role in chasing, as craving to gamble consists of both the anticipation of enjoyment from wagering and an expectation of relief from negative affect derived from engaging in gambling ([21, 36]; see also [67]). Addiction theories (e.g., [29, 68]) suggest that the genesis of craving is associated with both positive and negative reinforcement. The excitement and thrill of gambling can act as a positive reinforcement for

continued gambling behavior, while gambling can also serve to escape or alleviate negative emotions, such as stress or anxiety, which can act as a negative reinforcement for gambling. In general, these findings support the notion that craving is a common feature of many forms of addiction and can be considered a transdiagnostic risk factor for unhealthy behaviors [69].

Partially consistent with our hypotheses, we observed that poor performance on the IGT correlated with a higher frequency of chasing behavior, but it was not associated with the decision to stop or continue gambling. Although the repeated measures analysis did not yield a significant effect of group (nonchasers versus chasers) after inserting the GACS scores as covariates, this finding dispels any doubts regarding whether participants randomly selected cards from the decks or lacked the ability (or willingness) to learn from the IGT trials. These outcomes suggest that the desire for both positive and negative emotional experiences associated with gambling (craving) might outweigh the influence of emotional decision-making when it comes to the choice to continue gambling. However, if craving triggers the choice to continue playing, the dependent decision-making style appears to counteract this tendency.

As regression analyses indicated, while there was no significant difference in the decision to chase across experimental conditions, participants in the loss condition exhibited a higher chasing frequency. This may suggest that optimistic beliefs about future outcomes motivated participants to continue playing, regardless of the number of losses they had already experienced. In the ChasIT task, chasing after the first phase of the game may not be immediately harmful, particularly in the control condition where the participant's budget has not been depleted and the prospect of winning is still plausible. However, the issue of frequency of chasing is more concerning, as it suggests a lack of ability to stop gambling at the appropriate time and may indicate a failure to adopt long-term beneficial strategies [70].

In exploring the role of decisional styles, we were surprised to find that the Dependent dimension of the GDMS emerged as a significant albeit weaker predictor of chasing behavior, while the other four decisional styles, which were theoretically considered more relevant, did not show a significant association with chasing. Specifically, our results revealed that individuals characterized by a dependent style were less inclined to engage in chasing. This suggests that such individuals may experience discomfort or distress when faced with making decisions independently [71].

Given that the dependent style is characterized by the search for and reliance on the advice of others when making decisions, it is not surprising that when performing a decision-demanding task, such as the ChasIT, dependent individuals would rather give up than continue playing. If so, the dependent style could represent a protective factor for chasing. Note that some authors reported positive associations between the rational and the dependent style (e.g., [72–74]), probably because an effort to seek advice from other people is part of a rational process [75]. Alternatively, it may be that individuals characterized by a dependent style are less confident in their ability to decide, mostly when time or resources are scarce when making decisions [53]. So, avoiding decisions in the absence of external support in some contexts, including gambling, may have an unexpected positive effect since it counteracts the negative impact of chasing or persistence in gambling. Put differently, the dependent style could be dysfunctional in situations in which people are requested to make good and quick decisions, but functional if the decision involves some risk. In essence, a decision-making style is the response pattern exhibited by an individual in a decision-making situation. This pattern depends on the decision-making situation, the decision-making task, and the decision-makers. Indeed, as stressed by Thunholm [71], "Individual differences between decision makers include differences in habits but also differences in basic cognitive abilities such as information processing, self-evaluation and self-regulation, which have a consistent impact on the response pattern across different decision-making tasks and situations" (p. 941).

Overall, our findings are consistent with previous studies, meta-analyses, reviews, and theoretical models (e.g., [76, 77]) assuming craving as a component of the core mechanisms involved in behavioral addictions (e.g., [34, 38]) and support further prior evidence about the crucial role of affective decision-making in chasing behavior [22].

Contrary to what was predicted, in both regression analyses gambling severity was not included in the final models, suggesting that chasing "may constitute a distinct entity or level of severity within pathological gambling" ([70], p. 43). This may be due to differences in their underlying cognitive and motivational factors. Chasing during gambling play is still a partially unexplored issue in terms of its underlying intrinsic motivations (for a few exceptions, see [10, 11]). However, research has identified two cognitive biases related to gambling, namely the gambler's fallacy and the hot-hand fallacy, which could encourage individuals to continue playing [12, 78]. Indeed, the more people believe that wins are more likely to occur after a series of losses or that previous wins increase the chances of future success, the more likely they engage in chasing. The pathways model proposed by Blaszczynski and Nower [8] posits that once an individual develops a pattern of habitual gambling, the

excitement of gambling and irrational beliefs about the probability of winning may contribute to both chasing losses and chasing wins, regardless of the initial reasons for starting gambling.

For individuals who engage in chasing behavior, withdrawing from gambling may be perceived as "kicking the luck", and continuing to gamble may serve to alleviate cognitive tension generated by incomplete tasks, as postulated by the Zeigarnik effect [79]. McCown and Chamberlain [15] suggested that when a gambler plays to win but ends up losing, it creates a sense of unfinished business, which motivates the gambler to return and complete the task. Additionally, tempting fate by continuing to gamble instead of giving up may serve to avoid possible future regret (e.g., [80–82]).

The study's findings suggest that individuals with a dependent decision-making style, coupled with the capacity to make advantageous choices amid uncertainty, can potentially attenuate the adverse impact of craving on chasing behavior among habitual gamblers. As our results showed that gambling severity did not play a leading role in chasing, it raises the possibility that the SOGS may not fully capture gambling severity. Alternatively, it could be that, all other things being equal, chasers and nonchasers belong to two quite distinct categories of gamblers, as observed in previous studies ([11, 12, 21, 25, 26, 83] see also [3]). The study also suggests that reducing craving and promoting more adaptive decision-making processes could contribute to mitigating chasing proneness. Besides, considering the marginal role of gambling severity in chasing, even if the latter is a diagnostic criterion for GD, a promising avenue in the clinical treatment of the disorder could be to calibrate the intervention according to different subtypes of gamblers, including nonchasers and chasers.

Future research endeavors should not only prioritize a comprehensive exploration of individual differences in loss-chasing [2] but also broaden investigations to encompass both normative and clinical populations. Another area of future research should focus on the role of emotional regulation, specifically positive reappraisal, in chasing behavior. Chasers may indeed use this adaptive emotional regulation strategy to sustain their involvement in gambling (about the role of emotion (dys)regulation in gambling disorder, see Velotti et al. [84]). Finally, we emphasize the importance of including adolescents and older individuals in future chasing research, as these demographics have been largely overlooked in previous studies and thus merit closer examination. In line with Banerjee et al. [2], we contend that future research efforts should focus on refining the definition of chasing. This would assist, among other objectives, in distinguishing between persistence in gambling and chasing in the strict sense, and in enhancing the precision of the behavioral tasks employed to measure chasing and/or persistence in gambling. Finally, future research should prioritize investigating between-session chasing, with a specific focus on both chasing after wins and losses, as well as the characteristics of gamblers who engage in chasing behaviors [85].

Limitations

While there were several strengths to this study, such as the large sample size and the use of behavioral tasks to assess chasing and affective decision-making, there were also some potential limitations that should be acknowledged. First, the participants were recruited using a convenient sampling of Italian habitual gamblers. Second, decision-making styles were evaluated through a self-report measure, which may limit the generalizability of the results. Lastly, gambling severity was assessed using the SOGS, a measure that has been subject to criticism, mostly because it has been found to overestimate the prevalence of pathological gambling [25]. However, it is worth noting that in this study SOGS score served as a research screen and not as a tool for individual diagnosis and that the SOGS performs well when used dimensionally [83, 86]; see also [87]). Another limitation is that our sample was nonclinical in nature, so no valid conclusions concerning patients suffering from gambling addiction can be drawn. However, just because the interactions among the variables of interest were detected in a nonclinical sample suggests that these effects might be even stronger in disordered gamblers.

Beyond that, the primary limitation of this study concerns the ecological validity of the two behavioral tasks used to evaluate affective decision-making and chasing behavior, as participants did not receive any compensation for their involvement in both the IGT and the ChasIT. Nevertheless, concerning the IGT, numerous studies have shown that participants' performance does not significantly differ between those who play with real money and those who do not (for a comprehensive review, refer to [11]). Furthermore, as noted by Weatherly and Meier [88], research findings on gambling that do not involve participants risking real money may still be relevant to real-world gambling scenarios. Nonetheless, caution must be exercised when generalizing such findings, as there is a potential risk of overestimating individuals' willingness to undertake risks. In the context of assessing chasing behavior, it's worth highlighting that in a study exploring the impact of motivation on chasing behavior using the ChasIT, participants were asked to elucidate their reasons for either halting or continuing play. Across three experimental conditions (Control, Loss, and Win), only a small fraction of participants cited the virtual

currency's nature as a decisive factor in their decision to either discontinue or extend their involvement [11].

In conclusion, despite these limitations, the present study is noteworthy for being the first to investigate the complex relationship between chasing, gambling severity, craving, affective decision-making, and decisional styles among adult habitual gamblers, providing a more comprehensive understanding of the factors that contribute to chasing behavior.

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Authors' contributions
MCo and GN: Conceptualization, Methodology, Software. MCi: Literature searches, summary of previous research studies. BP and MS: Data curation, Investigation. GN and MCo: Statistical analyses. MCo, SJM, and FFA: Writing - Review & Editing. GN: Supervision.

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Availability of data and materials
The data that support the findings of this study are available from the corresponding author, Marina Cosenza, upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Approval was obtained from the ethics committee of the University of Campania "Luigi Vanvitelli". The procedures used in this study adhere to the tenets of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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