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1 **The transition time to gambling disorder: The roles that age, gambling**
2 **preference and personality traits play**

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Abstract

Background and aims: Gambling Disorder (GD) is considered a heterogeneous, multidimensional pathology with high personal and social consequences. The transition time (TT) between problematic gaming and pathological gambling, which varies significantly across patients, may predict the disorder's severity. As only limited studies have investigated the factors implicated in the TT, the current study set out to identify its predictors and their relationships with GD severity.

Methods: Correlation were performed in 725 male GD patients to identify factors associated to TT and GD severity, including: age of onset of gambling behaviors, alcohol/drug use, personality traits and gambling preferences (i.e., strategic, non-strategic, and mixed). Then a regression analysis was performed to identify predictors of TT to GD.

Results: Longer TT correlated with higher GD severity, early age of onset of problematic gambling, substance use and a non-strategic gambling preference. Personality traits including low self-directedness, high novelty seeking, and low cooperativeness were also related with longer TT. The strongest associations with GD severity were substance use, and some of the personality traits (i.e., low self-directedness and cooperativeness, high harm avoidance and self-transcendence). Factors significantly predicting longer transition to GD were older ages, low self-directedness, and non-strategic gambling.

Conclusions: A clinical profile characterized by a longer TT and more severe GD symptoms pertains to older patients with low self-directedness, and preference for non-strategic gambling. Other relevant factors associated with this profile of patients included early age of onset problematic gambling, substance consumption, high novelty seeking and low cooperativeness.

Keywords: gambling disorder, transition time, personality traits, self-directedness, substance use

23

1 **1. Introduction**

2 Gambling disorder (GD) has been defined as a persistent, recurrent maladaptive gambling behavior
3 that has a negative impact on an individual's occupation, relationships, psychological health and
4 other quality of life domains (APA, 2013). The time lapse between the development of a
5 problematic form of gambling to the time he/she satisfies the criteria for GD as outlined in the fifth
6 edition of the DSM-5, has been defined as transition time (TT) to GD. While cultural and individual
7 variables may explain the risk for exposure to gambling behaviours (McComb & Sabiston, 2010),
8 little is known about the factors that affect the duration of TTs (Bruneau et al., 2016; Clarke et al.,
9 2006).

10 Sociodemographic variables such as gender have been shown to affect TT. Several studies
11 suggested that females compared to males tend to show a later initial engagement in gambling
12 behaviors but a faster progression in the development of an addictive disorder, which has been
13 defined as "telescopic phenomenon" (Grant et al., 2012; Ladd & Petry, 2002; Slutske et al., 2015;
14 Zakiniaez et al., 2017). The age of gamblers as well as the age gambling onset varies significantly;
15 in some cases the initial exposure can take place during childhood while in others it occurs during
16 adolescence or adulthood (Kessler et al., 2008). Since both chronological age and age at onset of
17 gambling have been linked to different gambling patterns (Jiménez-Murcia et al., 2010, 2016), these
18 variables may also affect the TT as well the treatment-seeking time (Shin et al., 2014). Several other
19 factors including some personality traits and substance use patterns have been linked to gambling
20 behaviors and could potentially affect the TT.

21 Alcohol and drug abuse have long been associated to gambling, and just as a high prevalence of
22 comorbidity between GD and substance use disorders has been noted in clinical and community-
23 based samples (Lorains et al., 2011; Singer et al., 2020), pathological gamblers show a high
24 prevalence of drug abuse and/or problem drinking (Barnes et al., 2015). Interestingly, some studies
25 have noted that substance use and behavioral addictions share common features given their similar

1 psychological and neurobiological underpinnings (Balodis & Potenza, 2020; Pettorruso et al., 2019;
2 Pettorruso, Zoratto, et al., 2020; Shaffer et al., 2004; Singer et al., 2020). In fact, some have
3 theorized that substance use and gambling could be different expressions of a common vulnerability
4 to addiction. Alcohol and substance use are, moreover, considered risk factors for the development
5 of GD (Shead et al., 2010; Welte et al., 2004), and, social gamblers with a parallel pattern of drug
6 abuse or problem drinking seem to be particularly vulnerable to GD. Substance use could thus be
7 seen as a factor that could affect the TT since it augments the severity of the disorder by
8 exacerbating cognitive distortions and feelings of loss of control.

9 As far as psychological factors are concerned, some personality traits have been linked to a
10 higher vulnerability to GD (Odlaug & Chamberlain, 2014). A widely adopted measure of
11 personality is the Temperament and Character Inventory (TCI), derived from the Cloninger's
12 psychobiological model (Cloninger, 1994). It is designed to provide a comprehensive evaluation of
13 normal and maladaptive individual differences and its dimensions are closely linked to those of the
14 five-factor model of personality (Svrakic et al., 1993). According to the model, both genetic and
15 environmental factors affect the development of a personality vulnerability that could lead, in turn,
16 to the onset of an addictive disorder (Cloninger et al., 1993; Pettorruso, Valle, et al., 2020).
17 Researchers using the TCI in the context of behavioral addictions (Álvarez-Moya et al., 2007;
18 Janiri, Martinotti, Dario, Schifano, & Bria, 2007; Jiménez-Murcia et al., 2013) identified some
19 personality traits related to GD, including: high-novelty seeking, which refers to the tendency to
20 seek out new stimuli and experiences, to be easily bored, impulsive, inclined to avoid monotony;
21 low cooperativeness, characterizing self-absorbed intolerant and opportunistic individuals, primarily
22 looking out for themselves; low self-directedness, conceptually related with external locus of
23 control, reflecting the lack of self-determination and low ability to direct one's own life according
24 to personal goals and values. These personality traits may predispose an individual to exacerbate the
25 clinical presentation GD and hypothetically impact the TT by determining the degeneration from
26 problematic gambling to pathological gambling (Martinotti et al., 2006).

1 While gambling is considered a rather heterogeneous disorder (Álvarez-Moya et al., 2010;
2 Calado & Griffiths, 2016; Granero et al., 2020; Jiménez-Murcia et al., 2019), two distinct subgroups
3 based on gambling preferences have been identified: strategic gambling preference (e.g., poker,
4 blackjack, dog and horse racing, sports betting), which refer to betting systems in which individual
5 skills or knowledge of the game can affect the outcome, and non-strategic gambling preferences
6 (e.g., slot machines, pull tabs, bingo), which refer to betting systems involving little or no decision
7 making or skill with the outcome depending basically on chance (Moragas et al., 2015; Odlaug et
8 al., 2011). Different gambling profiles have been linked to gambling preferences (Jiménez-Murcia,
9 Granero, Fernández-Aranda, & Menchón, 2020): some studies suggest that strategic gamblers show
10 higher levels of psychopathology, cognitive distortions and more severe GD symptoms (Lévesque
11 et al., 2017; Moragas et al., 2015; Mouneyrac et al., 2018), while others have reported that non-
12 strategic gamblers show more severe gambling addiction (Ronzitti et al., 2016). It has been
13 hypothesized that the time lapse between gambling onset and the development of GD is another
14 feature that can vary across gambling preferences. According to some studies, the non-strategic
15 gamblers who prefer slot-machines (Breen & Zimmerman, 2002) and electronic gambling machines
16 (Khanbhai et al., 2017) show a faster progression to GD, and consequently faster treatment-seeking,
17 than the non-strategic gamblers who prefer lotteries and bingo games. Few studies until now have
18 explored the differences in TT patterns between strategic and non-strategic gamblers and their
19 associations with GD severity.

20 The aims of the current study were to assess the predictors of TT in a large sample of male GD
21 patients and to analyze their associations with the severity of the symptoms as defined by the DSM-
22 5 criteria. Using this theoretical framework as our starting point, we hypothesized that an earlier
23 onset of problematic gambling is associated with a longer TT, a more chronic condition, and more
24 severe symptoms. Secondly, we explored the impact of different gambling preferences and
25 personality traits on TT; we predicted that some personality traits frequently linked to GD (e.g., low
26 self-directedness; high novelty seeking) and a non-strategic gambling preference could be

1 associated to a longer TT and more severe symptoms. Finally, we analyzed the co-occurrence of
2 problem drinking or drug abuse and gambling behaviors and predicted that one of the following
3 scenarios would emerge: more severe alcohol/drug addiction accelerates the progression to GD or,
4 alternatively, substance use is an expression of the same vulnerability to addictive behaviors. In the
5 latter case, it would not directly affect TT. In both cases, substance use is expected to be correlated
6 to a more severe clinical profile.

7

8 **2. Methods**

9 *2.1. Participants*

10 The sample consisted of 725 male patients diagnosed with GD in accordance with the DSM-5
11 criteria (APA, 2013) who were consecutively admitted for treatment of GD to the Gambling
12 Disorder Unit in the Psychiatry Department of the Bellvitge University Hospital in Barcelona
13 (Spain). The participants were enrolled between October 2014 and July 2018. Their diagnoses were
14 formulated by specialized psychologists and psychiatrists who had more than 15 years of clinical
15 experience. Only patients who sought treatment for GD as their primary mental health concern and
16 who met DSM-5 criteria for GD (APA, 2013) were included in our sample.

17 *2.2. Measures*

18 *2.2.1. Semi-structured clinical interview*

19 A semi-structured clinical interview (self-report format) was adopted to register sociodemographic
20 characteristics and some of the gambling related variables. Preferences for strategic or non-strategic
21 gambling were collected by asking for which type of gambling the person look for a treatment. This
22 comprised a list of a variety of gambling forms, including those considered as strategic (e.g. slot
23 machines, pull tabs, bingo etc) and non-strategic (e.g. poker, blackjack, dog and horse racing, sports
24 betting). Given that some patients were prone to engage with more than one form of gambling,
25 those cases were considered as “mixed” gambling preferences. The age at onset of problematic
26 gambling behaviors was collected by asking the patient: “when did you start perceiving your

1 gambling behavior as problematic?”. The time lapse between the development of a problematic
2 form of gambling to the time he/she satisfies the criteria for GD as outlined in the fifth edition of
3 the DSM-5, has been defined as transition time (TT) to GD.

4 2.2.2. *GD severity: Diagnostic Questionnaire for Pathological Gambling* (Stinchfield, 2003)

5 Stinchfield’s 19-item diagnostic questionnaire based on DSM-5 criteria (APA, 2013) assess the
6 presence of GD; the Spanish version of the scale showed good psychometric properties ($\alpha = 0.81$
7 calculated for the general population and $\alpha = 0.77$ for clinical populations) (Jiménez-Murcia et al.,
8 2009). The committee responsible for GD in the DSM-5 defined the count of criteria as a measure
9 of the intensity of the individual’s gambling activity, and it included a operationalized classification
10 in five ordered groups: no-gambling activity (0 criteria), problematic gambling (1-3 criteria), low
11 GD (4-5 criteria), moderate GD (6-7 criteria) and severe GD (8-9 criteria). In our study, we used the
12 sum of the DSM-5 criteria/symptoms as a measure of the GD severity within a continuum ranging
13 from 4 to 9. This measure has been successfully applied for other substance use disorders (Dawson
14 et al., 2010; Hasin et al., 2013), and studies focused on GD have also reported the validity of this
15 construct in gamblers selected from population-based samples and in GD patients selected from
16 clinical settings (Grant et al., 2017; Slecicka et al., 2015).

17 2.2.3. *Alcohol Use Disorders Identification Test (AUDIT)* (Saunders et al., 1993)

18 Developed as a simple method to screen for excessive alcohol consumption, the 10-item test
19 focuses on the frequency of drinking behavior, symptoms of dependence, and alcohol-related
20 consequences. Its internal consistency has been found to be high, its test–retest reliability is high
21 (0.86), and its sensitivity is approximately 0.90. Its specificity in different settings and for different
22 criteria averages 0.80 or more (Martínez Delgado, 1996). The cutoff points of 8 and 20 were
23 respectively used here to identify individuals with problem drinking or alcohol use disorders
24 (Reinert & Allen, 2002).

25 2.2.4. *Drug Use Disorders Identification Test (DUDIT)* (Berman et al., 2005)

1 The 11-item screening instrument was developed to identify non-alcohol substance-related
2 problems in the general public as well as in patients in clinical settings who probably meet the
3 criteria for a substance abuse and dependence. The first nine items are scored on a 5-point Likert
4 scale ranging from 0 to 4, and the last two are scored on 3-point scales (values of 0, 2, 4). Total
5 possible scores range between 0 and 44; higher scores are indicative of a more severe drug problem.
6 A score of 0–5 is generally considered indicative of a no substance-related situation, a score
7 between 6 and 24 is considered indicative of a possible substance-related problem or dependence,
8 and scores ≥ 25 are considered indicative of a probable substance use and dependency problem
9 (Berman et al., 2005; Hildebrand, 2015).

10 2.2.5. *Temperament and Character Inventory-Revised (TCI-R)* (Cloninger, 1999)

11 The 240-item inventory, which uses a five-point Likert scale format, intends to measure four
12 temperament dimensions (Harm Avoidance, Novelty Seeking, Reward Dependence and
13 Persistence) and three-character dimensions (Self-Directedness, Cooperativeness and Self-
14 Transcendence) of personality. According to Cloninger’s psychobiological theory of personality,
15 the characters are shaped more by the environment during adulthood, while the temperaments
16 manifest themselves earlier in childhood and show stronger heritability. The Spanish revised
17 version used in this study (Gutiérrez-Zotes et al., 2004) showed adequate internal consistency
18 (Table 1 includes Cronbach’s alpha; the mean value for novelty seeking was 0.71 and for
19 persistence it was 0.88).

20 2.3. *Procedure*

21 All the measures analyzed in the study correspond to the assessment at the arrival of patients at
22 the treatment setting, before starting the therapy. The information of the semi-structured clinical
23 interview was collected by psychologist and psychiatrists with extensive experience in behavioral
24 addictions, who helped the patients to complete the questionnaires (guaranteeing that the items were
25 all answered and that no problems had occurred due to lack of understanding).

1 The Ethics Committee for Clinical Trials of the Bellvitge University Hospital approved the study
2 design, and written informed consent was obtained from all the participants before the research was
3 initiated. The study was carried out in accordance with the latest version of the Declaration of
4 Helsinki.

5 *2.4. Statistical analyses*

6 The categorical variables were compared using chi-square tests (χ^2), and the quantitative
7 variables were compared using analysis of variance (ANOVA). The standardized Cohen's-*d*
8 coefficient was used to analyze the effect size of the proportion of variance and the mean
9 differences of these analyses (the effect size was considered null for $|d| < 0.20$, low-poor $|d| > 0.20$,
10 mild-medium for $|d| > 0.50$ and large-high for $|d| > 0.80$) (Kelley & Preacher, 2012).

11 Linear regression analysis was used to obtain a simple model with the variables statistically
12 related to the TT. Stepwise method was employed for automatically selecting the best subset of
13 predictors from the set of variables analyzed in the study: the patients' age, gambling preference
14 (strategic, non-strategic or mixed), personality traits (TCI-R scores) and substance use pattern
15 (AUDIT and DUDIT total scores). Stepwise constitutes a method of fitting regression based in the
16 choice of potential predictive variables through an automatic procedure in which each step of the
17 fitting process assesses the variables considering inclusion/subtraction based on pre-specified
18 criteria. This method has been largely used in clinical and research areas, as well as in community
19 health, since final fitted models alerts about potential risk factors that could impact on specific
20 outcomes (for example to identify at-high-risk patients), supports for developing clinical decision
21 plans or even provide early signs of health changes. In our study, the R-squared coefficient (R^2) was
22 used to evaluate the predictive capacity of the final selected model (values of 0.01, 0.06, and 0.14
23 were respectively considered: low-poor, mild-medium, and large-high effect size) (Levine &
24 Hullett, 2002).

25 All the statistical analyses were carried out using Stata 16 for windows software (StataCorp,
26 2019).

1

2 **3. Results**

3 *3.1. Characteristics of the sample*

4 Table 1 outlines the participants' demographic features and their mean scores on the
5 psychometric tests. Most of the participants achieved primary (56.7%) or secondary (37.7%)
6 educational levels, were single (48.3%) or married (37.9%), pertained to middle-low to low social
7 position indexes (85.7%), and were employed (62.3%). Their mean age was 40.8 years (SD=13.1),
8 the mean age of gambling onset was 28.5 years (SD=11.2) and the mean TT value was 6.5 yrs
9 (SD=6.6). Regarding gambling severity level, mean number of DSM-5 criteria for GD was 7.3
10 (SD=1.5) [$n=38$ (5.2%) participants met 4 criteria, $n=76$ (10.5%) 5 criteria, $n=106$ (14.6%) 6
11 criteria, $n=141$ (19.4%) 7 criteria, $n=145$ (20.0%) 8 criteria, and $n=219$ (30.2%) 9 criteria].

12 --- Insert Table 1 ---

13 *3.2. Substance use patterns in the different age groups and in connection with the gambling 14 preference*

15 Table 2 outlines the percentages of participants divided into three age groups who fell into
16 different levels of risk of alcohol or drug use and the percentages of gambling preference (strategic,
17 non-strategic, mixed) (See also Figure S1, supplementary material). The older age group reported
18 the lowest prevalence of alcohol use ($\chi^2=22.1$, $df=8$, $p=.005$) and other illegal drugs use ($\chi^2=43.3$,
19 $df=4$, $p<.001$). The likelihood of non-use of alcohol was also higher among non-strategic gambling
20 addiction ($\chi^2=36.8$, $df=8$, $p<.001$), while the non-use of drugs achieved the highest prevalence in the
21 groups defined by only non-strategic and only strategic gambling preference ($\chi^2=8.8$, $df=4$, $p=.046$).

22 --- Insert Table 2 ---

23 *3.3. The transition time in the substance use risk groups*

24 Table 3 outlines the means of the TTs in the different risk level groups of alcohol and drug use
25 according to ANOVA adjusted for age (see also Figure 1). Regarding alcohol use, the pairwise

1 comparisons showed that compared to non-users, longer TT was related to high risk of problem
 2 drinking (mean difference MD=2.3, $p=.046$) and addiction (MD=2.6, $p=.030$). Addictive alcohol
 3 use also obtained longer TT compared to low use (MD=2.65, $p=.021$) and medium risk (MD=2.8,
 4 $p=.019$). Regarding other illegal drugs use, TT was also longer for high risk consumers compared to
 5 non-users (MD=1.6, $p=.021$).

6 --- Insert Table 3 ---

7 --- Insert Figure 1 ---

8 *3.4. Correlation analysis*

9 Table 4 includes the correlation matrix for the variables of the study (partial correlations adjusted
 10 by age are reported). The strongest associations with TT was for self-directedness (lower level in
 11 this trait is related with longer TT, $R=-.12$), drugs consumption (higher use related with longer TT,
 12 $R=.10$), novelty seeking (higher level related to longer TT, $R=.09$), gambling subtype (non-strategic
 13 gambling associated to longer TT, $R=-.09$), cooperativeness (lower level related to longer TT,
 14 $R=-.08$) and alcohol consumption (higher use-abuse related to longer TT, $R=.07$). The strongest
 15 relationships with gambling severity were for self-directedness (lower level related with more
 16 severe gambling, $R=-.43$), harm avoidance (higher level related to higher severity, $R=.26$),
 17 cooperativeness (lower level related with higher severity, $R=-.24$), novelty seeking (higher level
 18 related with higher severity, $R=.22$), self-transcendence (higher level related to higher severity,
 19 $R=.22$), alcohol consumption (more use-abuse related with higher severity, $R=.20$) and drugs
 20 consumption (more use-abuse related with higher severity, $R=.17$).

21 --- Insert Table 4 ---

22 *3.5. Predictive model for TT the*

23 The final stepwise linear regression obtained using a stepwise procedure indicated that a longer
 24 TT is related to older aged individuals ($B=0.12$, $p<.001$), patients who reported preference for non-
 25 strategic compared to strategic gambling ($B=2.15$, $p<.001$) or mixed compared to strategic

1 gambling ($B=2.4, p=.004$), and those with lower scores on the self-directedness personality trait
2 ($B=-0.04, p=.001$).

3 --- Insert Table 5 ---

4 **4. Discussion**

5 The current study set out to evaluate the predictors of the transition time (TT) between problematic
6 gambling and gambling disorder (GD) in a large sample of GD patients and their associations with
7 GD severity. Longer TT was associated GD severity, early age of onset of problematic gambling,
8 substance use, non-strategic gambling preferences, and some of the personality traits (low self-
9 directedness and cooperativeness, high novelty seeking). The severity of GD was associated with
10 substance use, high harm avoidance and self-transcendence personality traits. The regression model
11 allowed identifying significant predictors of TT to GD, showing that patients with longer
12 progression were those with older ages, non-strategic gambling preference and low self-
13 directedness.

14 First, the association observed between TT and gambling severity may suggest that patients with
15 longer progression to GD present more chronic and severe symptoms once the diagnostic criteria
16 for the disorder are reached, which usually correspond to the moment at which they seek for
17 treatment. This profile of patients showing longer TT was further characterized by specific
18 personality traits, gambling preferences and substance use pattern.

19 As far as personality traits are concerned, the most relevant outcome was the strong association
20 between lack of self-directedness and longer TT (and more severe GD symptoms). In fact, this was
21 the only personality traits predicting the progression to the disorder. Some researchers have reported
22 low self-directedness in GD patients (Forbush et al., 2008; Janiri et al., 2007; Jiménez-Murcia et al.,
23 2019), which could reflect an inability to make decisions and to set goals as well as a lack of
24 purposefulness. In line with our results another study reported high self-directedness to be
25 correlated to less severe GD symptoms and lower general psychopathology (Moragas et al., 2015).

1 Low self-directedness character trait could hypothetically facilitate sporadic, prolonged exposure to
2 addiction-related behaviors (e.g., substance use, gambling) leading to a longer TT and greater
3 chronicity. Another possible explanation of these results could be related to the tendency of
4 individuals with low self-directedness to procrastinate in seeking treatment or in renewing their
5 efforts to seek or follow treatment guidelines due to their lack of planning and purposefulness.
6 These findings would suggest the relevance of applying treatment approach to improve decision
7 making and planning skills, especially in individuals scoring low on self-directedness.

8 Although not directly predicting TT to GD, other personality traits emerged from correlational
9 analysis. High novelty seeking, which has been associated to initial exposure to gambling behavior
10 (Martinotti et al., 2006), seems here to be also related with longer progression to GD and more
11 severe symptoms. This is possibly explained by the fact that patients with high novelty seeking are
12 impulsive individuals with lack of planning who may tend to postpone treatment seeking. Longer
13 TT and more severe symptoms were also related with low cooperativeness that is typical of low
14 empathetic and self-absorbed individuals who primarily look out for themselves. Thus, it could be
15 that these patients are less prone to recognize their gambling as problematic, despite of the external
16 pressure (e.g., family, partner) for seeking treatment. In addition, severity of the GD was
17 specifically related to high harm avoidance and self-transcendence. This is in line with studies
18 showing these personality traits, in more severe GD patients who tend to use gambling as a
19 dysfunctional mechanism to avoid problems and regulate emotions (Jiménez-Murcia et al., 2019).

20 When considering gambling preferences, non-strategic or mixed ones predicted longer TT to
21 GD. Non-strategic gambling preferences are usually reported in older individuals selecting low-skill
22 chance-based games (Jiménez-Murcia et al., 2020; Nower & Blaszczynski, 2008). In the present
23 study, older age is another predictor of longer TT, and it is possible that older patients with non-
24 strategic gambling preferences are those exhibiting also longer progression to GD. By contrast, the
25 severity of GD was not associated with gambling preferences. Some studies in the literature
26 reported association between gambling preferences and GD severity (Ronzitti et al., 2016), even

1 though this potential association should be assessed with caution (Jiménez-Murcia et al., 2020).
2 Indeed, others factors rather than gambling preferences, such as the level of gambling involvement,
3 have been more consistently related with GD severity (LaPlante et al., 2011).

4 Finally, even though substance use did not predict TT to GD, patients with problem drinking or
5 illicit drug use were characterized by longer TT to GD and more severe GD symptoms. Although
6 this may be counter-intuitive, it concords with the hypothesis that substance use and gambling both
7 represent maladaptive behaviors adopted interchangeably to obtain positive affective states or to
8 relieve negative ones (Estévez et al., 2017; Jauregui et al., 2016; Rash et al., 2016; Spano et al.,
9 2019). In fact, simultaneous substance use and gambling may be different expressions of the same
10 vulnerability to addictive behaviors, as recently suggested (Balodis & Potenza, 2020). Thus, the
11 tendency to switch or shift between addictions that has been described also in previous works (Di
12 Nicola et al., 2015), may contribute to a slower and more progressive development of GD and
13 delaying treatment seeking for gambling related problems, even though is associated with more
14 severe symptoms once meeting the criteria for GD. Interestingly, our analysis also uncovered very
15 different profiles of substance use in the different age groups, with older ages characterized by a
16 lower risk for alcohol and substance use. Patients' age is a variable which has been shown to
17 influence personality and psychopathology in GD (Granero et al., 2013), with different phenotypes
18 characterizing older gamblers (Granero et al., 2019).

19 These results have important implication in the clinical context of GD, suggesting the
20 identification of a clinical profile of patients showing longer TT to GD. This pertains to older
21 patients with non-strategic gambling preferences and low self-directedness. Furthermore, other
22 relevant factors including early age of onset problematic gambling, substance consumption and
23 certain personality traits (i.e., elevated novelty seeking and lack of cooperativeness), were
24 associated with this profile of patients with later identification of the disorder and consequently
25 delayed treatment seeking. Characterizing different clinical groups based on their TT to GD may

1 help to develop specific prevention and treatment approaches. Our findings underline the urgency of
2 assisting gamblers, in particular those with longer transition time to GD which has been shown to
3 be more severe and chronic patients.

4 The findings reported here must, of course, be interpreted in light of the study's limitations. First,
5 although we have information about the participants' substance use at the time of their inclusion in
6 the study we know nothing about it before they sought treatment. The fact that we have no
7 information about that time period does not permit us to speculate on if or how past abuse might be
8 involved in the disorder's pathophysiology. Moreover, the distinctions between the time the
9 participant was first exposed to gambling as a recreational activity and when it became pathological
10 and between that moment and the time treatment was actively sought are vague, hard-to-define
11 variables that may have caused bias in our study. Nevertheless, these time periods vary greatly from
12 individual to individual and their duration might be important for predicting later patterns. Another
13 limitation that should be considered is related to gender differences in TT. Previous literature
14 consistently reported the "telescoping effect" of TT to GD in women, consisting in later onset of
15 initial engagement in gambling behaviors but a faster progression in the development of an
16 addictive disorder in women compared to man (Grant et al., 2012; Ladd & Petry, 2002; Slutske et
17 al., 2015; Zakiniaieiz et al., 2017). Unfortunately, a characterization of gender profiles in relation to
18 TT was not possible in the present study, since only male patients were included.

19 Finally, the study was performed exclusively actively seeking treatment patients, whereas
20 gamblers who have not yet reached the point of choosing to be treated may present a different
21 clinical profile, clearly warrant research. On the positive side, the sample was made up of almost
22 800 participants who were consecutively admitted to a tertiary center for diagnosis and treatment.

23 **5. Conclusions**

24 In conclusion, older ages, low self-directedness and preferences for non-strategic gambling
25 predicted a longer TT to GD, reflecting a more chronic condition. Future studies should focus on
26 learning more about the interrelationships between these variables in the effort to identify the

1 neurobiological, psychological and social risk factors and underlying mechanisms linked to the
2 development of GD that will point in the right direction towards appropriate treatment strategies.

3
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11
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14
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16 17 18 **References**

- 19 Álvarez-Moya, Eva M., Jiménez-Murcia, S., Granero, R., Vallejo, J., Krug, I., Bulik, C. M., &
20 Fernández-Aranda, F. (2007). Comparison of personality risk factors in bulimia nervosa and
21 pathological gambling. *Comprehensive Psychiatry*, *48*(5), 452–457.
22 <https://doi.org/10.1016/j.comppsy.2007.03.008>
- 23 Álvarez-Moya, Eva Ma, Jiménez-Murcia, S., Aymamí, M. N., Gómez-Peña, M., Granero, R.,
24 Santamaría, J., Menchón, J. M., & Fernández-Aranda, F. (2010). Subtyping Study of a
25 Pathological Gamblers Sample. *The Canadian Journal of Psychiatry*, *55*(8), 498–506.
26 <https://doi.org/10.1177/070674371005500804>
- 27 APA. (2013). *American Psychiatric Association. Diagnostic and Statistical Manual of Mental*
28 *Disorders, Washington DC.*
- 29 Balodis, I. M., & Potenza, M. N. (2020). Common neurobiological and psychological
30 underpinnings of gambling and substance-use disorders. *Progress in Neuro-*
31 *Psychopharmacology and Biological Psychiatry*, *99*, 109847.
32 <https://doi.org/10.1016/J.PNPBP.2019.109847>
- 33 Barnes, G. M., Welte, J. W., Tidwell, M.-C. O., & Hoffman, J. H. (2015). Gambling and substance
34 use: co-occurrence among adults in a recent general population study in the United States.
35 *International Gambling Studies*, *15*(1), 55–71. <https://doi.org/10.1080/14459795.2014.990396>
- 36 Berman, A. H., Bergman, H., Palmstierna, T., & Schlyter, F. (2005). Evaluation of the Drug Use
37 Disorders Identification Test (DUDIT) in Criminal Justice and Detoxification Settings and in a
38 Swedish Population Sample. *European Addiction Research*, *11*(1), 22–31.

- 1 <https://doi.org/10.1159/000081413>
- 2 Breen, R. B., & Zimmerman, M. (2002). Rapid Onset of Pathological Gambling in Machine
3 Gamblers. *Journal of Gambling Studies*, 18(1), 31–43.
4 <https://doi.org/10.1023/A:1014580112648>
- 5 Bruneau, M., Grall-Bronnec, M., Vénisse, J.-L., Romo, L., Valleur, M., Magalon, D., Fatséas, M.,
6 Chéreau-Boudet, I., Luquiens, A., Challet-Bouju, G., & Hardouin, J.-B. (2016). Gambling
7 transitions among adult gamblers: A multi-state model using a Markovian approach applied to
8 the JEU cohort. *Addictive Behaviors*, 57, 13–20.
9 <https://doi.org/10.1016/J.ADDBEH.2016.01.010>
- 10 Calado, F., & Griffiths, M. D. (2016). Problem gambling worldwide: An update and systematic
11 review of empirical research (2000–2015). *Journal of Behavioral Addictions*, 5(4), 592.
12 <https://doi.org/10.1556/2006.5.2016.073>
- 13 Clarke, D., Tse, S., Abbott, M., Townsend, S., Kingi, P., & Manaia, W. (2006). Key Indicators of
14 the Transition from Social to Problem Gambling. *International Journal of Mental Health and*
15 *Addiction*, 4(3), 247–264. <https://doi.org/10.1007/s11469-006-9024-x>
- 16 Cloninger, C. R. (1994). Temperament and personality. *Current Opinion in Neurobiology*, 4(2),
17 266–273. <https://doi.org/10.1192/bjp.150.4.443>
- 18 Cloninger, C. R. (1999). *The temperament and character inventory-revised*.
- 19 Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A Psychobiological Model of
20 Temperament and Character. *Archives of General Psychiatry*, 50(12), 975–990.
21 <https://doi.org/10.1001/archpsyc.1993.01820240059008>
- 22 Dawson, D. A., Compton, W. M., & Grant, B. F. (2010). Frequency of 5+/4+ Drinks as a Screener
23 for Drug Use and Drug-Use Disorders*. In *Stud. Alcohol Drugs* (Vol. 71).
- 24 Di Nicola, M., Tedeschi, D., De Risio, L., Pettorruso, M., Martinotti, G., Ruggeri, F., Swierkosz-
25 Lenart, K., Guglielmo, R., Callea, A., Ruggeri, G., Pozzi, G., Di Giannantonio, M., & Janiri, L.
26 (2015). Co-occurrence of alcohol use disorder and behavioral addictions: relevance of
27 impulsivity and craving. *Drug and Alcohol Dependence*, 148, 118–125.
28 <https://doi.org/10.1016/j.drugalcdep.2014.12.028>
- 29 Estévez, A., Jáuregui, P., Sánchez-Marcos, I., López-González, H., & Griffiths, M. D. (2017).
30 Attachment and emotion regulation in substance addictions and behavioral addictions. *Journal*
31 *of Behavioral Addictions*, 6(4), 534–544. <https://doi.org/10.1556/2006.6.2017.086>
- 32 Forbush, K. T., Shaw, M., Graeber, M. A., Hovick, L., Meyer, V. J., Moser, D. J., Bayless, J.,
33 Watson, D., & Black, D. W. (2008). Neuropsychological characteristics and personality traits
34 in pathological gambling. *CNS Spectrums*, 13(4), 306–315.
35 <https://doi.org/10.1017/S1092852900016424>
- 36 Granero, R., Jiménez-Murcia, S., del Pino-Gutiérrez, A., Mena-Moreno, T., Mestre-Bach, G.,
37 Gómez-Peña, M., Moragas, L., Aymamí, N., Giroux, I., Grall-Bronnec, M., Sauvaget, A.,
38 Codina, E., Vintró-Alcaraz, C., Lozano-Madrid, M., Camozzi, M., Agüera, Z., Martín-Romera,
39 V., Sánchez-González, J., Casalé, G., ... Fernández-Aranda, F. (2019). Gambling Phenotypes
40 in Older Adults. *Journal of Gambling Studies*, 1–20. <https://doi.org/10.1007/s10899-019-09922-4>
- 41
- 42 Granero, R., León-Vargas, D., Martín-Romera, V., Fernández-Aranda, F., Mena-Moreno, T., del
43 Pino-Gutiérrez, A., Codina, E., Gómez-Peña, M., Moragas, L., Aymamí, N., Mestre-Bach, G.,
44 Agüera, Z., Vintró-Alcaraz, C., Lozano-Madrid, M., Casalé-Salayet, G., Menchón, J. M., &
45 Jiménez-Murcia, S. (2020). Clustering Gambling Disorder Patients with Lotteries as a
46 Preferred Form of Gambling. *Journal of Gambling Studies*, 1–13.
47 <https://doi.org/10.1007/s10899-020-09940-7>
- 48 Granero, R., Penelo, E., Stinchfield, R., Fernandez-Aranda, F., Savvidou, L. G., Fröberg, F.,
49 Aymamí, N., Gómez-Peña, M., Pérez-Serrano, M., del Pino-Gutiérrez, A., Menchón, J. M., &
50 Jiménez-Murcia, S. (2013). Is Pathological Gambling Moderated by Age? *Journal of*
51 *Gambling Studies*, 30(2), 475–492. <https://doi.org/10.1007/s10899-013-9369-6>

- 1 Grant, J. E., Odlaug, B. L., & Chamberlain, S. R. (2017). Gambling disorder, DSM-5 criteria and
2 symptom severity. *Comprehensive Psychiatry*, *75*, 1–5.
3 <https://doi.org/10.1016/j.comppsy.2017.02.006>
- 4 Grant, J. E., Odlaug, B. L., & Mooney, M. E. (2012). Telescoping phenomenon in pathological
5 gambling: Association with gender and comorbidities. *Journal of Nervous and Mental*
6 *Disease*, *200*(11), 996–998. <https://doi.org/10.1097/NMD.0b013e3182718a4d>
- 7 Gutiérrez-Zotes, J. A., Bayón, C., Montserrat, C., Valero, J., Labad, A., Cloninger, C. R., &
8 Fernández-Aranda, F. (2004). Temperament and Character Inventory-Revised (TCI-R).
9 Standardization and normative data in a general population sample. In *Actas Esp Psiquiatr*
10 (Vol. 32, Issue 1).
- 11 Hasin, D. S., O, C. P., Auriacombe, M., Borges, G., Kathleen Bucholz, S., Budney, A., Compton,
12 W. M., Thomas Crowley, M., Ling, W., Petry, N. M., Schuckit, M., & Grant, B. F. (2013).
13 Reviews and Overviews DSM-5 Criteria for Substance Use Disorders: Recommendations and
14 Rationale. In *Am J Psychiatry* (Vol. 170, Issue 8).
- 15 Hildebrand, M. (2015). The Psychometric Properties of the Drug Use Disorders Identification Test
16 (DUDIT): A Review of Recent Research. *Journal of Substance Abuse Treatment*, *53*, 52–59.
17 <https://doi.org/10.1016/J.JSAT.2015.01.008>
- 18 Janiri, L., Martinotti, G., Dario, T., Schifano, F., & Bria, P. (2007). The gamblers' Temperament
19 and Character Inventory (TCI) personality profile. *Substance Use and Misuse*, *42*(6), 975–984.
20 <https://doi.org/10.1080/10826080701202445>
- 21 Jauregui, P., Estévez, A., & Urbiola, I. (2016). Pathological Gambling and Associated Drug and
22 Alcohol Abuse, Emotion Regulation, and Anxious-Depressive Symptomatology. *Journal of*
23 *Behavioral Addictions*, *5*(2), 251–260. <https://doi.org/10.1556/2006.5.2016.038>
- 24 Jiménez-Murcia, Granero, R., Fernández-Aranda, F., & Menchón, J. M. (2020). Comparison of
25 gambling profiles based on strategic versus non-strategic preferences. In *Current Opinion in*
26 *Behavioral Sciences* (Vol. 31, pp. 13–20). Elsevier Ltd.
27 <https://doi.org/10.1016/j.cobeha.2019.09.001>
- 28 Jiménez-Murcia, Granero, R., Fernández-Aranda, F., Stinchfield, R., Tremblay, J., Steward, T.,
29 Mestre-Bach, G., Lozano-Madrid, M., Mena-Moreno, T., Mallorquí-Bagué, N., Perales, J. C.,
30 Navas, J. F., Soriano-Mas, C., Aymamí, N., Gómez-Peña, M., Agüera, Z., del Pino-Gutiérrez,
31 A., Martín-Romera, V., & Menchón, J. M. (2019). Phenotypes in Gambling Disorder Using
32 Sociodemographic and Clinical Clustering Analysis: An Unidentified New Subtype? *Frontiers*
33 *in Psychiatry*, *10*(MAR), 173. <https://doi.org/10.3389/fpsy.2019.00173>
- 34 Jiménez-Murcia, S., Stinchfield, R., Álvarez-Moya, E., Jaurrieta, N., Bueno, B., Granero, R.,
35 Aymamí, M. N., Gómez-Peña, M., Martínez-Giménez, R., Fernández-Aranda, F., & Vallejo, J.
36 (2009). Reliability, Validity, and Classification Accuracy of a Spanish Translation of a
37 Measure of DSM-IV Diagnostic Criteria for Pathological Gambling. *Journal of Gambling*
38 *Studies*, *25*(1), 93–104. <https://doi.org/10.1007/s10899-008-9104-x>
- 39 Jiménez-Murcia, Susana, Álvarez-Moya, E. M., Stinchfield, R., Fernández-Aranda, F., Granero, R.,
40 Aymamí, N., Gómez-Peña, M., Jaurrieta, N., Bove, F., & Menchón, J. M. (2010). Age of onset
41 in pathological gambling: Clinical, therapeutic and personality correlates. *Journal of Gambling*
42 *Studies*, *26*(2), 235–248. <https://doi.org/10.1007/s10899-009-9175-3>
- 43 Jiménez-Murcia, Susana, Granero, R., Fernández-Aranda, F., Stinchfield, R., Tremblay, J., Steward,
44 T., Mestre-Bach, G., Lozano-Madrid, M., Mena-Moreno, T., Mallorquí-Bagué, N., Perales, J.
45 C., Navas, J. F., Soriano-Mas, C., Aymamí, N., Gómez-Peña, M., Agüera, Z., del Pino-
46 Gutiérrez, A., Martín-Romera, V., & Menchón, J. M. (2019). Corrigendum: Phenotypes in
47 Gambling Disorder Using Sociodemographic and Clinical Clustering Analysis: An
48 Unidentified New Subtype? *Frontiers in Psychiatry*, *10*, 358.
49 <https://doi.org/10.3389/fpsy.2019.00358>
- 50 Jiménez-Murcia, Susana, Granero, R., Stinchfield, R., Fernández-Aranda, F., Penelo, E., Savvidou,
51 L. G., Fröberg, F., Aymamí, N., Gómez-Peña, M., Moragas, L., Del Pino-Gutiérrez, A.,

- 1 Fagundo, A. B., & Menchón, J. M. (2013). Typologies of young pathological gamblers based
2 on sociodemographic and clinical characteristics. *Comprehensive Psychiatry*, *54*(8), 1153–
3 1160. <https://doi.org/10.1016/j.comppsy.2013.05.017>
- 4 Jiménez-Murcia, Susana, Granero, R., Tárrega, S., Angulo, A., Fernández-Aranda, F., Arcelus, J.,
5 Fagundo, A. B., Aymamí, N., Moragas, L., Sauvaget, A., Grall-Bronnec, M., Gómez-Peña, M.,
6 & Menchón, J. M. (2016). Mediation Role of Age of Onset in Gambling Disorder, a Path
7 Modeling Analysis. *Journal of Gambling Studies*, *32*(1), 327–340.
8 <https://doi.org/10.1007/s10899-015-9537-y>
- 9 Kelley, K., & Preacher, K. J. (2012). On effect size. *Psychological Methods*, *17*(2), 137–152.
10 <https://doi.org/10.1037/a0028086>
- 11 Kessler, R. C., Hwang, I., LaBrie, R., Petukhova, M., Sampson, N. A., Winters, K. C., & Shaffer,
12 H. J. (2008). DSM-IV pathological gambling in the National Comorbidity Survey Replication.
13 *Psychological Medicine*, *38*(9), 1351–1360. <https://doi.org/10.1017/S0033291708002900>
- 14 Khanbhai, Y., Smith, D., & Battersby, M. (2017). Gender by Preferred Gambling Activity in
15 Treatment Seeking Problem Gamblers: A Comparison of Subgroup Characteristics and
16 Treatment Outcomes. *Journal of Gambling Studies*, *33*(1), 99–113.
17 <https://doi.org/10.1007/s10899-016-9614-x>
- 18 Ladd, G. T., & Petry, N. M. (2002). Gender differences among pathological gamblers seeking
19 treatment. *Experimental and Clinical Psychopharmacology*, *10*(3), 302–309.
20 <https://doi.org/10.1037/1064-1297.10.3.302>
- 21 LaPlante, D. A., Nelson, S. E., LaBrie, R. A., & Shaffer, H. J. (2011). Disordered gambling, type of
22 gambling and gambling involvement in the British Gambling Prevalence Survey 2007.
23 *European Journal of Public Health*, *21*(4), 532–537.
24 <https://doi.org/10.1093/EURPUB/CKP177>
- 25 Lévesque, D., Sévigny, S., Giroux, I., & Jacques, C. (2017). Gambling-Related Cognition Scale
26 (GRCS): Are skills-based games at a disadvantage? *Psychology of Addictive Behaviors*, *31*(6),
27 647–654. <https://doi.org/10.1037/adb0000297>
- 28 Levine, T. R., & Hullett, C. R. (2002). Eta Squared, Partial Eta Squared, and Misreporting of Effect
29 Size in Communication Research. *Human Communication Research*, *28*(4), 612–625.
30 <https://doi.org/10.1111/j.1468-2958.2002.tb00828.x>
- 31 Lorains, F. K., Cowlishaw, S., & Thomas, S. A. (2011). Prevalence of comorbid disorders in
32 problem and pathological gambling: systematic review and meta-analysis of population
33 surveys. *Addiction*, *106*(3), 490–498. <https://doi.org/10.1111/j.1360-0443.2010.03300.x>
- 34 Martínez Delgado, J. M. (1996). *Validación de los cuestionarios breves: audit, cage y cba para la*
35 *detección precoz del síndrome de dependencia de alcohol en atención primaria. Cadiz:*
36 *Doctoral thesis, Department of Neurosciences. University of Cadiz. 1.*
- 37 Martinotti, G., Andreoli, S., Giametta, E., Poli, V., Bria, P., & Janiri, L. (2006). The dimensional
38 assessment of personality in pathologic and social gamblers: the role of novelty seeking and
39 self-transcendence. *Comprehensive Psychiatry*, *47*(5), 350–356.
40 <https://doi.org/10.1016/J.COMPPSYCH.2005.12.005>
- 41 McComb, J. L., & Sabiston, C. M. (2010). Family Influences on Adolescent Gambling Behavior: A
42 Review of the Literature. In *Journal of Gambling Studies* (Vol. 26, Issue 4, pp. 503–520).
43 <https://doi.org/10.1007/s10899-010-9181-5>
- 44 Moragas, L., Granero, R., Stinchfield, R., Fernández-Aranda, F., Fröberg, F., Aymamí, N., Gómez-
45 Peña, M., Fagundo, A. B., Islam, M. A., del Pino-Gutiérrez, A., Agüera, Z., Savvidou, L. G.,
46 Arcelus, J., Witcomb, G. L., Sauchelli, S., Menchón, J. M., & Jiménez-Murcia, S. (2015).
47 Comparative analysis of distinct phenotypes in gambling disorder based on gambling
48 preferences. *BMC Psychiatry*, *15*(1), 1–11. <https://doi.org/10.1186/s12888-015-0459-0>
- 49 Mouneyrac, A., Lemerrier, C., Le Floch, V., Challet-Bouju, G., Moreau, A., Jacques, C., & Giroux,
50 I. (2018). Cognitive Characteristics of Strategic and Non-strategic Gamblers. *Journal of*
51 *Gambling Studies*, *34*(1), 199–208. <https://doi.org/10.1007/s10899-017-9710-6>

- 1 Nower, L., & Blaszczynski, A. (2008). Characteristics of Problem Gamblers 56 Years of Age or
2 Older: A Statewide Study of Casino Self-Excluders. *Psychology and Aging, 23*(3), 577–584.
3 <https://doi.org/10.1037/a0013233>
- 4 Odlaug, B. L., & Chamberlain, S. R. (2014). Gambling and Personality Dimensions. *Current*
5 *Behavioral Neuroscience Reports, 1*(1), 13–18. <https://doi.org/10.1007/s40473-013-0002-x>
- 6 Odlaug, B. L., Marsh, P. J., Kim, S. W., & Grant, J. E. (2011). Strategic vs nonstrategic gambling:
7 Characteristics of pathological gamblers based on gambling preference. *Annals of Clinical*
8 *Psychiatry, 23*(2), 105–112.
- 9 Pettorruso, M., Martinotti, G., Cocciolillo, F., De Risio, L., Cinquino, A., Di Nicola, M.,
10 Camardese, G., Migliara, G., Moccia, L., Conte, E., Janiri, L., & Di Giuda, D. (2019). Striatal
11 presynaptic dopaminergic dysfunction in gambling disorder: A (123) I-FP-CIT SPECT study.
12 *Addiction Biology, 24*(5), 1077–1086. <https://doi.org/10.1111/adb.12677>
- 13 Pettorruso, M., Valle, S., Cavic, E., Martinotti, G., di Giannantonio, M., & Grant, J. E. (2020).
14 Problematic Internet use (PIU), personality profiles and emotion dysregulation in a cohort of
15 young adults: trajectories from risky behaviors to addiction. *Psychiatry Research, 289*,
16 113036. <https://doi.org/10.1016/j.psychres.2020.113036>
- 17 Pettorruso, M., Zoratto, F., Miuli, A., De Risio, L., Santorelli, M., Pierotti, A., Martinotti, G.,
18 Adriani, W., & di Giannantonio, M. (2020). Exploring dopaminergic transmission in gambling
19 addiction: a systematic translational review. *Neuroscience & Biobehavioral Reviews*.
20 <https://doi.org/10.1016/j.neubiorev.2020.09.034>
- 21 Rash, C. J., Weinstock, J., & Van Patten, R. (2016). A review of gambling disorder and substance
22 use disorders. *Substance Abuse and Rehabilitation, 7*, 3–13.
23 <https://doi.org/10.2147/SAR.S83460>
- 24 Reinert, D. F., & Allen, J. P. (2002). The Alcohol Use Disorders Identification Test (AUDIT): A
25 Review of Recent Research. *Alcoholism: Clinical and Experimental Research, 26*(2), 272–279.
26 <https://doi.org/10.1111/j.1530-0277.2002.tb02534.x>
- 27 Ronzitti, S., Soldini, E., Lutri, V., Smith, N., Clerici, M., & Bowden-Jones, H. (2016). Types of
28 gambling and levels of harm: A UK study to assess severity of presentation in a treatment-
29 seeking population. *Journal of Behavioral Addictions, 5*(3), 439–447.
30 <https://doi.org/10.1556/2006.5.2016.068>
- 31 Saunders, J. B., Aasland, O. G., Babor, T. F., De La Fuente, J. R., & Grant, M. (1993).
32 Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative
33 Project on Early Detection of Persons with Harmful Alcohol Consumption-II. *Addiction*,
34 *88*(6), 791–804. <https://doi.org/10.1111/j.1360-0443.1993.tb02093.x>
- 35 Shaffer, H. J., LaPlante, D. A., LaBrie, R. A., Kidman, R. C., Donato, A. N., & Stanton, M. V.
36 (2004). Toward a syndrome model of addiction: Multiple expressions, common etiology. In
37 *Harvard Review of Psychiatry* (Vol. 12, Issue 6, pp. 367–374).
38 <https://doi.org/10.1080/10673220490905705>
- 39 Shead, N. W., Derevensky, J. L., & Gupta, R. (2010). Risk and protective factors associated with
40 youth problem gambling. *International Journal of Adolescent Medicine and Health, 22*(1), 39–
41 58. <http://www.ncbi.nlm.nih.gov/pubmed/20491417>
- 42 Shin, Y.-C., Choi, S.-W., Ha, J., Mok, J. Y., Lim, S.-W., Choi, J.-S., & Kim, D.-J. (2014). Age of
43 Pathological Gambling Onset. *Journal of Addiction Medicine, 8*(3), 205–210.
44 <https://doi.org/10.1097/ADM.0000000000000031>
- 45 Singer, B. F., Anselme, P., Robinson, M. J. F., & Vezina, P. (2020). An overview of commonalities
46 in the mechanisms underlying gambling and substance use disorders. *Progress in Neuro-*
47 *Psychopharmacology and Biological Psychiatry, 101*, 109944.
48 <https://doi.org/10.1016/j.pnpbp.2020.109944>
- 49 Slezcka, P., Braun, B., Piontek, D., Bühringer, G., & Kraus, L. (2015). DSM-5 criteria for gambling
50 disorder: Underlying structure and applicability to specific groups of gamblers. *Journal of*
51 *Behavioral Addictions, 4*(4), 226–235. <https://doi.org/10.1556/2006.4.2015.035>

- 1 Slutske, W. S., Piasecki, T. M., Deutsch, A. R., Statham, D. J., & Martin, N. G. (2015). Telescoping
2 and gender differences in the time course of disordered gambling: Evidence from a general
3 population sample. *Addiction, 110*(1), 144–151. <https://doi.org/10.1111/add.12717>
- 4 Spano, M. C., Lorusso, M., Pettorruso, M., Zoratto, F., Di Giuda, D., Martinotti, G., & di
5 Giannantonio, M. (2019). Anhedonia across borders: Transdiagnostic relevance of reward
6 dysfunction for noninvasive brain stimulation endophenotypes. *CNS Neuroscience and*
7 *Therapeutics, 25*(11), 1229–1236. <https://doi.org/10.1111/cns.13230>
- 8 StataCorp. (2019). *Stata Statistical Software: Release 16*. StataCorp LLC.
- 9 Stinchfield, R. (2003). Reliability, Validity, and Classification Accuracy of a Measure of DSM-IV
10 Diagnostic Criteria for Pathological Gambling. *American Journal of Psychiatry, 160*(1), 180–
11 182. <https://doi.org/10.1176/appi.ajp.160.1.180>
- 12 Svračić, D. M., Whitehead, C., Przybeck, T. R., & Cloninger, C. R. (1993). Differential Diagnosis
13 of Personality Disorders by the Seven-Factor Model of Temperament and Character. *Archives*
14 *of General Psychiatry, 50*(12), 991–999.
15 <https://doi.org/10.1001/archpsyc.1993.01820240075009>
- 16 Welte, J. W., Barnes, G. M., Wieczorek, W. F., Tidwell, M. C. O., & Parker, J. C. (2004). Risk
17 factors for pathological gambling. *Addictive Behaviors, 29*(2), 323–335.
18 <https://doi.org/10.1016/j.addbeh.2003.08.007>
- 19 Zakiniaez, Y., Cosgrove, K. P., Mazure, C. M., & Potenza, M. N. (2017). Does telescoping exist in
20 male and female gamblers? Does it matter? *Frontiers in Psychology, 8*(SEP), 1–5.
21 <https://doi.org/10.3389/fpsyg.2017.01510>
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2 **Table 1** Descriptive for the variables of the study (n=725)

	<i>n</i>	<i>Percent</i>		α	<i>Mean</i>	<i>SD</i>
Education level <i>Primary</i>	411	56.7%	Age (years-old)		40.78	13.14
<i>Secondary</i>	273	37.7%	Age of onset (years-old)		28.45	11.16
<i>University</i>	41	5.7%	Transition time of GD		6.49	6.61
Civil status <i>Single</i>	350	48.3%	AUDIT: alcohol use/problem drinking (total)		5.40	6.49
<i>Married / stable couple</i>	275	37.9%	DUDIT: drugs use/abuse (total)		3.11	7.05
<i>Divorced / separated</i>	100	13.8%	Gambling severity: DSM-5 criteria	.742	7.29	1.54
Social index <i>High</i>	4	0.6%	TCI-R Novelty seeking	.706	110.13	12.93
<i>Middle-high</i>	36	5.0%	TCI-R Harm avoidance	.834	100.11	16.81
<i>Middle</i>	64	8.8%	TCI-R Reward dependence	.773	97.07	13.86
<i>Middle-low</i>	269	37.1%	TCI-R Persistence	.878	107.37	19.37
<i>Low</i>	352	48.6%	TCI-R Self-directedness	.867	128.81	20.67
Employment <i>Unemployed</i>	273	37.7%	TCI-R Cooperativeness	.808	129.30	15.44
<i>Employed</i>	452	62.3%	TCI-R Self-transcendence	.833	61.11	13.90

3 *Note.* SD: standard deviation. α : Cronbach's alpha in the sample.

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6 **Table 2** Comparison of the risk for alcohol and drugs between groups of age and gambling preference

Groups of age →	Age 18-34; n=251		Age 35-44; n=243		Age 45-75; n=231			
Alcohol	n	%	n	%	n	%	χ^2	<i>p</i>
No use	33	13.1%	55	22.6%	63	27.3%	22.10	.005*
Low risk	161	64.1%	129	53.1%	108	46.8%		
Medium risk	36	14.3%	38	15.6%	40	17.3%		
High risk	6	2.4%	11	4.5%	8	3.5%		
Addiction	15	6.0%	10	4.1%	12	5.2%		
Drugs	n	%	n	%	n	%	χ^2	<i>p</i>
No use	156	62.2%	155	63.8%	200	86.6%	43.33	<.001*
Low risk	49	19.5%	44	18.1%	12	5.2%		
High risk	46	18.3%	44	18.1%	19	8.2%		
Gambling preference →	Non-strategic; n=458		Strategic; n=185		Mixed; n=82			
Alcohol	n	%	n	%	n	%	χ^2	<i>p</i>
No use	106	23.1%	32	17.3%	13	15.9%	36.76	<.001*
Low risk	220	48.0%	132	71.4%	46	56.1%		
Medium risk	81	17.7%	17	9.2%	16	19.5%		
High risk	19	4.1%	2	1.1%	4	4.9%		
Addiction	32	7.0%	2	1.1%	3	3.7%		
Drugs	n	%	n	%	n	%	χ^2	<i>p</i>
No use	328	71.6%	136	73.5%	47	57.3%	8.81	.046*
Low risk	61	13.3%	27	14.6%	17	20.7%		
High risk	69	15.1%	22	11.9%	18	22.0%		

7 *Note.* Groups of age defined by the terciles in the sample. *Bold: significant comparison.

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2 **Table 3** Comparison of the transition time to GD between groups of alcohol use: ANOVA adjusted by age

Alcohol	Descriptives			Pairwise comparisons					
	<i>n</i>	<i>Mean</i>	<i>SD</i>	Reference: no use	<i>p</i>	<i> d </i>	Reference: addiction	<i>p</i>	<i> d </i>
No use	151	6.32	6.48	Low <i>versus</i> no use	.976	0.01	Low <i>versus</i> addiction	.021*	0.35
Low	398	6.34	6.69	Medium <i>versus</i> no use	.733	0.04	Medium <i>versus</i> addiction	.019*	0.51†
Medium	114	6.05	5.84	High <i>versus</i> no use	.046*	0.33	High <i>versus</i> addiction	.785	0.03
High	25	8.59	7.39	Addiction <i>versus</i> no use	.030*	0.36			
Addiction	37	8.85	7.44						

Drug	Descriptives			Pairwise comparisons		
	<i>n</i>	<i>Mean</i>	<i>SD</i>	Contrast	<i>p</i>	<i> d </i>
No use	511	6.16	6.64	Low <i>versus</i> no use	.313	0.11
Low risk	105	6.85	5.99	High <i>versus</i> no use	.021*	0.23
High risk	109	7.73	7.07	Low <i>versus</i> high	.312	0.13

3 Note. SD: standard deviation.

4 *Bold: significant comparison. †Bold: effect size into the range mild-medium ($|d| > 0.50$) to large-high ($|d| > 0.80$).

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Table 4 Partial correlations adjusted by age

	Transition time	Gambling severity
Gambling severity (DSM-5 total criteria)	.106*	---
Gambling subtype (strategic or mixed)	-.091*	.051
Age of onset of the gambling disorder	-.475*	-.041
TCI-R Novelty seeking	.094*	.224*
TCI-R Harm avoidance	.002	.256*
TCI-R Reward dependence	-.022	-.059
TCI-R Persistence	-.016	-.021
TCI-R Self-directedness	-.124*	-.429*
TCI-R Cooperativeness	-.077*	-.236*
TCI-R Self-transcendence	.024	.218*
Alcohol use/abuse (AUDIT total)	.074*	.199*
Drugs use/abuse (DUDIT total)	.101*	.168*

8 Note. Sample size: $n=725$. *Significant correlation.

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2 **Table 5** Predictive model for the transition time for the onset of GD: linear regression (Stepwise)

		<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>T</i>	<i>p</i>	95%CI (<i>B</i>)	<i>R</i> ²
Age (years-old)		0.123	0.020	.245	6.249	<.001	0.084 0.162	.118[†]
Preferences	Strategic vs Non-strategic	-2.146	0.598	-.142	-3.587	<.001	-3.320 -0.971	
	Mixed vs Non-strategic	0.236	0.777	.011	0.304	.761	-1.290 1.762	
	Strategic vs Mixed	-2.382	0.829	-.157	-2.875	.004	-4.009 -0.755	
TCI-R Self-directedness		-0.037	0.011	-.116	-3.294	.001	-0.059 -0.015	

3 *Note.* *B*: non-standardized coefficient. *SE*: standard error. *Beta*: standardized coefficient. *T*: T-statistic. 95% CI: 95% confidence
4 interval for the non-standardized coefficients.

5 Sample size: $n=725$. [†]Bold: effect size into the range mild-medium ($|R^2|>0.06$) to large-high ($|R^2|>0.14$).

6 List of predictors: age, preference (strategic, non-strategic, mixed), personality traits (TCI-R scores), alcohol use (AUDIT-total),
7 drugs use (DUDIT-total).

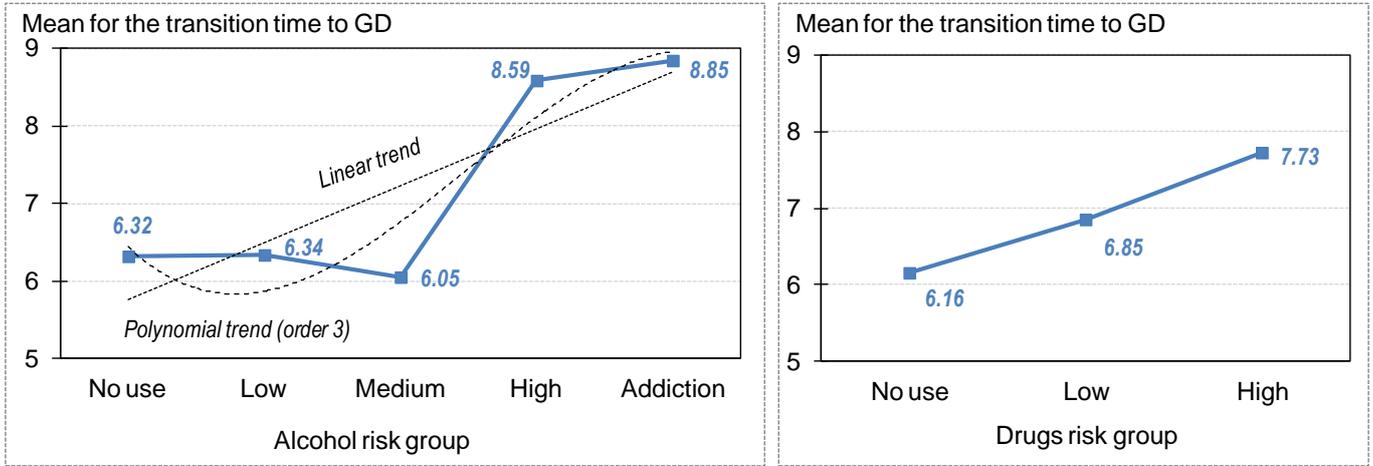
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2 **Figure 1** Mean for the transition time to GD for the alcohol and drugs risk groups

3 Note. Sample size: $n=725$



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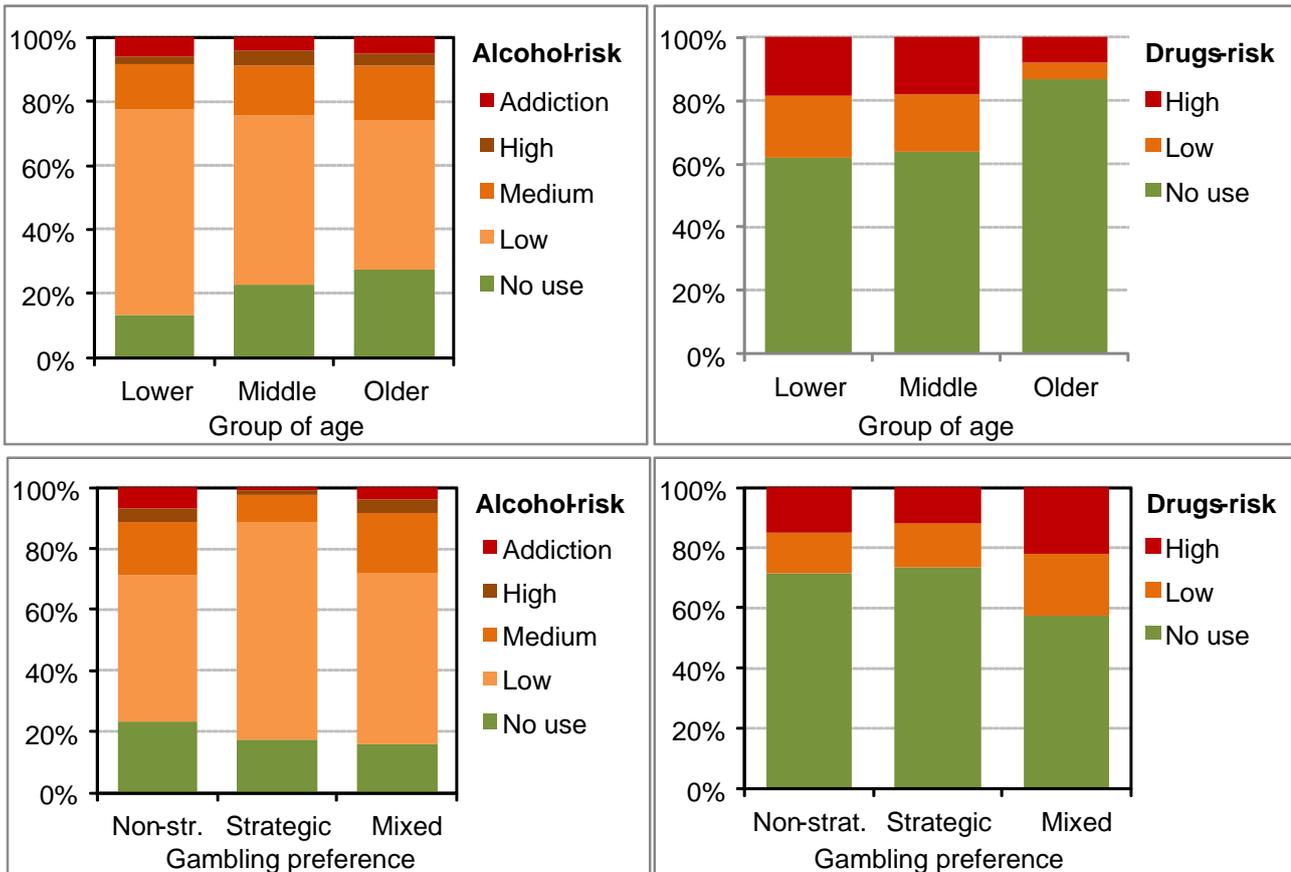
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8 **Figure S1 (supplementary)** Distribution of the groups of risk for alcohol and drugs in the sample

9 Note. Sample size: $n=725$



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