Desire thinking about gambling: Assessment and associations with gambling disorder and responsible gambling among Chinese gamblers

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**Abstract**

Desire thinking, within the metacognitive model of addictive behaviors, is conceptalized as a transdiagnostic process linked to the escalation and maintenance of craving; however, its application to the understanding of gambling and the Chinese community remains at an early stage. The present study aimed to introduce desire thinking into the gambling research line in the Chinese context by: (1) testing the applicability of its two-factor conceptualization and assessment tool, Desire Thinking Questionnaire (DTQ); and (2) exploring its association with dysregulated and regulated engagements in gambling (i.e., Gambling Disorder [GD] and responsible gambling [RG], respectively). We conducted a telephone survey in Macao, China, and obtained a probability sample of 837 Chinese adult past-year gamblers (48.5% men; age: M = 41.11, SD = 14.31) with a two-stage cluster random sampling method. Our data indicated the psychometric adequacy of the two-factor DTQ (i.e., verbal perseveration and imaginal prefiguration) for measuring Chinese gamblers' desire thinking about gambling. After controlling for craving and demographics, desire thinking contributed to an additional 12.1% and 18.9% variance explained in GD tendency and RG behaviors, respectively. This study provides the first empirical evidence on the utility of the desire thinking construct and the DTQ in facilitating gambling research in the Chinese context. Our findings also suggest the value of incorporating desire thinking in the detection and treatment of GD and in promoting RG.

***Keywords:*** addictive behavior;craving; desire thinking; gambling disorder; metacognitive model; responsible gambling.

**Introduction**

As a typology of behavioral addiction, Gambling Disorder (GD) is characterized by a persistent and recurrent pattern of problematic gambling behavior, resulting in significant distress and/or impairment in personal, familial, social, educational, and occupational domains (American Psychiatric Association, 2013; World Health Organization, 2019). Similarly to other addictive behaviors, one of the dominant features of GD is preoccupation about gambling (i.e., a desired target), such as thinking and imagining past and future gambling activity (American Psychiatric Association, 2013). According to the metacognitive model of addictive behaviors (Spada, Caselli, Nikčević, et al., 2015), desire thinking plays a vital role in the development and maintenance of addictive behaviors (i.e., dysregulation in addictive behaviors).

Desire thinking is a deliberate cognitive process in which an individual consciously conjures positive mental representations of a desired target (e.g., an activity, an object, or a state) through verbal and imaginal elaborations (Caselli & Spada, 2010), namely, verbal perseveration and imaginal prefiguration (Caselli & Spada, 2011). Verbal perseveration refers to repetitive and motivated self-talk about the need to acquire the desired target; imaginal prefiguration refers to building mental images and multi-sensory elaboration of the desired target by recalling an experience or anticipating a future one (Caselli & Spada, 2011). In the metacognitive model of addictive behaviors, desire thinking functions as a repetitive, maladaptive, and inflexible thinking pattern that preserves intrusive feelings and thoughts in one’s consciousness; prolonged desire thinking gradually transpires into increased craving and negative affect, eventually resulting in engagement in the desired target (e.g., addictive behaviors) and post-engagement rumination and thought suppression (Caselli & Spada, 2015; Spada, Caselli, Nikčević, et al., 2015).

A growing body of literature has shown that desire thinking could be utilized to discern between problematic and non-problematic use across addictive behaviors, plausibly through its influences on craving and addictive disorders cross-culturally (Mansueto et al., 2019). Extant research has also highlighted the transdiagnostic feature of desire thinking in elucidating the underlying mechanism of a broad range of addictive behaviors, including but not limited to problematic engagement in gambling (Caselli & Spada, 2015; Fernie et al., 2014), Internet gaming (Aydın et al., 2022; Brandtner et al., 2020), social media (Awad et al., 2022; Bastan et al., 2022), and alcohol use (Khosravani et al., 2022; Solem et al., 2021). The latest systematic and meta-analytic review further suggested that studying desire thinking can not only improve our knowledge of the persistence of addictive behaviors, but also allow for timely assessment and intervention of addictive disorders in various community and clinical settings at different preventive stages (Mansueto et al., 2019).

However, the limited number of empirical studies on desire thinking about gambling (i.e., only two in Italy; Caselli & Spada, 2015; Fernie et al., 2014) or desire thinking in the Chinese context (i.e., only one regarding problematic mobile phone use among adolescents; Gao et al., 2023) indicates the application of desire thinking to gambling and Chinese adults remains in its infancy. Considering the promising potential of desire thinking for understanding and preventing addictive behaviors, the present study aimed to address the paucity of research on desire thinking about gambling in the Chinese context and provide the first piece of empirical evidence of the applicability of desire thinking to understanding GD and responsible gambling (RG), the dysregulated and regulated forms of gambling, respectively, in China.

 In order to extend the use of desire thinking to study gambling in China, the first objective of the present study was to evaluate the psychometric properties of Caselli and Spada’s (2011) Desire Thinking Questionnaire (DTQ) among Chinese past-year gamblers to provide the first assessment tool for measuring desire thinking about gambling in China. The 10-item DTQ is a reliable and valid self-report questionnaire designed to assess individuals’ proclivity for desire thinking, with a conceptualized two-factor structure of verbal perseveration and imaginal prefiguration (Caselli & Spada, 2011). Its satisfactory reliability (e.g., internal consistency and test-retest reliability) and validity (e.g., construct and criterion validity), along with evidence supporting the two-factor conceptualization (i.e., structural validity), were discovered in ten European or Asian countries and across various forms of addictive behaviors due to substance (e.g., alcohol and nicotine) or rewarding behaviors (e.g., Internet gaming and social media) (Awad et al., 2022; Aydın et al., 2022; Caselli & Spada, 2011; Chakroun-Baggioni et al., 2017; Dragan & Grajewski, 2021; Efrati et al., 2020; Gao et al., 2023; Khosravani et al., 2022; Markus et al., 2019; Solem et al., 2021). Verbal perseveration and imaginal prefiguration, the two components of desire thinking, were strongly associated with craving, negative affect (e.g., depression), and addictive behaviors in clinical, sub-clinical, and community populations (Mansueto et al., 2019). Based on the psychometric soundness of DTQ displayed in previous studies, the present study hypothesized that DTQ would perform similarly well among Chinese adult past-year gamblers (Hypothesis 1, H1): (a) adequate structure validity for the two-factor conceptualization (i.e., verbal perseverance and imaginal prefiguration); (b) satisfactory reliability; and (c) good criterion validity (i.e., positive associations with craving, GD tendency, and depressive symptoms) and convergent validity (i.e., positive association with gambling frequency and expenditure).

 The second objective of the present study was to explore the effects of desire thinking on GD (i.e., dysregulated engagement in gambling) and RG (i.e., regulated engagement in gambling) under the metacognitive model of addictive behaviors in Macao, the only city with legitimate casino gambling industries in China. Being the city that generates the highest yearly gambling revenue in the world (e.g., 36.7 billion USD; DSEC, 2020), Macao has inevitably exposed its residents to more gambling-related information and activities, which may constitute one of the prerequisites of higher risks for gambling problems. According to recent-year estimates for community-dwelling adults, the prevalence of probable GD of 0.8-2.1% in Macao (J. H. Chen et al., 2018; Institute for the Study of Commercial Gaming, 2019; Wu et al., 2014) is higher than other regions with authorized casino gambling businesses, such as 0.1% in Singapore (National Council on Problem Gambling, 2018), 0.5% in the United States (Potenza et al., 2019), and 0.7% in Spain (Chóliz et al., 2021). These statistics indicate that Macao has a long-term obligation to safeguard its citizens from developing GD and to promote RG (e.g., regulated/controlled engagement in gambling that minimize gambling-related harm; Blaszczynski et al., 2004). Testing the effects of desire thinking on GD and RG could provide additional empirical evidence to the applicability of desire thinking under the metacognitive model of addictive behaviors to Chinese gamblers, paving the path toward early detection and management of emerging and lingering gambling problems. Learning from extant studies on desire thinking among Italian gamblers (i.e., Caselli & Spada, 2015; Fernie et al., 2014), we hypothesized that Chinese gamblers’ desire thinking could exert extra influences on the tendency for GD, with a positive valence, beyond craving (Hypothesis 2, H2). Although no studies have yet examined the relationship between desire thinking and RG, we anticipated a negative association between the two (Hypothesis 3a, H3a) and negative valence of desire thinking on regulated gambling (e.g., RG behaviors) after controlling for craving (Hypothesis 3b, H3b), based on Zhou et al.’s (2022) findings that metacognitions (i.e., under the same metacognitive conceptualization as desire thinking) negatively related to RG among Chinese gamblers.

**Method**

**Participants and procedure**

The present study gained ethical approval by the Department of Psychology, University of Macau (Approval Code: DPSY2022-22). In the fall of 2022, we conducted an anonymous telephone survey with a two-stage cluster random sampling method in Macao, China. In the first stage, households from the latest residential phonebook were coded and randomly drawn. Trained interviewers screened all family members within each household for participation eligibility. The inclusion criteria were being an adult (≥18 years old), both sexes, Chinese ethnicity, Cantonese/Mandarin literacy, and past-year gambling experience; individuals who our investigators could not reach during the data collection period were excluded. For households with more than one eligible participant, the second-stage random selection was performed by the “last-birthday” rule (Gaziano, 2008); the family member who most recently celebrated his/her birthday was invited to participate in our study voluntarily. Every chosen participant received a briefing on the study’s key information and their rights to reject or withdraw from participation. We only administered the formal survey among those who provided verbal consent to voluntary participate. As a result, 837 past-year gamblers, out of 1052 respondents with known eligibility, completed our telephone survey, which resulted in a cooperation rate of 79.6% according to the American Association for Public Opinion Research’s (2016) formula.

The overall sample was 837 past-year gamblers (48.5% men) aged between 18 and 83 years (*M*= 41.11, *SD*= 14.31). Regarding gambling frequency, the proportion of respondents who gambled at least weekly, monthly, and bi-monthly were 10.4%, 29.8%, and 21.0%; while the remaining 38.8% gambled at least once in the past 12 months. The overall sample’s monthly expenditure on gambling was approximately 64.53 USD on average (*SD* = 129.68; *Mdn* = 24.82).

**Measures**

***Desire thinking about gambling***

The 10-item DTQ (2011) was translated and back-translated independently by two English-Chinese bilingual Ph.D. candidates in psychology, and then further reviewed by a clinical psychologist and a health psychologist to produce a Chinese version of DTQ to measure Chinese gamblers’ desire thinking about gambling. In this version, we retained all ten items and specified “the desired activity” as “gambling” (e.g., “I imagine myself gambling”; see Appendix A for the Chinese items), on a 4-point Likert scale (from 1 = *almost never* to 4 = *almost always*). A higher composite score (i.e., arithmetic mean) of DTQ or its subscales indicates a greater level of corresponding desire thinking for gambling.

***Depressive symptoms***

Respondents’ depressive symptoms were assessed by the 7-item depression subscale of the 21-item Depression Anxiety Stress Scales (DASS-21; Lovibond & Lovibond, 1995; Wang et al., 2016), on a 4-point Likert scale, where 0 = *do not apply to me at all* and 3 = *apply to me very much*. A sample item is “I felt that life was meaningless”. This 7-item subscale displayed satisfactory internal consistency in the current sample (*α* = 0.86). A greater converted composite score (i.e., multiply the total score by two) represents a greater degree of depression.

***Craving***

The craving for gambling was measured by three items (*α* = 0.92 in the current sample) adapted from the Penn Alcohol Craving scale (Flannery et al., 1999). Respondents rated how frequently, how strongly, and how uncontrollably their gambling craving was, on a 7-point scale (1 = *never/not at all*, 7 = *always/very strong and uncontrollable*). A sample item is “how often have you thought about how great it would get if you could gamble right now”. A higher composite score (i.e., arithmetic mean) corresponds to a greater craving for gambling.

***GD tendency and probable GD***

According to the DSM-5 diagnostic criteria for GD (American Psychiatric Association, 2013), this study measured respondents’ GD tendency by counting how many GD symptoms they had experienced during the past 12 months (0 = *no* and 1 = *yes* for each symptom [e.g., “is restless or irritable when attempting to cut down or stop gambling”]; KR-20 = 0.68 for the present study). A greater summative scale score indicates one’s greater propensity for GD. In line with previous studies among Chinese adults (e.g., J. H. Chen et al., 2018; Zhou et al., 2022), we applied a cutoff point ≥ 4 to divide the overall sample into probable GD and non-GD subsamples for additional probing.

***RG behaviors***

This study used Tong et al.’s (2020) adapted version of the Positive Play Scale (Wood et al., 2017), specifically its 7-item behavioral subscale (*α* = 0.83 in the current sample), to evaluate respondents’ past-year responsible behaviors. Respondents used a 5-point Likert scale (from 1 = *never* to 5 = *always*) to indicate how frequently they implemented RG practices (e.g., “I only gambled with money that I could afford to lose”). A higher composite scale score (i.e., arithmetic mean) indicates a higher level of compliance with RG.

***Demographics and gambling characteristics***

Respondents reported basic demographic information (sex [1 = men; 0 = women] and age) and gambling frequency (from 1 = *once a year to 9 = almost once or more per day*) and monthly expenditure (in Macao Patacas) on average in the past 12 months.

**Statistical analysis**

We began by evaluating the psychometric properties of the DTQ with item rating distribution and corrected item-total correlations. As DTQ has an established two-factor a priori, we followed the COSMIN reporting guidelines (Gagnier et al., 2021) and assessed the DTQ’s hypothesized two-factor structure, in comparison to its baseline one-factor model, with confirmatory factor analysis (CFA). The adequacy of structure validity was measured by: (a) comparative fit index (CFI) ≥ 0.90 (Hu & Bentler, 1999); (b) root mean square error of approximation (RMSEA) ≤ 0.08 (Browne & Cudeck, 1992); (c) smaller values of Akaike information criteria (AIC) and Bayesian Information Criteria (BIC) than the competing model (Kline, 2016); and (d) standardized factor loading ≥ 0.40 (Hair et al., 2014). Additional multi-group CFA was conducted to test the measurement invariance between sexes on configural, metric, and scalar levels (i.e., ΔCFI < 0.01 and ΔRMSEA < 0.01; F. F. Chen, 2007). The internal consistency of the DTQ was measured by Cronbach’s alpha (i.e., ≥ 0.70 as acceptable; Cortina, 1993). We utilized bivariate correlation analyses (i.e., *r* = 0.10, 0.30, and 0.50 signifies mild, moderate, and strong correlations, respectively; Cohen, 1988) to examine the hypothesized positive associations of desire thinking (measured by DTQ) with craving, GD tendency, depressive symptoms, and gambling frequency and expenditure for testing the criterion and convergent validity of the DTQ for Chinese gamblers. Moreover, we profiled the DTQ by demographic indicators and probable GD status with *t*-test or bivariate correlation analysis; we also explored the expected negative association between desire thinking and RG with bivariate correlation analysis. These analyses aforementioned provided a comprehensive testing of H1. For testing H2 and H3, we employed hierarchical multiple regressions to evaluate the hypothesized additional influences of desire thinking over craving on GD tendency and RG, respectively, after controlling for the demographic effect. In Mplus 7.3 (Muthén & Muthén, 2012), we tested CFAs with the robust Maximum Likelihood (MLR) estimator, which accounts for missing values (i.e., seven respondents [0.8%] failed to report at least one DTQ item) and is not based on multivariate normality. The remaining analyses were conducted in SPSS 26.0 (IBM Corp, 2019).

**Results**

As shown in Table 1, all ten DTQ items were positively skewed (i.e., M = 1.15 to 1.29, SD = 0.44 to 0.62, Mdn = 1) as expected, with a corrected item-total correlation ranging from 0.53 to 0.78, exceeding the threshold of 0.30 (Boateng et al., 2018). The conceptualized two-factor model of the DTQ exhibited a satisfactory goodness-of-fit (χ2(34) = 91.37, p < .001, CFI = 0.95, RMSEA = 0.045, 90% CI [0.034, 0.056], AIC = 8911.67, BIC = 9058.30), superior to its baseline one-factor model (AIC = 9004.08, BIC = 9145.98). This two-factor model also presented adequate standardized factor loadings from 0.53 to 0.83 (see Table 1), higher than the minimally expected 0.40 (Hair et al., 2014). The measurement invariance test indicated that the scalar invariance was held across sexes for the DTQ among Chinese gamblers (ΔCFI = 0.001-0.009, ΔRMSEA = 0.004-0.006; see Table 2). Both factors of the DTQ displayed good internal consistency, with Cronbach’s α of 0.89 for verbal perseveration and 0.82 for imaginal prefiguration. Table 3 presents that both DTQ factors showed: (1) significant and strong correlations with GD tendency, depressive symptoms, and craving in the positive direction (r = 0.50 to 0.60, p < 0.001) as well as with RG in a negative direction (r = –0.59 and –0.52, p < 0.001); and (2) a significant and moderate correlation with gambling expenditure in the positive direction (r = 0.31, p < 0.001), and (3) a significant and moderate correlation with gambling frequency in the positive direction (r = 0.15 and 0.19, p < 0.001).

 The t-test showed that probable GD gamblers (n = 26; probable GD prevalence: 3.1% in 837 Chinese past-year gamblers) reported significantly more desire thinking than their non-GD counterparts (Verbal perseveration: *M*probable GD = 2.12, *M*non-GD = 1.16, t(26) = 8.79, p < 0.001; Imaginal prefiguration: *M*probable GD = 2.06, *M*non-GD = 1.20, t(819) = 11.34, p < 0.001). No significant differences in the two DTQ factors (i.e., verbal perseveration and imaginal prefiguration) were observed across sexes (t(832/835) = –1.13 and 0.31, p = 0.26 and 0.75), but negative correlations were observed with age (r = –0.18 and –0.17, p < 0.001) at significant levels. Hierarchical multiple regressions demonstrated that verbal perseveration and imaginal prefiguration were significant antecedents of GD tendency (β = 0.24 and 0.23, p < 0.001, respectively) and RG behavior (β = *–*0.42 and *–*0.15, p < 0.001, respectively), contributing additional explained variance (GD tendency: ΔR2 =0.121, p < 0.001; RG behavior: ΔR2 =0.189, p < 0.001), after controlling for craving and demographics (see Table 4).

**Discussions**

In light of the practical importance of and shortage of studies on desire thinking about gambling, the present study provided the first piece of empirical evidence on the applicability of the DTQ for assessing gamblers’ desire thinking in the Chinese context, fulfilling Study Objective 1. In support of H1, we found that the 10-item, two-factor DTQ has satisfactory structure validity (i.e., adequate goodness-of-fit and standardized factor loading), internal consistency (i.e., acceptable Cronbach’s α for both DTQ factors), criterion validity (i.e., expected positive correlations of DTQ factors with GD tendency, depressive symptoms, and craving), and convergent validity (i.e., expected positive correlations of DTQ factors with gambling frequency and expenditure) in a probability sample of Chinese past-year gamblers. Our findings were consistent with previous accounts of psychometric soundness of the DTQ across various language versions (e.g., Aydın et al., 2022; Chakroun-Baggioni et al., 2017; Dragan & Grajewski, 2021; Khosravani et al., 2022; Markus et al., 2019; Solem et al., 2021). Although the DTQ has been used in studying gambling among Italian adults (i.e., Caselli & Spada, 2015; Fernie et al., 2014), its measurement reliability and validity have not yet been established among gamblers; the current study addressed this missing link and lent a strong piece of empirical evidence to DTQ’s psychometric adequacy across various addictive behaviors and regions.

 In line with the conceptualized model of DTQ first proposed by Caselli and Spada (2011), our data suggested that desire thinking about gambling among Chinese gamblers comprises of two components (i.e., verbal perseveration and imaginal prefiguration). The positive skewness of items from these two components exhibited the typical pattern of screening assessment tools (e.g., J. H. Chen et al., 2021). Corresponding to such a pattern, we also found significantly higher levels of verbal perseveration and imaginal prefiguration in probable GD gamblers than non-GD gamblers, implying the discriminant effect of desire thinking in identifying individuals at risk for GD. Similar discriminant power of desire thinking has been reported for screening for Internet Gaming Disorder (Dragan & Grajewski, 2021), Alcohol Use Disorder (Markus et al., 2019), and binge eating (Spada, Caselli, Fernie, et al., 2015).

We further tested measurement invariance of the DTQ across sexes for the first time and found not only scalar invariance but also no significant sex differences in verbal perseveration and imaginal prefiguration for gambling. This nonsignificant finding indicates that desire thinking appears to be a shared experience for individuals engaging in gambling regardless of sex. Regarding other demographic effects on the DTQ, we observed an inverted relationship of two DTQ components with age, which suggests that relatively younger gamblers tended to report more desire thinking about gambling. As a similar pattern of vulnerability has been observed among those who were prone to GD (Potenza et al., 2019), stakeholders of health professionals could consider prioritizing gambling interventions at a younger age to lower one’s desire thinking about gambling to mitigate their GD risk.

 For Study Objective 2, we first investigated the effect of desire thinking on GD tendency following Spada et al.’ (2015) metacognitive model of addictive behaviors. The strong and positive associations of desire thinking with GD tendency and craving shown in our study were corroborated with previous studies on desire thinking and various addictive behaviors (Mansueto et al., 2019). We further discovered the additional impact of desire thinking on GD tendency (12.1% variance explained) after excluding the effects of craving and demographics, supporting H2. Consistent with Fernie et al.’s (2014) finding, our data revealed the unique contribution of desire thinking, in terms of verbal perseveration and imaginal prefiguration, on addictive behaviors (i.e., GD tendency in this study), independently of craving. In the metacognitive model of addictive behaviors (Spada, Caselli, Nikčević, et al., 2015), desire thinking activates and maintains craving in the pre-engagement phase (Phase 1), and then leads to dysregulated engagement (i.e., addictive behaviors) and increased negative affect during the engagement phase (Phase 2) and the post-engagement phase (Phase 3), respectively. Aligning with this triphasic formulation, our findings indicate that desire thinking is a distinct construct from craving, regardless of their close association shown in the current study (i.e., *r* = 0.56, *p* < 0.001) and previous ones (e.g., *r* = 0.50 to 0.63, *p* < 0.01; Caselli & Spada, 2015; Fernie et al., 2014). The additional explanatory value of desire thinking for the individual variations on GD tendency is also in accordance with the multiple roles of desire thinking in the triphasic metacognitive model, suggesting the applicability of this model to understanding GD in China, in where gambling has a long history and related activities are well accepted for entertainment and socialization (Wu & Lau, 2015). Subsequent longitudinal studies could further test the relationship among desire thinking, craving, and GD, especially exploring the partial mediating effect of craving on the link between desire thinking and GD.

 Learning from the precedent application of metacognitive components to RG behaviors (i.e., Zhou et al., 2022), the present study also extended the exploration of desire thinking from dysregulated engagement (i.e., GD tendency) to regulated engagements(i.e., RG behaviors). As hypothesized, we uncovered: (1) a strong and negative association between desire thinking and RG behaviors (H3a held); and (2) nearly one-fifth variance in RG behaviors explained by desire thinking, on top of craving and demographics (H3b held). Unlike exerting the nearly equivalent effects on GD tendency (i.e., *β* = 0.24 and 0.23, *p* < 0.001), verbal perseveration (*β* = –0.42, *p* < 0.001) exhibited a larger influence on RG behaviors than imaginal prefiguration (*β* = –0.15, *p* < 0.001). These findings imply that the verbal and imaginal domains of desire thinking might work differently in engagement dysregulation and regulation; specifically, the activation of verbal perseveration appeared to hamper one’s adherence to RG behaviors more than imaginal prefiguration. Correspondingly, Caselli and Spada (2015) also conjured up a similar proposition that imaginal prefiguration can be commonly observed among community populations and induce transient craving at first; it is the function of verbal perseveration to ‘transform’ everyday desires toward (potentially) clinically significant ones (e.g., failures in regulated gambling in this study). Therefore, early interventions are recommended to psycho-educate those who experience imaginal prefiguration about the intensification of verbal perseveration; interventions in later phases should concentrate on interrupting the vicious cycle of verbal perseveration and perceived uncontrollability of desire thinking (i.e., metacognition). Tailored strategies for each phase could take into account the core skills of Wells’ (2009) Metacognitive Therapy, which shares the same theoretical system as desire thinking in the metacognitive model of addictive behaviors (Caselli & Spada, 2015; Spada, Caselli, Nikčević, et al., 2015) and also displayed promising therapeutic effects in treating addictions (Normann & Morina, 2018).

 There are several limitations that the present study cannot fully address. First, our study only focused on adult gamblers and omitted adolescent gamblers, the population under at least equally high risk for GD as adults (Volberg et al., 2011). As this limitation was also evident in other extant studies on desire thinking about gambling (i.e., Caselli & Spada, 2015; Fernie et al., 2014), we call for researchers to put adolescent gamblers under the research scope and intervene in gambling-related problems at an earlier stage (e.g., the first onset). Second, the cross-sectional design of the current study prevented us from further exploring DTQ’s test-retest reliability and predictive validity, as well as the temporal relationships among desire thinking, craving, and addictive behaviors (including its dysregulation and regulation) despite the strong theoretical framework based on the metacognitive model. Longitudinal designs are recommended to address these missing links and continue empirically examining the metacognitive model of addictive behaviors to deepen our understanding of the development and perseveration of related disorders. Third, although desire thinking displayed possibilities for designing strategies to alleviate GD and promote RG, we could not test the related causal relationships nor confirm the potential therapeutic merits in the current study. Randomized controlled trials are required to follow up these directions.

 In conclusion, the present study highlights the applicability of desire thinking and advances its development to reveal the underlying mechanism of GD (i.e., dysregulated engagement in gambling) and RG (i.e., regulated engagement in gambling) from the perspective of metacognitive model of addictive behaviors in two ways. Firstly, by confirming the two components of desire thinking in the gambling domain and providing a reliable and valid translated Chinese version of the DTQ for assessing desire thinking about gambling. Secondly, by revealing the DTQ’s discriminant power in differentiating between probable GD and non-GD gamblers, indicating the potential of utilizing desire thinking for early identification and intervention of dysregulated engagement in gambling. Our study did not only identify the distinct effect of desire thinking, differing from craving, on dysregulated gambling in the Chinese context, but also extended such findings to RG, gambling’s regulated form. These findings shed light on incorporating Metacognitive Therapy strategies in targeting either imaginal or verbal components of desire thinking in the triphasic engagement in addictive behaviors.

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**Table 1. Item performance and CFA factor loadings of DTQ among Chinese gamblers (*N* = 837)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Subscale/Item** | **Endorsement a %** | **Descriptive Statistics** | **ITC** | **Factor****Loadingb** |
| **1** | **2** | **3** | **4** | ***M*** | ***SD*** | ***Mdn*** |
| **Verbal Perseveration** |  |  |  |  |  |  |  |  |  |
| 4. If I did not gamble for a long time, I would think about it continuously | 82.9 | 12.3 | 3.7 | 1.1 | 1.23 | 0.56 | 1.00 | 0.74 | 0.68\*\*\* |
|  5. When I begin to think about gambling, I find it difficult to stop | 84.8 | 9.3 | 4.5 | 1.2 | 1.22 | 0.58 | 1.00 | 0.76 | 0.69\*\*\* |
|  6. When I begin to think about gambling, I would continue thinking about it until I manage to gamble | 85.4 | 9.2 | 4.1 | 1.3 | 1.21 | 0.57 | 1.00 | 0.78 | 0.53\*\*\* |
|  7. I repeat mentally to myself that I need to gamble | 86.5 | 9.2 | 3.9 | 0.4 | 1.18 | 0.50 | 1.00 | 0.72 | 0.78\*\*\* |
|  10. My mind is focused on repeating gambling till I manage to satisfy this desire | 87.9 | 9.2 | 2.6 | 0.2 | 1.15 | 0.44 | 1.00 | 0.73 | 0.73\*\*\* |
| **Imaginal Prefiguration** |  |  |  |  |  |  |  |  |  |
|  1. I imagine myself gambling | 81.6 | 15.2 | 2.6 | 0.6 | 1.22 | 0.51 | 1.00 | 0.63 | 0.80\*\*\* |
|  2. I imagine how I would feel like when gambling | 81.2 | 13.0 | 5.1 | 0.6 | 1.25 | 0.57 | 1.00 | 0.67 | 0.83\*\*\* |
|  3. I imagine the sensations I would feel when gambling | 83.4 | 12.5 | 3.3 | 0.4 | 1.20 | 0.50 | 1.00 | 0.53 | 0.83\*\*\* |
|  8. I begin to imagine gaming every time it comes to my mind | 78.7 | 14.2 | 6.2 | 0.8 | 1.29 | 0.62 | 1.00 | 0.65 | 0.76\*\*\* |
|  9. I imagine myself gambling as if it were a movie | 86.4 | 9 | 3.9 | 0.4 | 1.18 | 0.50 | 1.00 | 0.58 | 0.76\*\*\* |

*Note.* DTQ = Desire Thinking Questionnaire, ITC = corrected item-total correlation. a 1 = *almost never*, 2 = *sometimes*, 3 = *often*, 4 = *almost always.* b The goodness-of-fit indices for DTQ-G was χ2(34) = 91.37, *p* < .001, CFI = .95, RMSEA = .045, 90% CI [.034, .056], AIC = 8911.67, BIC = 9058.30. \*\*\* *p* < .001.

**Table 2. Test of measurement invariance of DTQ among Chinese gamblers (*N* = 837)**

|  |  |  |
| --- | --- | --- |
|  | **Model fit** | **Model comparison*a*** |
| **Model** | **χ2** | ***df*** | ***p*** | **CFI** | **RMSEA [90% CI]** | **Δχ2** | **Δ*df*** | ***p*** | **ΔCFI** | **ΔRMSEA** |
| Configural | 136.58 | 62 | <0.001 | 0.947 | 0.049 [0.037, 0.061] |  |  |  |  |  |
| Metric | 146.15 | 54 | <0.001 | 0.946 | 0.047 [0.035, 0.058] | 10.38 | 8 | 0.24 | 0.001 | 0.006 |
| Scalar | 165.63 | 46 | <0.001 | 0.937 | 0.048 [0.037, 0.059] | 28.67 | 8 | <0.001 | 0.009 | 0.004 |

*Note*. DTQ = Desire Thinking Questionnaire. a Chi-square difference testing (Δχ2) was carried out using a scaling correction factor for MLR.

**Table 3. Descriptive statistics and bivariate correlation among key variables (*N* = 837)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | ***M* (*SD*)** | **Possible range** a | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1. Verbal Perseveration | 1.19 (0.45) | 1 – 4 | 1 |  |  |  |  |  |  |
| 2. Imaginal Prefiguration | 1.23 (0.41) | 1 – 4 | 0.75\*\*\* | 1 |  |  |  |  |  |
| 3. GD tendency | 0.52 (1.09) | 0 – 9 | 0.60\*\*\* | 0.59\*\*\* | 1 |  |  |  |  |
| 4. RG behavior | 4.40 (0.75) | 1 – 5 | –0.59\*\*\* | –0.52\*\*\* | –0.48\*\*\* | 1 |  |  |  |
| 5. Depressive symptoms | 4.91 (6.86) | 0 – 42 | 0.54\*\*\* | 0.50\*\*\* | 0.36\*\*\* | –0.46\*\*\* | 1 |  |  |
| 6. Craving | 1.67 (1.02) | 1 – 7 | 0.56\*\*\* | 0.56\*\*\* | 0.58\*\*\* | –0.39\*\*\* | 0.27\*\*\* | 1 |  |
| 7. Gambling frequency | 4.25 (1.57) | 1 – 9 | 0.15\*\*\* | 0.19\*\*\* | 0.21\*\*\* | 0.002 | –0.05 | 0.44\*\*\* | 1 |
| 8. Gambling expenditure b | 64.53 (129.68) | -- | 0.31\*\*\* | 0.31\*\*\* | 0.41\*\*\* | –0.22\*\*\* | 0.12\*\*\* | 0.38\*\*\* | 0.29\*\*\* |

*Note.* GD = gambling disorder, RG = responsible gambling. \*\*\* *p* < .001. Sex: 1 = *male*, 0 = *female*. a Possible range entails the lowest and highest ratings one can endorse/obtain on each variable. b The monthly gambling expenditure has been converted to US dollars.

**Table 4. Hierarchical multiple linear regressions of GD tendency and RG behavior (*N* = 818)**

|  |  |  |
| --- | --- | --- |
| **Step/variable** | **Model 1: GD tendency** | **Model 2: RG behavior** |
| *B* (SE) | 95% CI of *B* | *β* | *p* | *B* (SE) | 95% CI of *B* | *β* | *p* |
| **Step 1a** |  |  |  |  |  |  |  |  |
|  Sex | 0.04 (0.08) | (–0.11, 0.19) | 0.02 | 0.62 | 0.17 (0.05) | (0.08, 0.27) | –0.12 | < 0.001 |
|  Age | 0.01 (0.003) | (–0.008, 0.02) | 0.17 | < 0.001 | –0.02 (0.002) | (–0.02, –0.01) | –0.30 | < 0.001 |
| Δ*F* (ΔR2) | 11.90*\*\*\** (0.029) | 46.45*\*\*\** (0.102) |
| **Step 2** |  |  |  |  |  |  |  |  |
|  Craving | 0.61 (0.03) | (0.55, 0.68) | 0.57 | < 0.001 | –0.25 (0.02) | (–0.30, –0.21) | –0.35 | < 0.001 |
| Δ*F* (ΔR2) | 380.18*\*\*\** (0.313) | 121.56*\*\** (.117) |
| **Step 3** |  |  |  |  |  |  |  |  |
|  Verbal Perseveration  | 0.61 (0.11) | (0.40, 0.82) | 0.24 | < 0.001 | –0.71 (0.07) | (–0.85, –0.57) | –0.42 | < 0.001 |
|  Imaginal Prefiguration | 0.60 (0.11) | (0.38, 0.81) | 0.23 | < 0.001 | –0.27 (0.08) | (–0.43, –0.12) | –0.15 | < 0.001 |
| Δ*F* (ΔR2) | 89.87*\*\*\** (0.121) | 129.28*\*\*\** (0.189) |

*Note.* GD = gambling disorder, RG = responsible gambling.\*\* *p < .*01,\*\*\* *p <* .001.

**Appendix A. The Chinese version of Desire Thinking Questionnaire for Gambling (中文版關於賭博的渴望性思維量表)**

**【指導語】當人們強烈渴望去賭博時，可能會在腦中對賭博相關的事情展開一些想象。請問你有多經常經歷以下這些情況？請用1-4評分，1 = 幾乎從不，2 = 有時，3 = 經常，4 = 幾乎總是。**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **幾乎從不** | **有時** | **經常** | **幾乎總是** |
| 1. 我想像自己正在賭博
 | 1 | 2 | 3 | 4 |
| 1. 我想像自己在賭博時的內心感受
 | 1 | 2 | 3 | 4 |
| 1. 我想像自己在賭博時身體上的感官體驗（例如視、聽、觸、嗅、味覺）
 | 1 | 2 | 3 | 4 |
| 1. 如果我長時間沒有賭博，我的腦中就不斷地想賭博及其相關的事情
 | 1 | 2 | 3 | 4 |
| 1. 一想起賭博，我就很難停下來
 | 1 | 2 | 3 | 4 |
| 1. 一想起賭博，我就會想個不停，直到我可以賭博為止
 | 1 | 2 | 3 | 4 |
| 1. 我在心裏反覆對自己說我需要去賭博
 | 1 | 2 | 3 | 4 |
| 1. 每當賭博出現在我的腦海，我就開始想像與它相關的情境
 | 1 | 2 | 3 | 4 |
| 1. 我在腦海里如放電影般想像自己在賭博
 | 1 | 2 | 3 | 4 |
| 1. 我滿腦子都反覆想著賭博，直到我可以賭博為止
 | 1 | 2 | 3 | 4 |

**備註:**《中文版關於賭博的渴望性思維量表》的雙因子結構與其原版Desire Thinking Questinnaire (Caselli & Spada, 2011) 一致，其中條目4、5、6、7、10為言語性持續，條目1、2、3、8、9為圖像性預想。