A Family Study of Executive Function in Gambling Disorder

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Introduction

- ***GAMBLING DISORDER (GD)***
  - Characterized by persistent and habitual patterns of problematic gambling despite negative consequences, leading to clinically significant impairments (American Psychiatric Association, 2013).
  - Presence and severity of gambling symptoms predict functional outcome (Kourgiantakis et al., 2013).
- ***FAMILY STUDIES***
  - Some argue that gambling disorder carries the potential to indicate addiction vulnerability markers unconfounded by the neurotoxic impact of chronic substance use (Verdeja-Garcia, et al., 2008), although neuroplasticity resulting from exposure to chronic cycle of wins and loses undermines this proposition (Draganski et al., 2004)
  - Alternative method is studying unaffected family members using an endophenotype approach (Ersche et al., 2010)
  - Family studies offer a unique opportunity to assess the manifestation of possible vulnerability markers in a sample which shares not only genetic by environmental risk factors (Hodgins et al., 2010).
- ***NEUROCOGNITION***
  - Executive functions are a group of high-order cognitive processes identified as necessary for the formation and execution of successful goal-oriented behaviours (Lezak., 2012).
  - Several cognitive processes included within executive functions have been hypothesized to play critical roles within the pathophysiology of GD
  - Results suggest individuals diagnosed with GD consistently report elevated levels of impulsivity (Kräplin et al., 2014), reduced capacity to delay gratification (Amlung et al., 2017), a reduced capacity to inhibition responses (Chowdhury et al., 2017), and elevated propensity for risky behaviours (Wilson & Vassileva, 2018).
  - Given inconsistencies, additional research characterizing the cognitive profile of individuals diagnosed with GD and their familial relatives are needed.

Objectives

- Investigate the manifestation of a broad range of higher-order cognitive processes in a sample of GD.
- Investigate similarities and differences regarding neurocognitive performance between a sample of GD, their unaffected familial relatives, and a sample of community controls.

Hypotheses

1. .Performance on tasks that measure response inhibition and decision-making (i.e., capacity to delay gratification) will be impaired within the GD sample compared to the relative and control sample.
2. Performance on tasks measuring visual-spatial working memory, planning, risk-taking, and cognitive control will be statistically similar between the GD sample, their familial relatives, and the community controls.
3. Performance of the relative sample will be worst than the control sample and better than the GD sample within domains predicted to be impaired within the GD sample

Contact Information

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Methodology

- ***Participants***
  - GD Group: 40
  - Relative Group: 19
  - Control Group: 50
- ***Design***
  - Two testing sessions
  - Session 1: Confirmation of eligibility and diagnosis
  - Session 2: Completion of neuropsychological measures
- ***Statistical Analyses***
  - Separate univariate or multivariate analyses of variance were conducted for between group differences reflected within performance on each of the neurocognitive tests administered

Clinical Assessments	Neuropsychological Measures
Structured Clinical Interview for the DSM-5-CV	Color-Word Interference Test
Composite International Diagnostic Interview	Tower of London Task
Problem Gambling Severity Index	Spatial Working Memory Task
Hamilton Depression Rating Scale	Stop-Signal Anticipation Task
Young Mania Rating Scale	Balloon Analogue Risk Task
Wechsler Test of Adult Reading	Delayed Discounting Task
Social and Occupational Functioning Assessment Scale	

Results

Table 1. Means (Standard Deviations) of Primary Outcome Measures for Executive Function

	Probands	*Relatives*	*Controls*	*Contrasts*
CWIT ($\bar{x}$, SD)	(*n* = 38)	(*n* = 17)	(*n* = 41)	
Condition 1. Colour Naming	9.39 (2.63)	9.47 (1.33)	10.05 (2.17)	N.S
Condition 2. Reading Score	10.13 (2.42)	9.82 (1.94)	10.88 (1.57)	N.S
Condition 3. Inhibition	**10.50 (2.42)**	**9.76 (2.14)**	**11.56 (2.25)**	**P*/R** > C**
Condition 4. Inhibition/Switching	10.63 (2.42)	10.35 (1.90)	11.07 (2.39)	N.S
Inhibit vs. Colour Naming	11.00 (2.63)	10.60 (.199)	11.68 (1.93)	N.S
Inhib/Swit vs. Cond 1+2	10.63 (2.79)	10.67 (1.59)	10.78 (1.73)	N.S
Inhib/Swit vs. Inhibition	10.26 (1.64)	10.60 (2.17)	9.77 (1.83)	N.S
Inhib/Swit vs. Colour Naming	11.26 (3.10)	11.20 (1.74)	11.45 (2.01)	N.S
Inhib/Swit vs. Word Reading	10.42 (2.86)	10.60 (2.10)	10.53 (1.68)	N.S
Colour Naming Scaled Errors	77. 32 (37.95)	74.83 (41.94)	95.62 (18.57)	N.S
Reading Scaled Errors	78.16 (39.05)	89.50 (30.60)	95.19 (20.04)	N.S
Inhibition Scaled Errors	10.08 (2.05)	10.39 (2.09)	10.89 (1.37)	N.S
Inhib/Swit Scaled Errors	10.78 (1.65)	10.67 (1.53)	10.89 (1.51)	N.S
ToLT ($\bar{x}$, SD)	(*n* = 36)	(*n* = 17)	(*n* = 45)	
Total Achievement	10.73 (1.64)	11.18 (3.37)	10.45 (2.29)	N.S
Total Rule Violations (%Rank)	**63.58 (35.50)**	**90.47 (21.23)**	**74.16 (34.81)**	**R > P ****
Mean 1st Move Time (Scaled)	9.17 (3.68)	8.35 (3.12)	8.53 (3.69)	N.S
Time-Per-Move-Ratio (Scaled)	9.83 (2.75)	8.71 (2.87)	10.11 (1.96)	N.S
Move Accuracy (Ratio)	9.22 (3.05)	9.76 (2.77)	8.69 (2.63)	N.S
Rule Violation Per Item (Ratio)	10.11 (1.70)	10.71 (.47)	10.04 (2.15)	N.S
SWMT ($\bar{x}$, SD)	(*n* = 36)	(*n* = 15)	(*n* = 47)	
Maintenance Score	17.83 (1.40)	16.87 (1.80)	17.76 (1.59)	N.S
Maint Reaction Time (s)	31.84 (11.97)	30.74 (6.12)	31.16 (14.28)	N.S
Manipulation Score	15.77 (2.33)	15.80 (1.82)	16.15 (2.23)	N.S
Manip Reaction Time (s)	42.89 (14.97)	37.41 (5.91)	37.84 (16.62)	N.S
SSAT ($\bar{x}$, SD)	(*n* = 24)	(*n* = 12)	(*n* = 30)	
SSP 17%	820.86 (28.36)	823.07 (31.63)	818 (23.00)	N.S
SSP 20%	821.52 (27.52)	827.45 (34.55)	825.15 (24.47)	N.S
SSP 25%	821.07 (28.56)	827.08 (31.19)	827.43 (23.58)	N.S
SSP 33%	825.75 (28.29)	826.84 (37.22)	828.44 (23.69)	N.S
SSP Overall	820.71 (25.88)	823.71 (31.91)	822.42 (20.53)	N.S
SSRT	259.75 (28.72)	242.54 (9.23)	246.59 (29.80)	N.S
BART ($\bar{x}$, SD)	(*n* = 36)	(*n* = 16)	(*n* = 43)	
Total Adjusted Score	5738.33 (1896.69)	5962.35 (2225.67)	5764.77 (2156.36)	N.S
Total Number of Pumps	803.88 (342.80)	737.29 (314.77)	750.54 (369.21)	N.S
Average Reaction Time (ms)	**309.58 (133.20)**	**348.22 (164.80)**	**261.48 (85.44)**	**R > C***

Notes. CWIT: Colour-Word Interference Task; ToLT: Tower of London Task; SWMT: Maintenance & Manipulation task; SSAT: Stop-Signal Anticipation Test; SSP: Stop-Signal Probability; SSRT: Stop Signal Reaction Time; BART: Balloon Analogue Risk Task, * $p < .05$, ** $p < .005$

Table 2. Delayed Discounting Task Outcome Variables Organized by Group

	Proband (*n* = 22)	Relatives (*n* = 10)	Controls (*n* = 31)
Indifference points ($\bar{x}$, SD)			
$\bar{x}$	.396	.477	.479
SD	.257	.303	.315
AUC ($\bar{x}$, SD)			
$\bar{x}$	**.114**	**.181**	**.281**
SD	.132	.190	.301

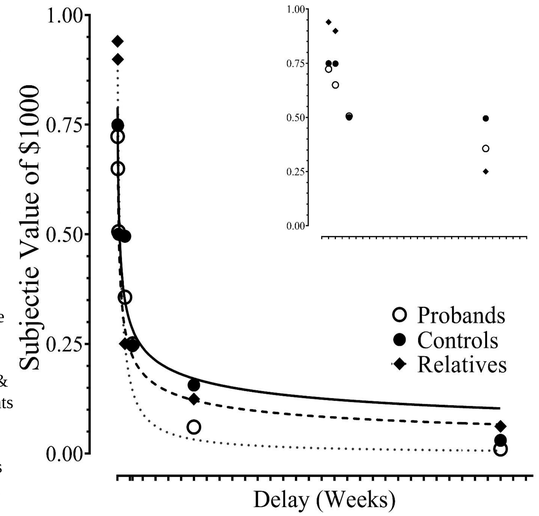

Figure 1. Discounting models organized by study group. Points on the figure represent median indifference points with lines indicating the best fitting discounting function (Myerson & Green, 1995). The inset figure represents the same data. The X-axis has been scaled to better represent the median indifference points at the shorter delays (i.e., one week, two weeks, one month, & 6 months).

Discussion & Conclusion

- Proposed hypotheses received mixed support
  - Performances reflecting capacity to inhibit response and delay gratification were poorer within the GD sample compared to both the control and relative sample.
  - Inhibition impairment was not generalized and was instead only observed regarding verbal response inhibition.
  - Performance on measures of cognitive control, planning, visuospatial working memory, and risk-taking were statistically similar between the three study samples.
- Preliminary evidence supporting response inhibition and impulsive choice deficits as possible vulnerability markers for the development of GD.
- Further research should directly explore variation in inhibition impairment based on task modality and clinical characters of the sample.