

An analysis of the *DRD4* genotype as a determinant of risk and/or sensation-seeking behavior related to career choice

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Abstract

The *DRD4* gene and associated receptor has been extensively studied and linked to a variety of psychological conditions from ADHD to Depression. It has also been linked to behaviors and personality types most prominently related to behavior. As research in the field of behavioral neurogenetics expands, there are many unanswered existential questions: How much of thought and behavior is written in genetic material? How much is determined by the environment? And what is left for individuals to decide for themselves? This study attempted to answer some of the aforementioned questions as it evaluated the impact of variants of the *DRD4* gene on risk seeking behavior, and further, how those features relate to career choice of undergraduate students. This was accomplished through risk and sensation-seeking behavioral surveys, DNA sample collection, PCR amplification, and fragment analysis. Ultimately, no relationship was found between either risk or sensation-seeking behavior, *DRD4* genotype, and career choice. Results of this study provide for further discussion into the historic nature versus nurture debate; while, it gathered more data about and provides additional insight for potential pathways associated with the prevalence of psychological conditions observed in populations of first responders and other high risk populations.

Introduction

The dopamine receptor 4, *DRD4* has recently been widely studied in the field of behavioral neurogenetics due to its apparent links to psychological disorders such as Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Major Depressive Disorder (MDD), Schizophrenia, and Addiction and Substance Abuse which has been shown to prevail across race and demographic differences (Cheuk, Li, and Wong, 2006), (Frank, Pergolizzi, and Perilla, 2004), (Hattori et al., 2009); additionally, it has been shown to be related to behavioral states such as aggression and risk taking (Dmitrieva et al., 2011). For the purposes of this study, *DRD4* will be analyzed as it related to risk-seeking and sensation-seeking behavior as well as career path and other demographics.

The gene that codes for *DRD4* contains a VNTR unit that can be present between 2 and 11 times with the most common alleles having 4 repeats (4R), 7 repeats (7R), and 2 repeats (2R) in that order (Ostadali et al. 2005). Previous research has hypothesized that although most of the variety of VNTR units present does little to impact the functionality of the produced receptor protein, the *DRD4-7R* allele corresponds to a decreased dopaminergic response in individuals (Dmitrieva et al., 2011). This has been the cornerstone of the *DRD4-7R* risk taking behavior link hypothesis. Because individuals who have the *DRD4-7R* allele are less susceptible to a dopaminergic response, they would be more likely to pursue behavior to reach the same dopamine-driven thrill level as an individual with a different *DRD4* allele for a lesser action.

The hypothesis of this study was that cohorts of students seeking careers in first-responder fields such as firefighting, criminal justice, and emergency medicine will score higher on risk and sensation-seeking scales and have a higher proportion of the *DRD4-7R* allele than cohorts of students seeking less risky careers.

Methods

- Obtain buccal cell samples, demographics survey, DOSPERT Scale survey, and Zuckerman Sensation Seeking survey from each participant.
- Cell samples were processed to isolate DNA according to the NEB Monarch DNA Purification Kit
- Purified DNA samples were amplified through a polymerase chain reaction according to the following specifications:
 - 25 μ L Taq PCR Mastermix 2x
 - 19 μ L Molecular Grade Water
 - 4 μ L Working Primer solution
 - 2 μ L DNA Purification Product
- 1x: 95.0°C 1:00
- 50x: 95.0°C 0:30, 50.0°C 0:30, 72.0°C, 1:00
- 1x: 72.0°C 30:00, 20.0°C Hold
- The DNA amplicons were then analyzed on the QIAxcel Advanced Instrument
- DNA analysis results were compared to career choice, demographic information, and results of the DOSPERT and Zuckerman Scales.

Results

- The results of the relationship between risk-seeking behavior and career choice is included in *Table 1*: The *p*-value for the differences between first responder career choice and non was *p*=.8079. Similarly, the relationship between sensation-seeking and the same two groups is included in *Table 2*: The *p*-value for the differences between first responder career choice and non was *p*=.6925.
- The results of the relationship between risk-seeking behavior between male and female gender participants is included in *Table 3*: The *p*-value for the differences between first responder career choice and non was *p*=.0018. Similarly, the relationship between sensation-seeking and the same two groups is included in *Table 4*: The *p*-value for the differences between first responder career choice and non was *p*=.1125.
- The relationship between risk-seeking behavior and cumulative GPA is included in *Table 5*: The *p*-value for the differences between first responder career choice and non was *p*=.0605. Similarly, the relationship between sensation-seeking and the same two groups is included in *Table 6*: The *p*-value for the differences between first responder career choice and non was *p*=.0889.
- The proportion of *DRD4* alleles found across all participants is included in *Table 7*.

Table 1: DOSPERT Risk Behavior Scores by Career Choice

Career Choice	n	(M/SD)	t-cal	t-crit	df	p	Decision
First Responder	47	106.7(14.0)	0.2441	1.98	71	0.8079	Fail to Reject
Non-First Responder	26	104.0(16.9)					

Table 2: Zuckerman's Sensation-Seeking Scores by Career Choice

Career Choice	n	(M/SD)	t-cal	t-crit	df	p	Decision
First Responder	47	106.5(15.8)	0.3971	1.98	71	0.6925	Fail to Reject
Non-First Responder	26	105.0(14.8)					

Table 3: DOSPERT Risk Behavior Scores by Gender

Gender	n	(M/SD)	t-cal	t-crit	df	p	Decision
Male	40	110.3(13.9)	3.25	1.98	71	0.0018	Reject
Female	33	99.5(14.4)					

Table 4: Zuckerman's Sensation-Seeking Scores by Gender

Gender	n	(M/SD)	t-cal	t-crit	df	p	Decision
Male	40	106.5(15.8)	1.61	1.98	71	0.1125	Fail to Reject
Female	33	105.0(14.8)					

Table 5: DOSPERT Risk Behavior Scores by GPA

Grade Point Average	n	(M/SD)	t-cal	t-crit	df	p	Decision
Above Median (3.5)	37	102.1(12.1)	1.91	1.98	71	0.0605	Fail to Reject
Below Median (3.5)	36	108.7(17.1)					

Table 6: Zuckerman's Sensation-Seeking Scores by GPA

Grade Point Average	n	(M/SD)	t-cal	t-crit	df	p	Decision
Above Median (3.5)	37	117.9(4.6)	1.73	1.98	71	0.0889	Fail to Reject
Below Median (3.5)	36	20.1(6.2)					

Table 7: Proportion of DRD4 Alleles Identified Across All Samples

DRD4-2R	DRD4-3R	DRD4-4R	DRD4-5R	DRD4-6R	DRD4-7R	DRD4-8R	DRD4-9R
0.368	0.019	0.151	0.443	0.000	0.009	0.009	0.000

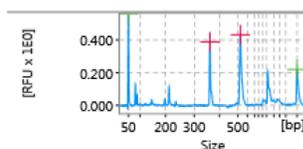


Figure 1

Discussion

For the behavior analysis, first, the relationship between behavior and career choice was evaluated. As seen in *Table 1* and *Table 2*, there was neither a significant difference between the two groups of participants for risk-seeking nor sensation seeking behavior (*p* > 0.05). Accordingly, the study fails to reject the null hypotheses that there are no differences for risk and sensation seeking behavior between first responder and non first responder students. Second, the data was analyzed to observe any differences in behavior and gender of the participants. As seen in *Table 3* and *Table 4* there was a significant difference between male and female students for risk-seeking behavior (*p* < 0.05); however, there was no difference between the groups for sensation seeking behavior (*p* > 0.05). Third, the data was analyzed to observe any differences in behavior and GPA of the participants. As seen in *Table 5* and *Table 6*, there was neither a significant difference between the two groups of participants for risk-seeking nor sensation seeking behavior (*p* > 0.05).

For the genetic analysis, the distribution of alleles isolated from the DNA samples (*Table 7*) was widely inconstant with the actual distribution of alleles in the population. This suggests that the primers used for amplification may have selectively amplified (a) different gene(s) over the *DRD4* gene. Accordingly, the genetic results are currently inconclusive. Further analysis including sequencing of DNA amplicons may provide additional insight.

Ultimately, the results of this study do not support the hypothesis that there are relationships between the genotype of the *DRD4* gene, risk taking, sensation seeking, and career choice.

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