Identification of Potentially Influential Genes in Pursuing Expertise in the Performing Arts

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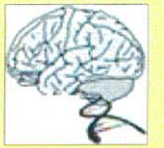


SUMMARY

Individuals who are experts in creative activities, such as the Performing Arts, may be more likely to have specific combinations of genetic variants related to specific pathways in the brain's frontal cortex, especially on the Dopaminergic pathway, as compared to individuals who are not Performing Artists. The Dopaminergic pathway is involved in Motivating, Rewarding and Reinforcing behaviors, Cognitive Processes such as Executive Functions (attention, working memory), and Novelty-Seeking — factors vital to the creative mind. The findings may provide insight into differences between persons who do and do not pursue and achieve creative expertise [1,2]

BACKGROUND

Association Studies Examine variants of genes, called Single Nucleotide Polymorphisms (SNPs, pronounced "snips"), and their correlation with psychological/behavioral phenotypes and/or cognitive functions

Most

Test atypical populations in relation to brain/cognitive functions[3,4]
Schizophrenia + Working Memory + COMT gene

Some

Study the general population using psychological tests to identify specific groups of typical individuals in relation to brain/cognitive functions[5,6]
Extroverts + Attention + DRD4 gene

One study

Dancers + genes associated with behaviors[7]
Social AVPR1a, Ritualistic SLC6A4

What are SNPs? Small genetic variations that occur within a person's DNA sequence. Humans have many SNPs

NEW QUESTION

Are there genetic factors involved in pursuing and achieving creative expertise?

NEW APPROACH

Expertise in creative activity across 3 domains
Dance, Music, Theatre

Richer array of SNPS
+ Cognitive, Reasoning, Creativity, Motor

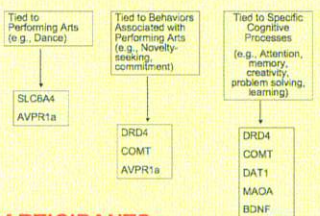
Searching the Dopaminergic & Serotonergic pathways for combinations of SNPs that differ between Experts in creative activity versus those without

HYPOTHESIS

Specific neural pathways may be important to expertise in creative activities

METHODS

WHY THESE GENES?



PARTICIPANTS

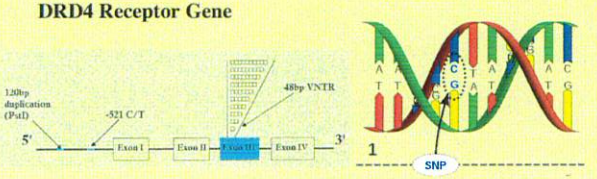
Participants had similar, and high SAT scores, academic performance, ethnicity, SES

Group	n	Performing Arts Experience
Dancers	18	> 8+ years continuous training, started before age 7, professional performances, active prior to and at time of testing, practices avg. 7 hours p.w., finds pleasurable (on personal scale)
Musicians	20	
Actors (Theater)	20	
Non-Art	36	< 3 years TOTAL Arts combined experience (across Dance, Music, Theater), finds not pleasurable

GENES - SINGLE NUCLEOTIDE POLYMORPHISMS (SNP)

SNP - A small genetic variation at a specific location in the genomic sequence that may have functional consequences, such as increase or decrease of a specific neurotransmitter

DRD4 Receptor Gene



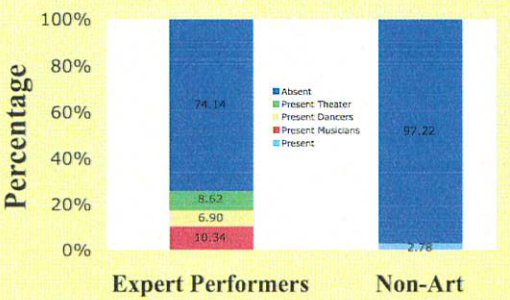
SNPs EVALUATED - BUCCAL SWABS

Pathway	Gene	Locus
Dopamine	DRD4	bp -521 exon 3 **bp 120 L/S***
	DAT1	3' VNTR
	COMT	**position 158 Val/Met***
Serotonin	SLC6A4	intron 2 VNTR 5HTT Promotor
	MAOA*	Exon 14 EcoRV Promotor VNTR
Vasopressin	AVPR1a	RS1 RS3
Other	BDNF	position 166

*also involved with dopamine and norepinephrine

RESULTS

We conducted a logistic regression of the SNP results for each pathway. It was significantly more common for Performing Artists than Novices to exhibit the Long/Short allele on DRD4 (bp 120; $p < .015$) and the Val158Met allele on COMT ($p < .015$). These genetic variants are involved in the dopaminergic system and mediates, for example, reasoning, reward, pleasure, motor processing, and perseveration



COMBINATION OF COMT (Val158Met) & DRD4 bp 120 Short/Long

Pathway	Gene	Locus	Chi square	Allele
Dopamine	DRD4	exon 3	$p < .005$	Short/Short
Other	BDNF	position 166	$p < .001$	Val/Val

DISCUSSION

We took a novel approach to studying potential links between Genes and Experience by examining (1) persons with creative expertise in 3 artistic domains (Dance, Music, Theatre) as compared to persons with minimal or no expertise in these domains, (2) a richer array of genetic variants (SNPs) linked to Cognitive, Reasoning, Creativity, Motor abilities, and by searching (3) the dopaminergic and serotonergic pathways for combinations of SNPs that differ between Experts in the Performing Artists versus those who are not. Together, this three-pronged approach afforded a new tool to test the hypothesis that specific biological pathways may be important to experts in creative activity, especially in the Performing Arts

It was significantly more common for Performing Artists to exhibit genetic variants involved in the dopaminergic system, particularly involving the DRD4 bp120 gene

CONCLUSIONS

Combinations of genetic variants, rather than specific genetic variants, may be linked to pursuing and achieving expertise in creative activities

These results are preliminary. Following from this research, further studies need to increase sample size using greater population diversity. Genetic factors are *not* deterministic; 25% of the expert Performing Artists showed the specific combination of genetic variants on the *Dopaminergic* pathway, implying that *experience* remains an important factor, and that there may be other genes involved that were not examined. It will be fascinating to study whether those who are truly the world's most acclaimed virtuoso creative experts (e.g., the Martha Graham, Yo-Yo Ma, and Kenneth Branagh creative experts of the world) consistently possess this specific combination of genetic variants

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