

Stimulogenetics: Redefining Neuromodulation in Neuropsychiatry

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Background

- Neuromodulation is the process of targeted modulation, regulation or therapeutic alteration of nervous system activity at the central, peripheral or autonomic levels.
- DBS is currently in clinical use for Parkinson's Disease, PTSD, Mood Disorders, etc. However, DBS is invasive, has poor spatial resolution, and is associated with adverse effects of unknown origin.
- Newer neuromodulation strategies can broaden the scope of neuropsychiatric disease intervention.

Semantic Ambiguity

- Only optogenetics is available on MeSH and other biomedical ontologies.
- Pan et al. (2018) developed a strategy to ultrasonically manipulate T cells labeled with mechanosensory receptors. This strategy was termed mechanogenetics instead of sonogenetics.
- Similarly, Kim et al. (2017) developed magnetoplasmonic nanoparticles which deliver mechanical stimulation to genetically labelled cells calling their strategy mechanogenetics. It could have been potentially classified under magnetogenetics.
- To reduce such conflicts, we advocate formalizing the associated nomenclature.

Stimulogenetics Toolkit

Optogenetics

Chemogenetics

Sonogenetics

Magnetogenetics

Clinical Relevance to Neuropsychiatry

- Stimulogenetic tools are theragnostic, research-friendly, and can target tissue with higher spatial resolution.
- None of the stimulogenetic strategies are currently adopted by clinicians, although they have been shown to be therapeutic in animal models such as for schizophrenia, anxiety and sleep disorders (Huang et al., 2012).
- Currently, chemogenetics and sonogenetics are possibly better suited for clinical applications since they are non-invasive and their effects can reach deep neural tissue.

MeSH tree

Genetic Techniques

- Cellular Reprogramming Techniques
- Chromatin Immunoprecipitation
- Chromosome Mapping
- Cloning, Molecular
- Cloning, Organism
- Contig Mapping
- Crosses, Genetic
- Cytogenetic Analysis
- DNA Fingerprinting
- DNA Footprinting
- Gene Expression Profiling
- Gene Targeting
- Gene Transfer Techniques
- Genetic Association Studies
- Genetic Engineering
- Genetic Testing
- Genotyping Techniques
- In Situ Nick-End Labeling
- Molecular Diagnostic Techniques
- Molecular Epidemiology
- Molecular Typing
- Mutagenicity Tests
- Nuclease Protection Assays
- Nucleic Acid Amplification Techniques
- Nucleic Acid Denaturation
- Nucleic Acid Hybridization

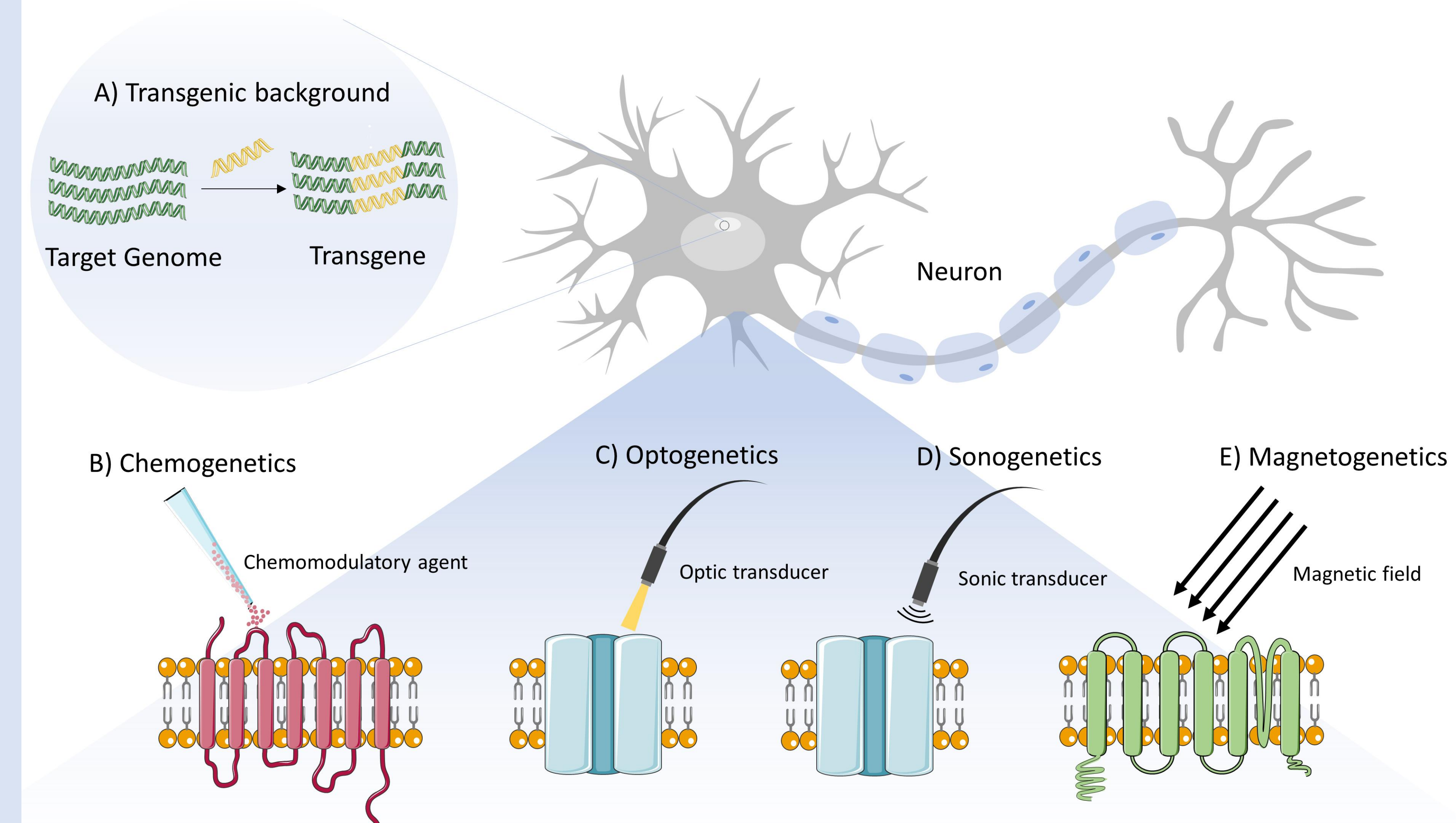
Optogenetics

- Pedigree
- Restriction Mapping
- Reverse Genetics
- Sequence Alignment
- Sequence Analysis
- Viral Pseudotyping

Conclusions

The inclusion of "stimulogenetics" as a MeSH/Ontology term will:

- Allow reliable indexing
- Improve the discoverability of records with similar techniques aiding translation for the management of neuropsychiatric disorders.
- Aid in analyzing information, causal modeling, and maintenance of knowledgebases (WormBase, XenBase, FlyBase etc.)
- 'Stimulogenetics' via its comprehensive definition allows the inclusion of difficult to classify strategies.



References

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All figures are adapted from Garg et al., 2022.