# Bill Griesar, Ph.D.



- Introduction
- Arts-integrated psychology and neuroscience community outreach: good for our students
- A few outreach examples
- DC!
- Hallucinogens: pharmacology and behavior

# Outreach: Brains and Art

nwnoggin.org Bill Griesar, Ph.D., Neuroscience Jeff Leake, MFA, Art

- Graduates
- Undergraduates
- K-12 students
- Scientists
- Artists
- <u>PSU</u>, OHSU, WSU
  Vancouver, Portland
  Art Museum, Phillips



# nwnoggin.org

Neuroscience Outreach Group: Growing in Networks...



# Why outreach?

- Motivation and engagement
- Exploration, creativity, and discovery
- Diversity, personal relevance of STEAM material
- Access to internships, grad school, jobs, careers
- "Let knowledge serve the City"



nwnoggin.org



# Who is involved?





- Academic priority K-12 students
  - Portland/Vancouver Public Schools
- <u>Art, psychology and neuroscience undergraduates</u>
  - Portland State University, Washington State University Vancouver, Pacific Northwest College of Art
- <u>Art, psychology and neuroscience graduate students</u>
  - PSU, WSUV, Oregon Health & Science University, PNCA
- Working artists and scientists

# Where do we go?

- K-12 schools
- Universities
- Retirement communities
- Hospitals
- Science museums
- Art museums
- Conferences
- Homeless shelters
- Bike shops, pubs
- Thousands reached















### P:ear Homeless Youth Center





## **STEAM Outreach: Four types**

### **Classroom visits**



### Public events 问



Multi-day instruction





### Summer Programs (MESA, PPS, GEAR UP)



### Inspired Teaching Charter School, Washington DC





# EXIT Last advertise

Inspired Teaching Charter School, Washington DC



### NW Noggin: Art and Brains

TANOCCIN. DRB DC 2018

BRAINS + ART

ASHING

Portland State

American Brain Coaliti M

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# Hallucinogens

# Drugs that produce unusual sensory, perceptual and cognitive distortions



Derived from plants (mushrooms, cacti); but some are synthetic. Include: **mescaline**, **psilocin**, **DMT**, **LSD** 

# Depictions of the effects of hallucinogens



**Yan Dargent** "Le rêve d'un êthêrês" A depiction of ether-induced hallucinations 1865



Viktor Oliva "The absinthe drinker" 1901

WHEN I WAS YOUNG I TOOK ALOT OF



Robert Crumb "LSD"



# Mescaline

From dried crown of cacti (including **peyote cactus**). Common in northern Mexico, SW U.S.; used for thousands of years in cultural/religious rituals...

Aldous Huxley, 1950's; 1960's rise in U.S. use of peyote

"If the doors of perception were cleansed, the world would appear to man as it is, infinite..." - Blake





# **Psilocybin/Psilocin**



### Magic mushrooms;

psilocybin converted to **psilocin** *in vivo* 





Timothy Leary ("Turn on, tune in, drop out")



Algerian cave painting 3500 B.C. **Timothy Leary** founded the Harvard Psilocybin Project (1960 - 1962)

# Ayahuasca (Hoasca)

### **"Vine of the soul"** Brew from plants containing **DMT** and **beta-carbolines**



**DMT:** hallucinations, cognitive distortions



**Beta-carbolines** *inhibit DMT breakdown* by MAO



Christian Spiritist Sect; use protected by Supreme Court in 2006...





A synthetic **ergot** derivative synthesized by **Albert Hoffman** in 1938 (LSD-25)







ergot fungus

Some derivatives toxic; some clinically useful

LSD re-examined in 1943; Hoffman ingested it (by accident) and took an unusual trip! LSD is a very potent drug...

# **Early applications**

LSD initially available to psychiatrists and medical researchers (1940 - 1962)

**Psycholytic therapy**: Popular in Europe; LSD in psychotherapy to release repressed memories





**Psychedelic therapy**: Popular in U.S.; LSD in high doses for "spiritual" shock



**MK-ULTRA**: 1950's CIA program, secret LSD administration to U.S. citizens; British testing too

# Your brain: made of cells

Neurons



- Neurons carry *electrical* messages
- Neurons connect *chemically* across synapses
- Neurotransmitters



# All cells have membranes



Many drugs, including hallucinogens, cannot get through, but instead act at RECEPTORS to affect neuron function...

Drugs like LSD attach (or "bind") to receptors, changing the activity of affected neurons...

# All hallucinogens act at ONE type of SEROTONIN receptor (5-HT2A)



Potency linked directly to hallucinogenic effects

# Where are these receptors?



Virginia Cornea-Hébert (1999)



Neocortex

– Layer V

- Olfactory cortex
- Hippocampus
- Basal ganglia
- Thalamus
- Cerebellum
  - Brainstem
- Spinal cord

http://www.meduniwien.ac.at/neuroimaging/downloads.html

# Changes in perception

"If the doors of perception were cleansed, everything would appear to man as it is, infinite" - William Blake

"The legs, for example, of that chair - how miraculous their tubularity, how supernatural their polished smoothness"

- Aldous Huxley, "The Doors of Perception" (1954)

"I looked around me and noticed details of physiognomy that had never struck me before. Each pore in my companion's skin was now visible..." - Solomon Snyder, "Drugs and the Brain"

"I clapped my hands and saw sound waves passing before my eyes" - Solomon Snyder, "Drugs and the Brain"



### Hallucinogens Enhance Sensory Responses in the Locus Coeruleus via 5-HT<sub>2A</sub> Receptors

Ordinary stimuli become extraordinary





"...it is of interest that the systemic administration of LSD, mescaline, or other psychedelic hallucinogens in rats, although decreasing spontaneous activity, produces a paradoxical facilitation of the activation of LC neurons by sensory stimuli..." (Aghajanian 1980; Rasmussen & Aghajanian 1986)



Kusama's vast fields of polka dots, or "infinity nets," as she calls them, were taken directly from her hallucinations.

Yayoi Kusama "I pray with all of my love for tulips" at the National Museum of Art, Osaka, 2012

The 50's become the 60's right before your eyes!

# What else do hallucinogens do?

Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin, Carhart-Harris et al, PNAS (2011)

Psychedelic drugs have a long history of use in healing ceremonies, but despite renewed interest in their therapeutic potential, we continue to know very little about how they work in the brain. Here we used psilocybin, a classic psychedelic found in magic mushrooms, and fMRI to capture the transition from normal waking consciousness to the psychedelic state.

Profound changes in consciousness were observed after psilocybin, but surprisingly, only decreases in cerebral blood flow were seen, maximal in hub regions, such as thalamus and anterior and posterior cingulate cortex (ACC and PCC). Decreased activity in the ACC/medial prefrontal cortex (mPFC) was a consistent finding and the magnitude of this decrease predicted the intensity of the subjective effects. Psilocybin caused a significant decrease in the coupling between the mPFC and PCC. These results strongly imply that the subjective effects of psychedelic drugs are caused by decreased activity and connectivity in the brain's key connector hubs, enabling a state of unconstrained cognition.

# Greater functional connectivity

Homological scaffolds of brain functional networks, G. Petri, et al (2014)



"there is an increased integration between cortical regions in the psilocybin state... One possible by-product of this greater communication across the whole brain is the phenomenon of synesthesia which is often reported in conjunction with the psychedelic state..."



Charles Burchfield, Autumnal Fantasy 1916-1944

# Changes in sense of "self"

"Worse than the demonic transformations of the outer world were the alterations that I perceived in myself...Every exertion of my will, every attempt to put an end to the dissolution of my ego, seemed to be wasted effort."

-Albert Hoffman (1948)

"The fear, as I analyze it in retrospect, was of being overwhelmed, of disintegrating under a pressure of reality greater than a mind, accustomed to living in a cozy world of symbols, could possibly bear."

- Aldous Huxley, "The Doors of Perception" (1954)

"Who am I?"

- Solomon Snyder, "Drugs and the Brain"



"There was no doubt that this poor man was mad, but there is something in the madness of this man which interests me more than the sanity of Lord Byron and Walter Scott." William Wordsworth

William Blake "The Ghost of a Flea" 1819–1820

# "Default mode" network

Critical for... Self-reflection Self awareness Rumination

Decreased activity on hallucinogens (psilocybin)





- 3. ANTERIOR MIDDLE CINGULATE CORTEX
- 4. PRECUNEUS
- 5. POSTERIOR CINGULATE CORTEX
- 6. INFERIOR PARIETAL LOBULE
- 7. HIPPOCAMPUS

Source: Immordino-Yang, M.H., Christodoulou, J.A., & Singh, V. (2012). Rest is not idleness: Implications of the brain's default mode for human development and education. *Perspectives on Psychological Science*, 7, 352-364. Adapted with permission.

Carhart-Harris et al, PNAS (2011)

# Is there a link between creativity and hallucinogens?



Created under the influence of a psychedelic in a clinical setting (Roubíček 1961) mushroominspired image created by a French subject in Paris.





Mandalas created before (left) and during (right) an LSD session conducted in 1972 at the Maryland Psychiatric Center

### What artists come to mind when thinking of hallucinogenic drugs? Salvador Dali



Rene Magritte

### Hieronymus Bosch



Jackson Pollock





### Hallucinogens as a strategy for making art

### **Stanislaw Witkacy**

**Type A** -- Suitable rather for women's faces than for men's. Slick execution, with a certain loss of character in the interest of beautification or accentuation of "prettiness".

**Type B** -- Intensification of character, bordering on caricature. The head larger than natural size. The possibility of preserving "prettiness" in women's portraits, and even of intensifying it in the direction of the "demonic."

### Type C, C + Co, E, C + H, C + Co + E, etc. --

Subjective characterization of the model, caricatural intensification both formal and psychological are not ruled out. Approaches abstract composition, otherwise known as Pure Form.



Stanislaw Witkacy "Self-portrait" 1938

Witkacy made this portrait under the influence of mescaline.



Stanislaw Witkacy "Teodora Bialynickiego-Birul " 1929



Witkacy made this portrait under the influence of peyote.

Stanislaw Witkacy "Neny Stachurskiej" 1929



Henri Michaux "Dessin Sous Mescaline" 1956



Henri Michaux "Dessin Sous Mescaline" 1962

Michaux's self-transcended drawings "*Dessin mescalinien*" from 1956/1957 – were done during various phases of neurological excitement induced by mescaline