Creative Thinking

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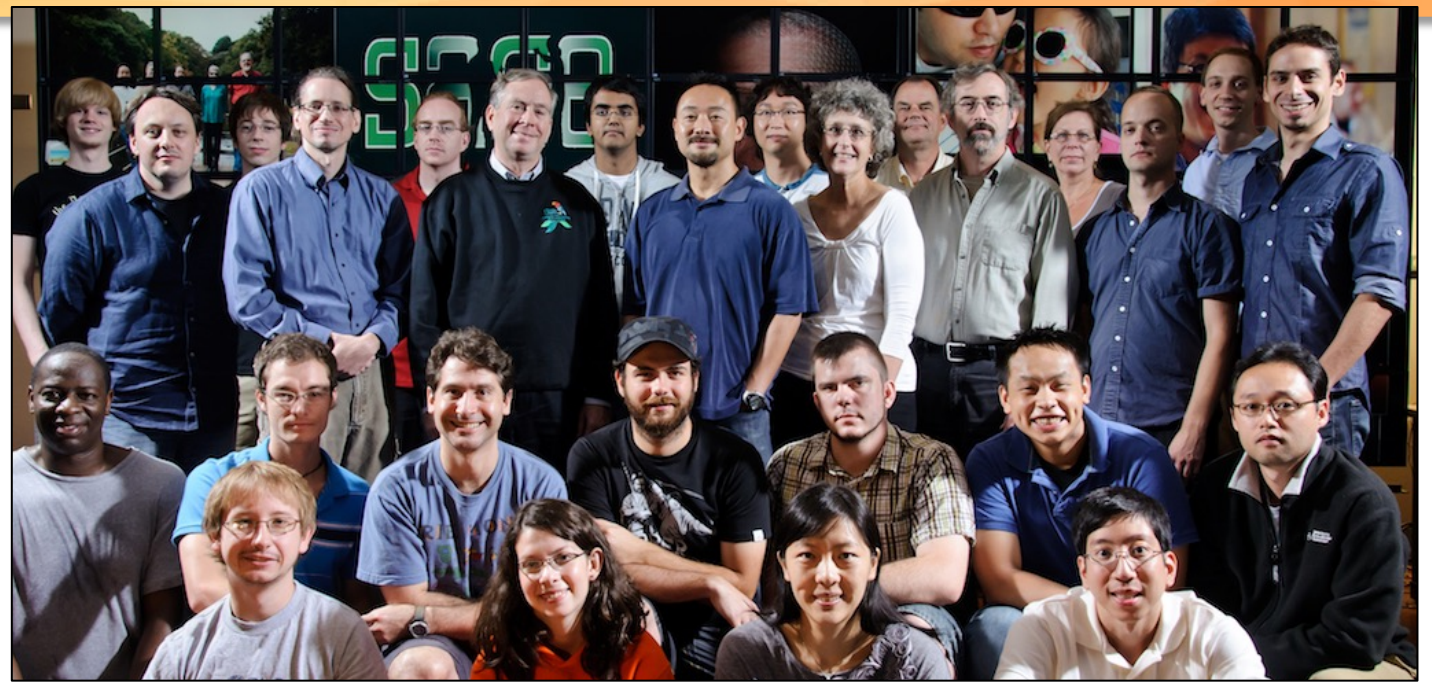
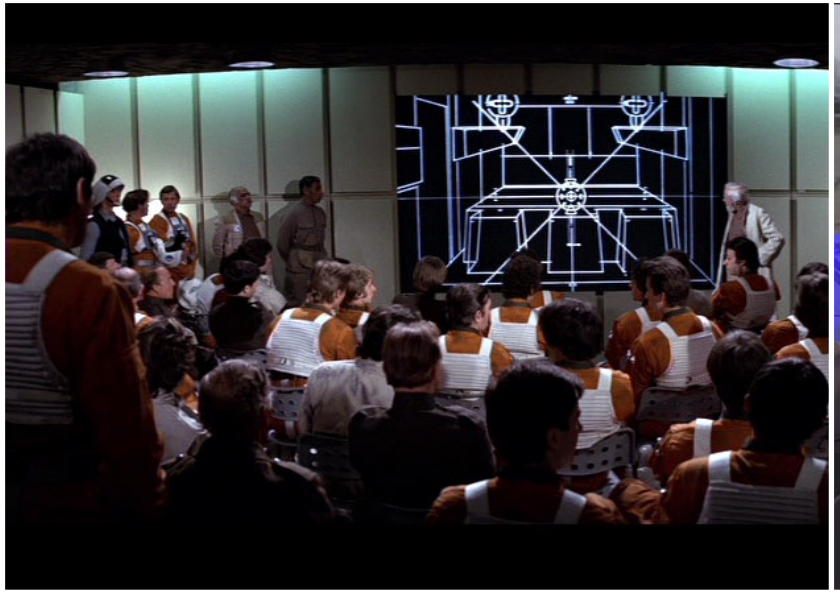
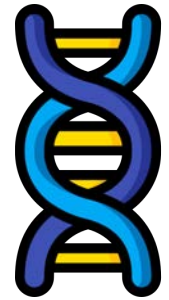


Electronic Visualization Laboratory, University of Illinois at Chicago



What Does Science Say About Creativity?



Ukkola-Vuoti, L., Kanduri, C., Oikkonen, J., Buck, G., Blancher, C., Raijas, P., ... & Järvelä, I. (2013). Genome-wide copy number variation analysis in extended families and unrelated individuals characterized for musical aptitude and creativity in music, PLoS One, 8(2), e56356.

Extra copy of the Glucose Mutarotase Gene. Gene involved in the release of Serotonin- neurotransmitter that promotes neural connections. GALM increases production of serotonin & brain's ability to use it.

Jung, R. E., Mead, B. S., Carrasco, J., & Flores, R. A. (2013). The structure of creative cognition in the human brain, Frontiers in human neuroscience, 7.

Forget the idea: Left is logical part of your brain, Right is creative.

- Language is on the left but creativity draws on multiple interacting brain networks.
- 3 brain networks
- Executive Attention Network depends on your working memory, and is active when you're focused on a task
- Imagination Network / Default Mode Network - creates mental simulations about future events & is active when you consider other peoples thoughts or perspectives.
- Salience Network - monitors your internal consciousness and events that occur outside your body so it can direct your attention to what's most important / what is the most salient in our environment / what is most interesting to us
- When all networks are active it can actually **diminish** creativity
- **Reducing executive attention network a little can boost creativity**

Fassbender, C., Zhang, H., Buzy, W. M., Cortes, C. R., Mizuiri, D., Beckett, L., & Schweitzer, J. B. (2009). A lack of default network suppression is linked to increased distractibility in ADHD, Brain research, 1273, 114-128.

- Study of ADHD in children and adults showed that people with ADHD have more active imagination networks and less execute attention network vs neurotypical.
- Focused attention has been shown to limit spontaneity.

Limb, C. J., & Braun, A. R. (2008). Neural substrates of spontaneous musical performance: an FMRI study of jazz improvisation, PLoS One, 3(2), e1679.

- Jazz musicians inside an fMRI machine found that when they were improvising their imagination networks were more active.
- But when they just played over-learned musical sequence their executive attention network were more active.

Pisapia, N. et al, Brain Networks for Visual Creativity : a Functional Connectivity Study of Planning a Visual Artwork, Nature, Scientific Reports 6, Article 39185 (2016).

- When planning an artwork: Found stronger connection between IN (Imagination Network) and EN (Executive Control Network), and this effect was enhanced in professional artists as compared to non-professional.
- IN creates spontaneous ideas, EN approves the promising ones for further thought.
- In other-words **pros know how to better manage the communication between the IN and ECN to be creative** and to produce useful creative ideas. They know how and when to dial up and down IN vs ECN. (more about this later)

Can Creativity be Trained, Honed or Taught?

Berkowitz, A. L., & Ansari, D. (2008). Generation of novel motor sequences: the neural correlates of musical improvisation, Neuroimage, 41(2), 535-543.

- Pro dancers, artists, musicians were compared with novices in their fields.
- During mental or active improvisational sessions like compose 5 note tune or mentally compose a drawing or mentally perform a dance, **pros thought about the task differently engaging different parts of their brain than novices.**

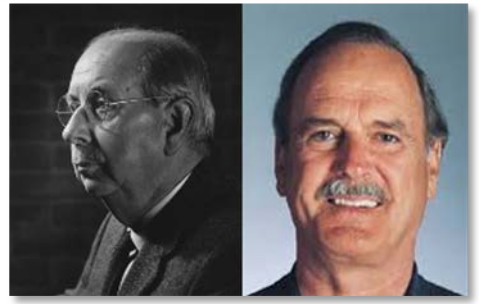
So How Do We Become More Creative?

The model of the 3 brain networks suggests we want to control these networks in a way that they are not competing, so we need to structure the way we create ideas so that this competition does not happen.

Treat it like learning a skill. Regular practice. Like learning to play an instrument. You can't expect to be able to be creative to meet a deadline tomorrow, unless you're trained with skills to do so.

- Conditions
- Mechanics

Conditions for Creativity



Based on work of Donald MacKinnon (Berkeley) & later John Cleese

Creativity is not a talent. It is a way of operating.

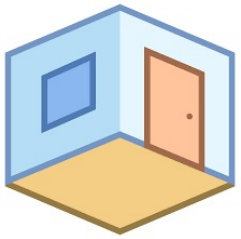
Creative people put themselves in a “mood” that allowed their natural creativity to function.

An ability to play and even to be childlike.
In this state people are able to explore and discover, even though there may not be any immediate practical purpose to their play.
Play for its own sake is the key.

Open & Closed Mode of Working

- You can describe the way people work in these two ways.
- Closed mode is the mode we are in most of the time when we are at work.
- Creativity is not possible in the closed mode.
- Open mode is more relaxed, less purposeful, more contemplative, and more inclined to humor.
- The open mode is more playful and curiosity can operate for its own sake since there is less pressure to get to a particular goal quickly.
- Play allows our natural creativity to surface.

Conditions Necessary to be More Creative



1. ## Space

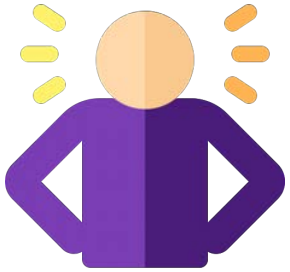
   - Cannot be creative in your "work" environment since there you are focused on getting the job done. You are in closed mode. You need a space that gets you away from that.

2. ## Time

   - Creative time must be scheduled (90 minutes) – a specific start time and end time. Otherwise it is too easy to drift back to work mode.
   - Must not use the Space/Time Oasis to sneak back to get work done.

3. ## Deferring Decisions

   - More creative people are willing to tolerate the discomfort of not solving the problem quickly in order that they may discover a much better and more original solution.
   - Deferring decisions makes people in meetings uncomfortable (especially in a results driven world) and has to be overcome in order for creativity to happen.



4. ## Confidence

- You need confidence to be free to play. Open to trying anything without fear of it not working.
- You cannot be playful if you are frightened of being wrong.
- In your creative oasis you play with ideas, you do not judge them.

5. ## Humor

- Humor gets us from closed mode to open mode faster than anything else.
- Laughter creates relaxation & humor widens our perspective.
- Do not confuse being serious with being solemn. Laughter does not make what you are working on less serious.

- When the creative “work” is done and you now have to implement the decisions, being creative is bad. Now it’s time for the Closed Mode.
- But after implementation and you are reviewing the feedback, open mode is good again.

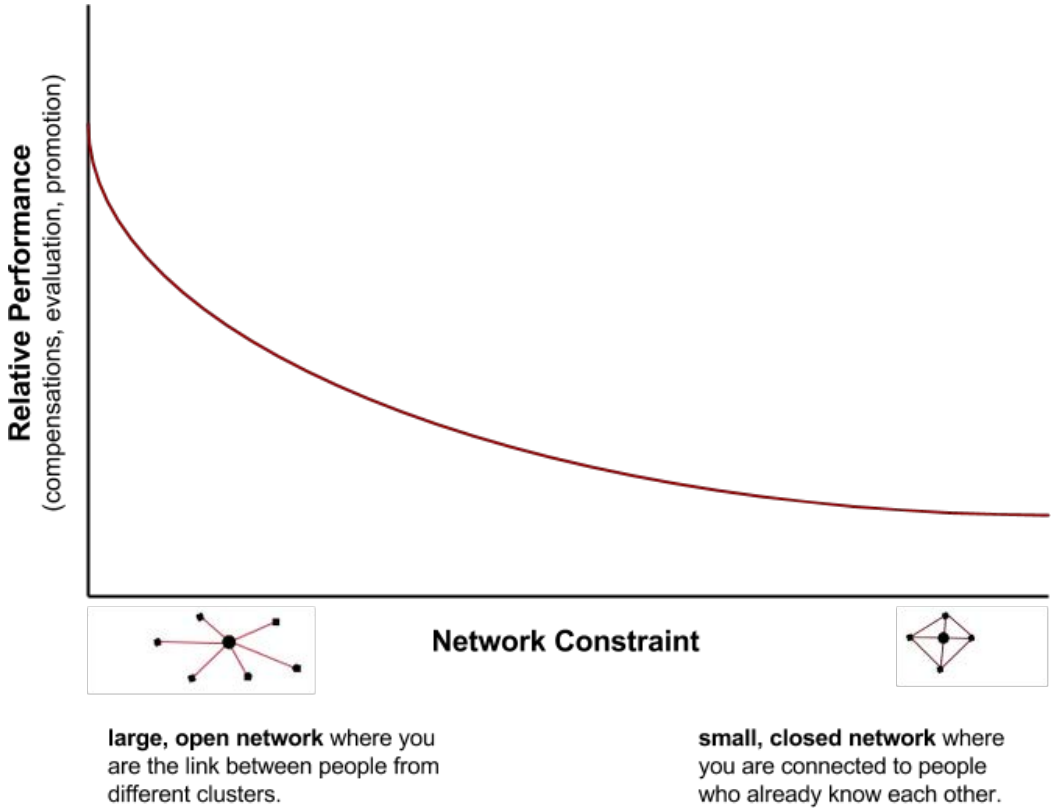
Importance of Collaboration

- Steven Johnson – American popular science author & media theorist
- “Where Good Ideas Come From”
- Myth of the brilliant individual in a Eureka Moment.
- There is a long gestation period before a good idea emerges.
- It comes from random collisions with other ideas from other people over long periods of time.

- https://www.youtube.com/watch?v=NugRZGDbPFU

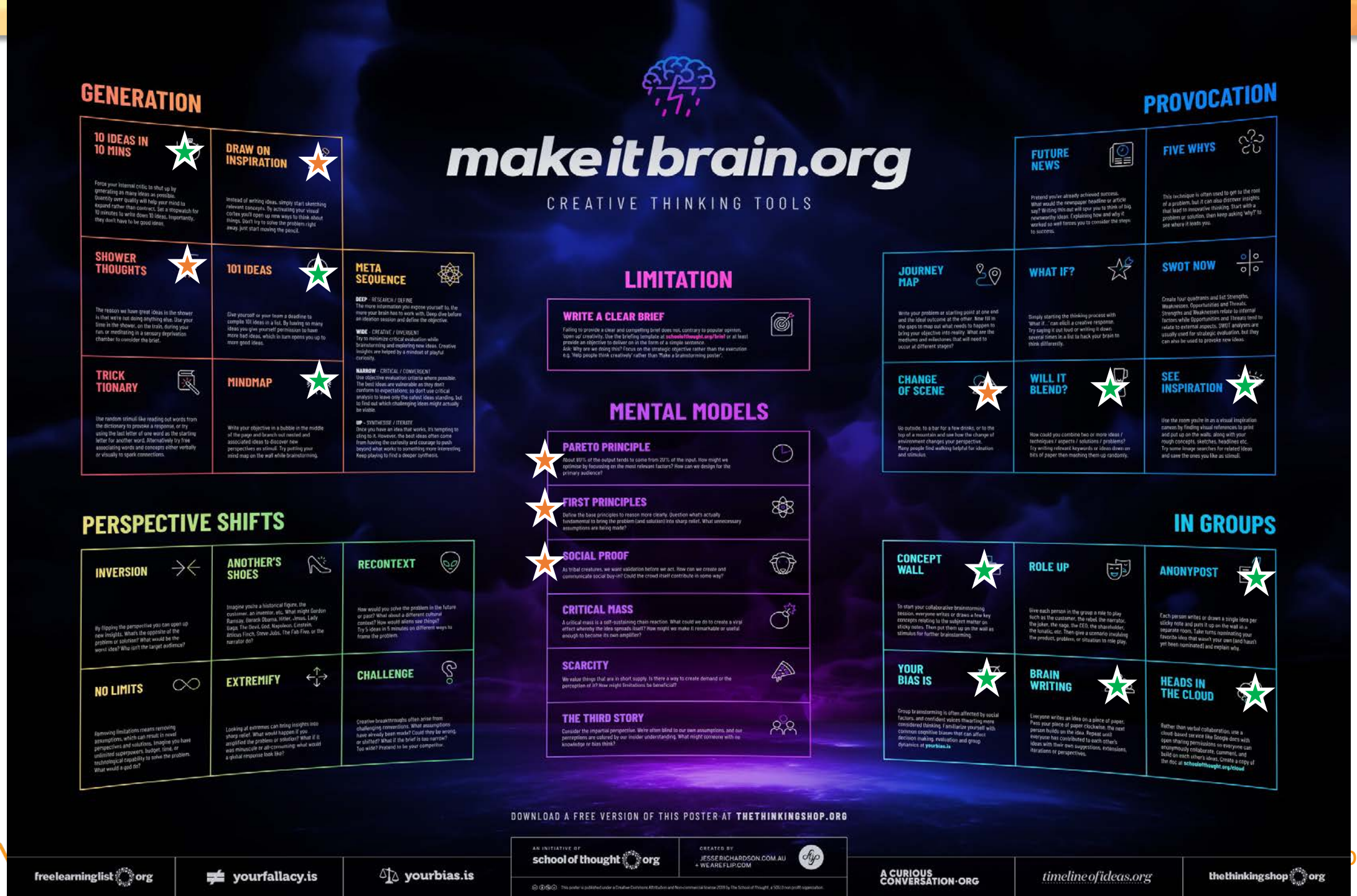
Single Variable That Explains What Really Causes Career Success

- Ron Burt – University of Chicago Booth School of Business



Mechanics

- Disney Animators – fast and furious sketching.
- Pick the medium you are most comfortable with getting the most ideas out as fast as possible – paper, typing, drawing, postits etc.
- It cannot just be thinking to yourself. Your working memory can only hold ~7 things at a time.
- There are many possible methods.
- First time you do these you will feel subconscious & it may not be rewarding.
- It takes **practice** to figure out which methods work best for you.
- Brainstorm on your own first, then bring your ideas to a meeting.


GENERATION
10 IDEAS IN 10 MINS
Force your internal critic to shut up by generating as many ideas as possible. Quantity over quality will help your mind to expand rather than contract. Set a stopwatch for 10 minutes to write down 10 ideas. Importantly, they don't have to be good ideas.
DRAW ON INSPIRATION
Instead of writing ideas, simply start sketching relevant concepts. By activating your visual cortex you'll open up new ways to think about things. Don't try to solve the problem right away, just start moving the pencil.
SHOWER THOUGHTS
The reason we have great ideas in the shower is that we're not doing anything else. Use your time in the shower, on the train, during your run, or meditating in a sensory deprivation chamber to consider the brief.
101 IDEAS
Give yourself or your team a deadline to compile 101 ideas in a list. By having so many ideas you give yourself permission to have more bad ideas, which in turn opens you up to more good ideas.
META SEQUENCE
DEEP - RESEARCH / DEFINE
The more information you expose yourself to, the more your brain has to work with. Deep dive before an ideation session and define the objective.
WIDE - CREATIVE / DIVERGENT
Try to minimize critical evaluation while brainstorming and exploring new ideas. Creative insights are helped by a mindset of playful curiosity.
NARROW - CRITICAL / CONVERGENT
Use objective evaluation criteria where possible. The best ideas are vulnerable as they don't conform to expectations; so don't use critical analysis to leave only the safest ideas standing, but to find out which challenging ideas might actually be viable.
UP - SYNTHESISE / ITERATE
Once you have an idea that works, it's tempting to cling to it. However, the best ideas often come from having the curiosity and courage to push beyond what works to something more interesting. Keep playing to find a deeper synthesis.
TRICK TIONARY
Use random stimuli like reading out words from the dictionary to provoke a response, or try using the last letter of one word as the starting letter for another word. Alternatively try free associating words and concepts either verbally or visually to spark connections.
MINDMAP
Write your objective in a bubble in the middle of the page and branch out nested and associated ideas to discover new perspectives as stimuli. Try putting your mind map on the wall while brainstorming.
make it brain.org
CREATIVE THINKING TOOLS
LIMITATION
WRITE A CLEAR BRIEF
Failing to provide a clear and compelling brief does not, contrary to popular opinion, 'open up' creativity. Use the briefing template at schoolofthought.org/brief or at least provide an objective to deliver on in the form of a simple sentence.
Ask: Why are we doing this? Focus on the strategic objective rather than the execution.
e.g. 'Help people think creatively' rather than 'Make a brainstorming poster'.
MENTAL MODELS
PARETO PRINCIPLE
About 80% of the output tends to come from 20% of the input. How might we optimise by focussing on the most relevant factors? How can we design for the primary audience?
FIRST PRINCIPLES
Define the base principles to reason more clearly. Question what's actually fundamental to bring the problem (and solution) into sharp relief. What unnecessary assumptions are being made?
SOCIAL PROOF
As tribal creatures, we want validation before we act. How can we create and communicate social buy-in? Could the crowd itself contribute in some way?
CRITICAL MASS
A critical mass is a self-sustaining chain reaction. What could we do to create a viral effect whereby the idea spreads itself? How might we make it remarkable or useful enough to become its own amplifier?
SCARCITY
We value things that are in short supply. Is there a way to create demand or the perception of it? How might limitations be beneficial?
THE THIRD STORY
Consider the impartial perspective. We're often blind to our own assumptions, and our perceptions are colored by our insider understanding. What might someone with no knowledge or bias think?
PROVOCATION
FUTURE NEWS
Pretend you've already achieved success. What would the newspaper headline or article say? Writing this out will spur you to think of big, newsworthy ideas. Explaining how and why it worked so well forces you to consider the steps to success.
FIVE WHYS
This technique is often used to get to the root of a problem, but it can also discover insights that lead to innovative thinking. Start with a problem or solution, then keep asking 'why?' to see where it leads you.
JOURNEY MAP
Write your problem or starting point at one end and the ideal outcome at the other. Now fill in the gaps to map out what needs to happen to bring your objective into reality. What are the mediums and milestones that will need to occur at different stages?
WHAT IF?
Simply starting the thinking process with 'What if...' can elicit a creative response. Try saying it out loud or writing it down several times in a list to hack your brain to think differently.
SWOT NOW
Create four quadrants and list Strengths, Weaknesses, Opportunities and Threats. Strengths and Weaknesses relate to internal factors while Opportunities and Threats tend to relate to external aspects. SWOT analyses are usually used for strategic evaluation, but they can also be used to provoke new ideas.
CHANGE OF SCENE
Go outside, to a bar for a few drinks, or to the top of a mountain and see how the change of environment changes your perspective. Many people find walking helpful for ideation and stimulus.
WILL IT BLEND?
How could you combine two or more ideas / techniques / aspects / solutions / problems? Try writing relevant keywords or ideas down on bits of paper then mashing them up randomly.
SEE INSPIRATION
Use the room you're in as a visual inspiration canvas by finding visual references to print and put up on the walls, along with your rough concepts, sketches, headlines etc. Try some image searches for related ideas and save the ones you like as stimuli.
PERSPECTIVE SHIFTS
INVERSION
By flipping the perspective you can open up new insights. What's the opposite of the problem or solution? What would be the worst idea? Who isn't the target audience?
ANOTHER'S SHOES
Imagine you're a historical figure, the customer, an inventor, etc. What might Gordon Ramsay, Barack Obama, Hitler, Jesus, Lady Gaga, The Devil, God, Napoleon, Einstein, Atticus Finch, Steve Jobs, The Fab Five, or the narrator do?
RECONTEXT
How would you solve the problem in the future or past? What about a different cultural context? How would aliens see things? Try 5 ideas in 5 minutes on different ways to frame the problem.
NO LIMITS
Removing limitations means removing assumptions, which can result in novel perspectives and solutions. Imagine you have unlimited superpowers, budget, time, or technological capability to solve the problem. What would a god do?
EXTREMIFY
Looking at extremes can bring insights into sharp relief. What would happen if you amplified the problems or solution? What if it was minuscule or all-consuming; what would a global response look like?
CHALLENGE
Creative breakthroughs often arise from challenging conventions. What assumptions have already been made? Could they be wrong, or shifted? What if the brief is too narrow? Too wide? Pretend to be your competitor.
IN GROUPS
CONCEPT WALL
To start your collaborative brainstorming session, everyone writes or draws a few key concepts relating to the subject matter on sticky notes. Then put them up on the wall as stimulus for further brainstorming.
ROLE UP
Give each person in the group a role to play such as the customer, the rebel, the narrator, the joker, the sage, the CEO, the shareholder, the lunatic, etc. Then give a scenario involving the product, problem, or situation to role play.
ANONYPOST
Each person writes or draws a single idea per sticky note and puts it up on the wall in a separate room. Take turns nominating your favorite idea that wasn't your own (and hasn't yet been nominated) and explain why.
YOUR BIAS IS
Group brainstorming is often affected by social factors, and confident voices thwarting more considered thinking. Familiarize yourself with common cognitive biases that can affect decision making, evaluation and group dynamics at yourbias.is
BRAIN WRITING
Everyone writes an idea on a piece of paper. Pass your piece of paper clockwise, the next person builds on the idea. Repeat until everyone has contributed to each other's ideas with their own suggestions, extensions, iterations or perspectives.
HEADS IN THE CLOUD
Rather than verbal collaboration, use a cloud based service like Google docs with open sharing permissions so everyone can anonymously collaborate, comment, and build on each other's ideas. Create a copy of the doc at schoolofthought.org/cloud
DOWNLOAD A FREE VERSION OF THIS POSTER AT THETHINKINGSHOP.ORG
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yourfallacy.is
yourbias.is
A CURIOUS CONVERSATION·ORG
timelineofideas.org
thethinkingshop.org

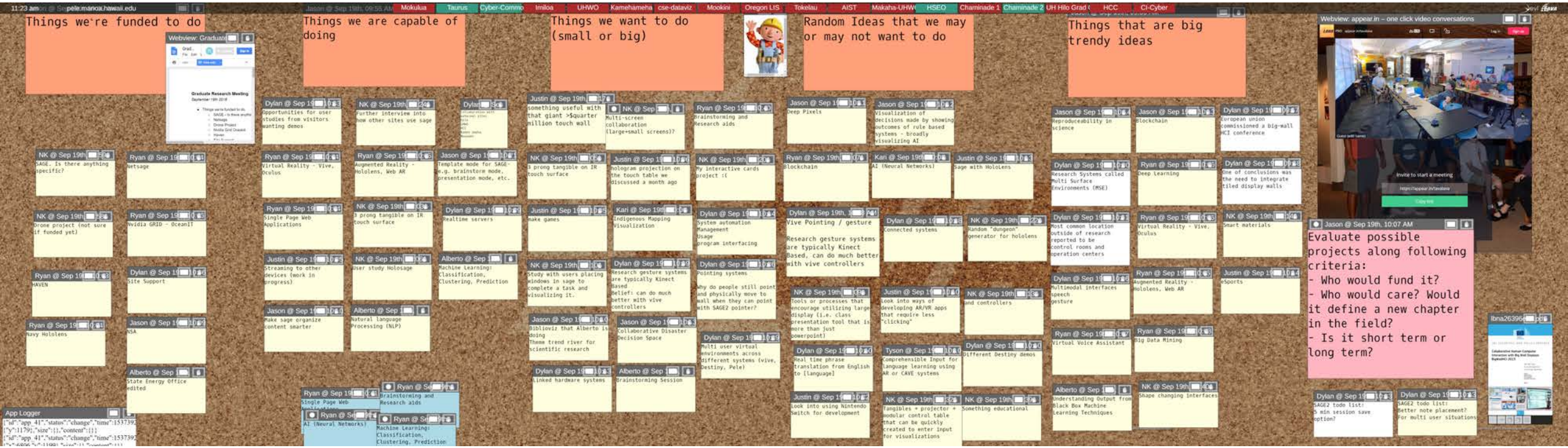
Very SAGEable Methods ★

- Concept Wall
- 10 ideas in 10 mins
- **101 ideas** – allow more flexibility to give bad ideas
- **Blend ideas**
- **See Inspiration** (post pictures)
- **Bias** – we love our own ideas; don't let confident voices drown others out
- Anonymous post
- Write an idea and pass it to next person to add (6 people, 3 ideas, 5 minutes)
- Use a collaborative cloud service (like SAGE3 ☺)

Open Mode Mantra

- Quantity over quality
- Don't judge any ideas
- Encourage wild ideas
- Build on the ideas of others
- Work independently at first

101 Ideas – Persistent Evolving Idea Board



Present | Past | Future | Ideas from Within | Ideas from Without

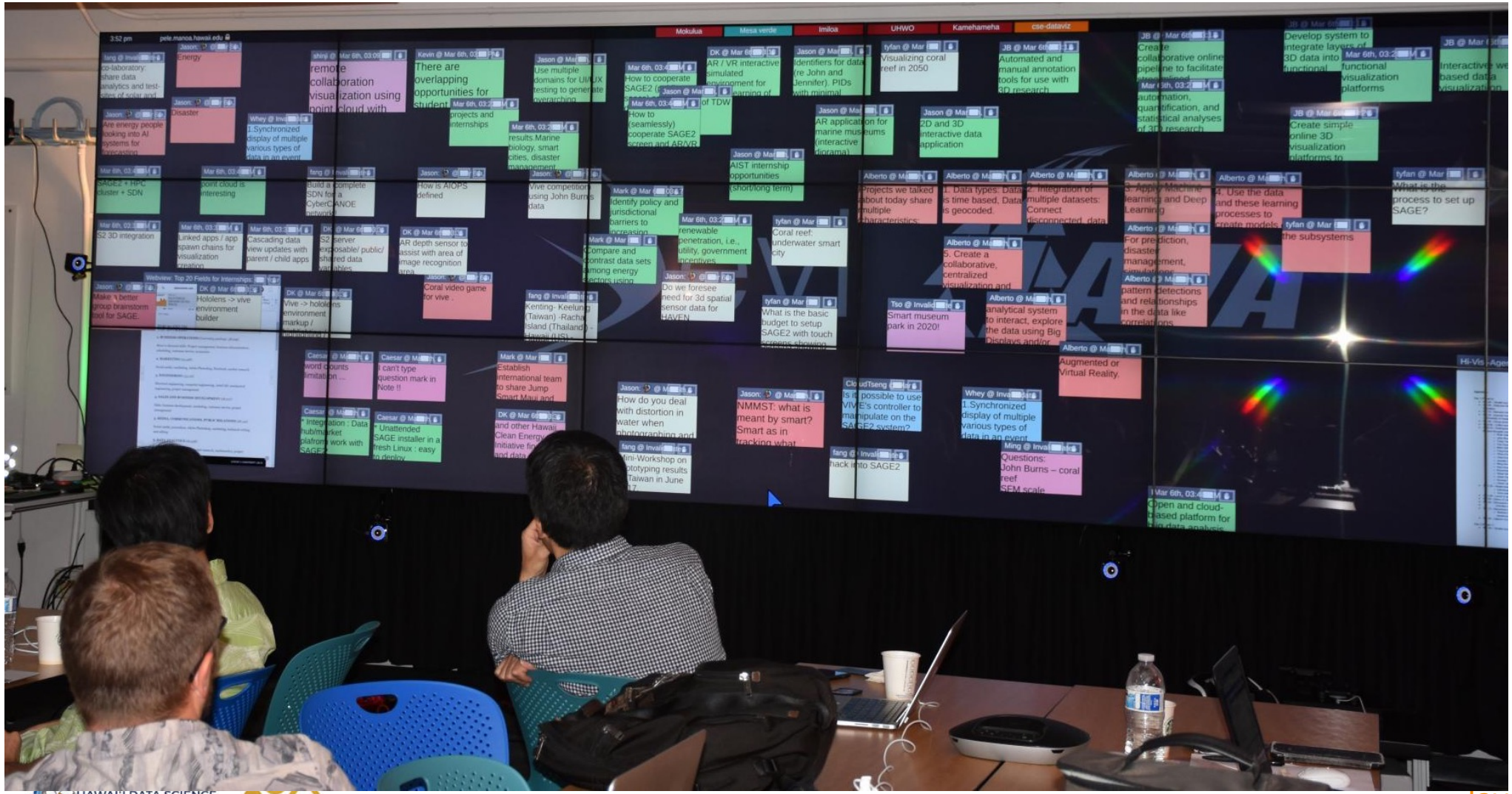
101 Ideas / See Inspiration – BMW Wall of Inspiration

Persistent Evolving Ideas

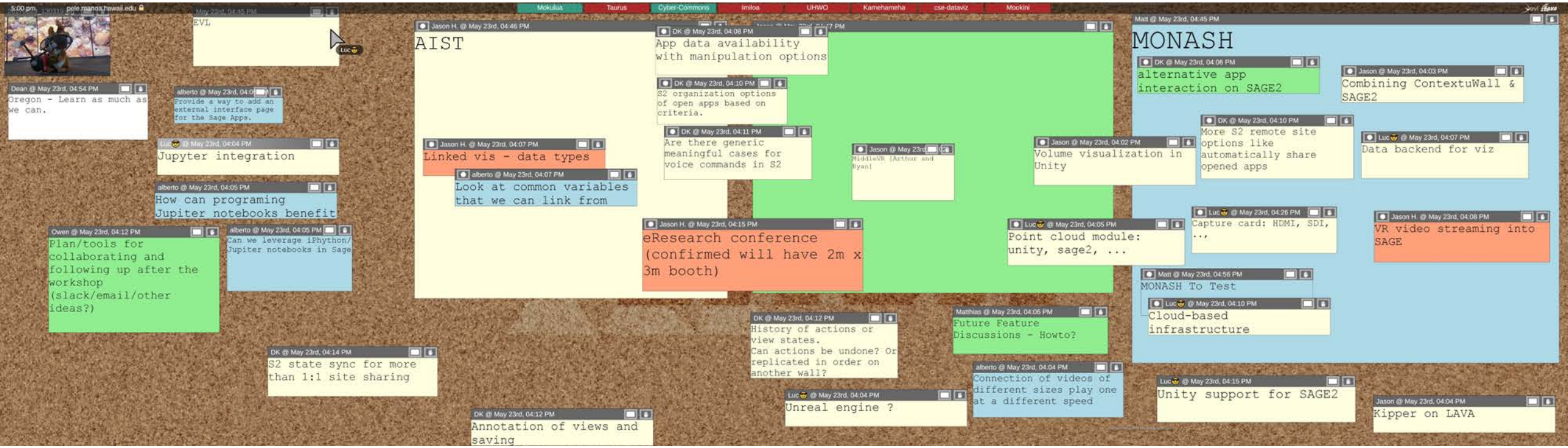
See Inspiration

https://miro.com/app/board/o9J_kpCBBfc=/

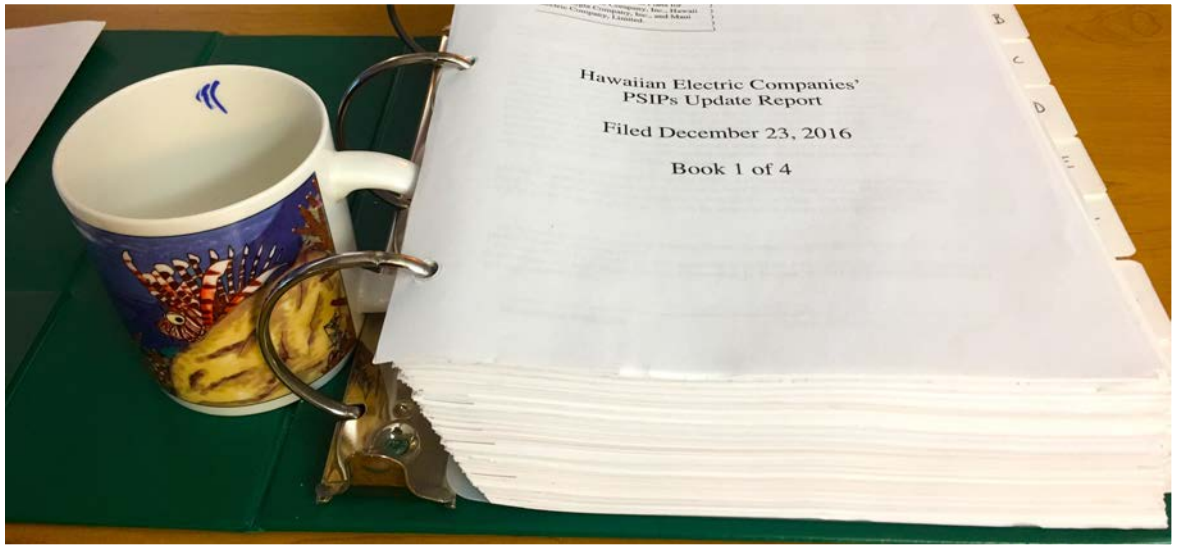
Bias - don’t let confident voices drown others out

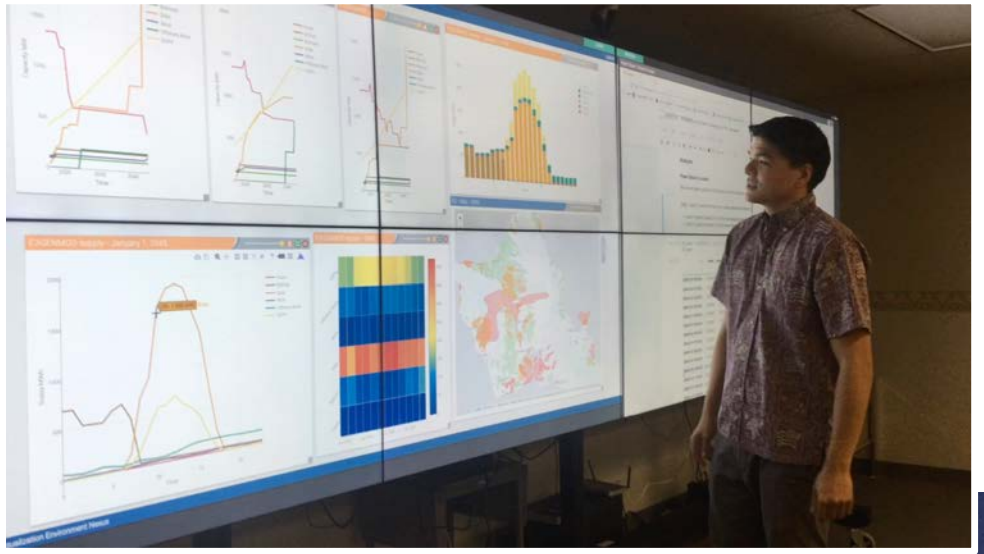


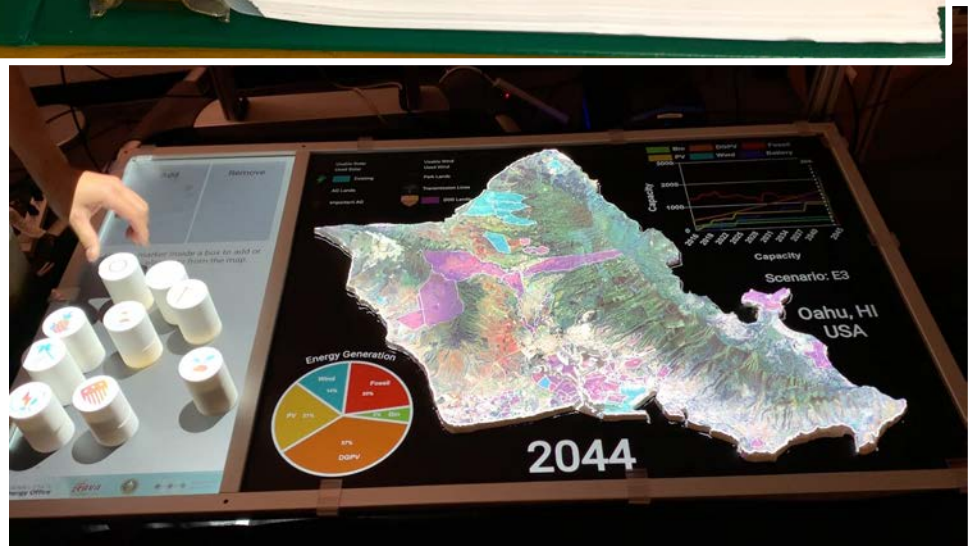
Blend Ideas

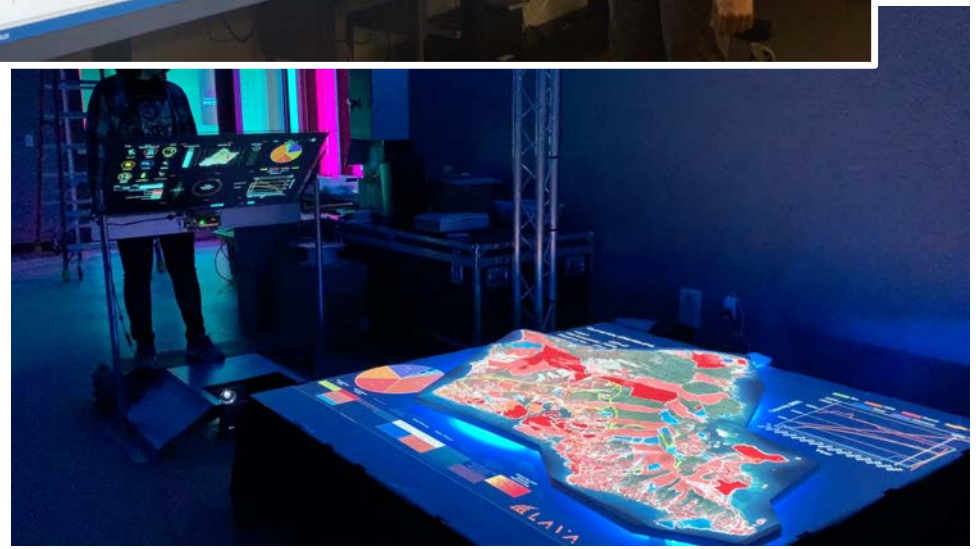

Mokulua
Taurus
Cyber-Commons
Imiloa
UHWO
Kamehameha
cse-dataviz
Mookini
EVL
AIST
App data availability with manipulation options
S2 organization options of open apps based on criteria.
Are there generic meaningful cases for voice commands in S2
Linked vis - data types
Look at common variables that we can link from
eResearch conference (confirmed will have 2m x 3m booth)
Volume visualization in Unity
Point cloud module: unity, sage2, ...
Future Feature Discussions - Howto?
History of actions or view states. Can actions be undone? Or replicated in order on another wall?
Connection of videos of different sizes play one at a different speed
Unreal engine ?
Annotation of views and saving
S2 state sync for more than 1:1 site sharing
Oregon - Learn as much as we can.
Provide a way to add an external interface page for the Sage Apps.
Jupyter integration
How can programing Jupiter notebooks benefit
Plan/tools for collaborating and following up after the workshop (slack/email/other ideas?)
Can we leverage iPhython/ Jupiter notebooks in Sage
MONASH
alternative app interaction on SAGE2
Combining ContextuWall & SAGE2
More S2 remote site options like automatically share opened apps
Data backend for viz
Capture card: HDMI, SDI, ...
VR video streaming into SAGE
MONASH To Test
Cloud-based infrastructure
Unity support for SAGE2
Kipper on LAVA

Blend Ideas - HAVEN

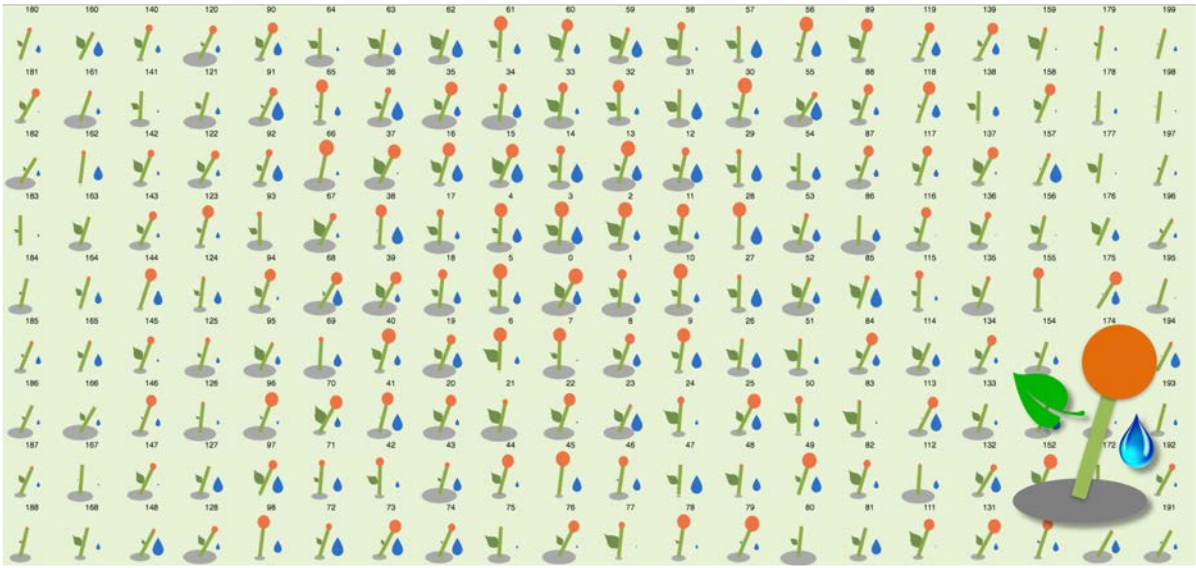






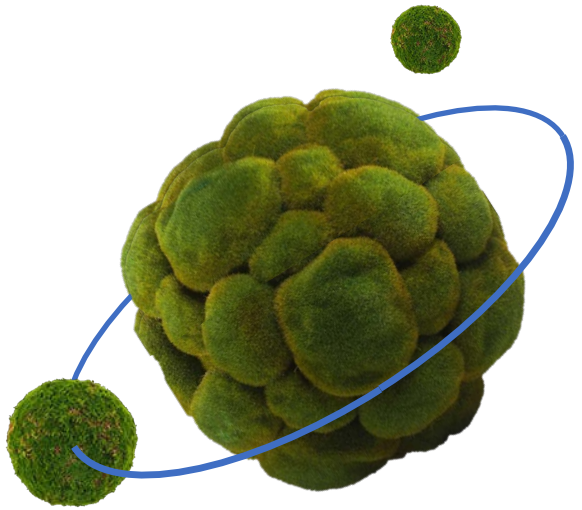


Blend Ideas – HAVEN – Energy Portfolio Garden



Brainstorm Topic

- Hawai‘i Museum of Science and Stuff – **HI-MOSS**
- You are tasked with designing this museum.
- Come up with ideas for what exhibits to put into it.



Consolidate

- Combine Ideas
- Identify Ideas You Like / Vote
- Group ideas- which floors will have which exhibits?

Future Brainstorm Topic: The CyberClub

- CyberClub Community of Practice in Data Science & Cyberinfrastructure
- Graduate Fellows as mentors and ‘cyber ambassadors’ to undergraduates across departments

URLs

- SAGE3 Support
  - tinyurl.com/sagecommunity
- CyberClub
  - tinyurl.com/hawaiidatascienceclub