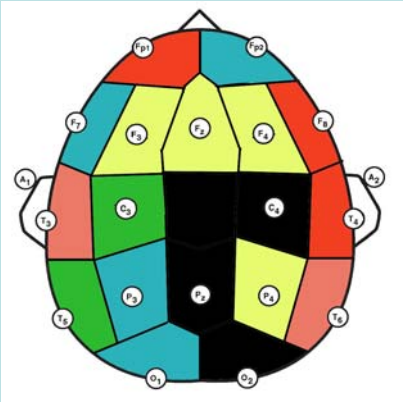
This Is Your Brain On Type

Dario Nardi

San Diego, March 2008



Agenda

- Why?
- What’s neuro-imagining (EEG)?
- Jung’s 8 processes and 16 types.
- Insights into type from research.
- More insights!
- Summary for the 16 types.

Why Explore Type Using Neuro-Imaging?

- Gain insights or resolve long-standing questions about the 16 psychological types.

- Provide neurological evidence to support a more scientific basis for Jung’s / Myer’s theory.

Typical Research Questions

Ex#1: Do your purchasing habits adhere to economic principles of maximum utility?

Ex#2: Should a political candidate focus on appealing to his/her base of voters or reach out to an opponent's base of voters?

Ex#3: Is there a best way for kids to learn mathematics?

Typical Neuro-imaging Studies

Ex#1: Only brain-damage subjects and economists answer according to classical economic theory.

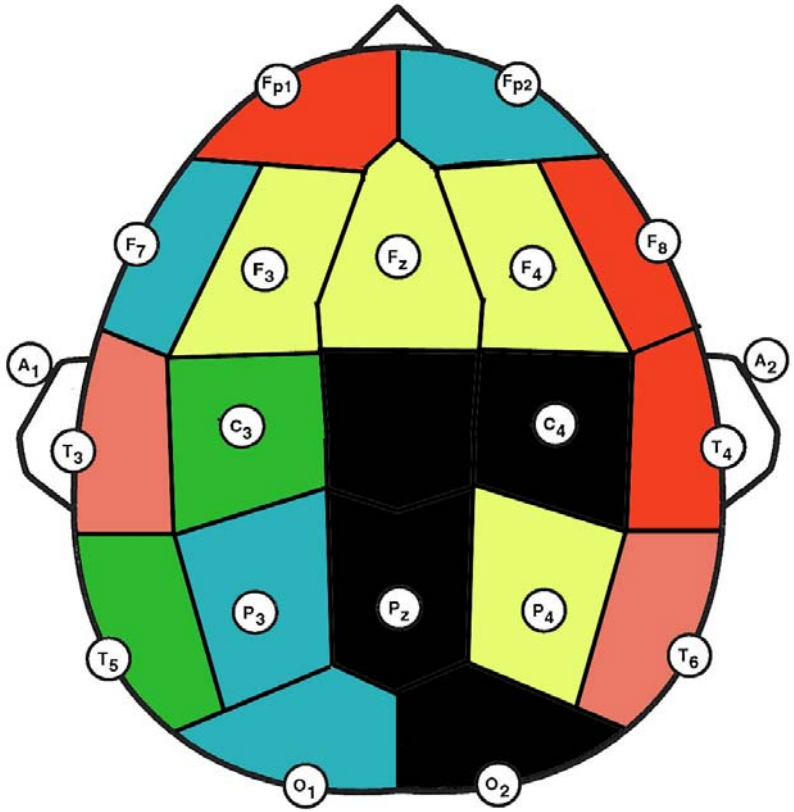
Ex#2: Non-supporters use both emotional and reasoning regions to deny the candidate, while supporters only use emotional regions.

Ex#3: People use differing regions to do math based on the teaching / learning method.

What’s This “EEG” That Your Speak of?

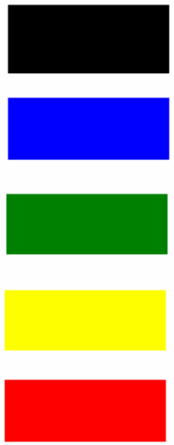
What's EEG?

- Electro-Encephala-Gram.
- Measures frequency and amplitude of electrical activity in the neocortex.
- Is fast, simple and cheap.
- Measures changes in real-time (microseconds).
- Low spatial resolution (19 regions), lots of data, gooey, must calibrate and clean equipment!



EEG Coding Scheme

Frequency in Hertz of electrical activity is represented by color wavelength:



Black: No activity

Blue: Highly Relaxed

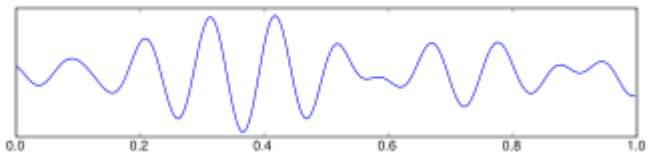
Green: Low-Intermediate level of activity

Yellow: High-Intermediate level of activity

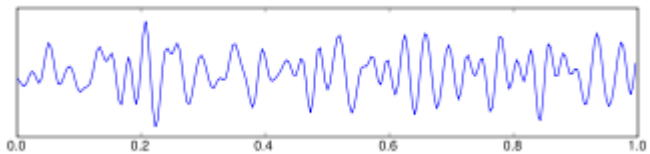
Red: Very active

Amplitude of electrical activity is represented by brightness. Example:
--Bright blue means relaxed but focused (activity in which you have expertise).
--Dull blue means relaxed and unfocused (meditation or drowsiness).

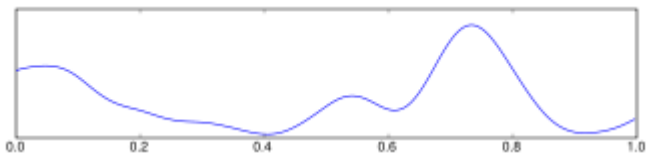
Frequency & Amplitude



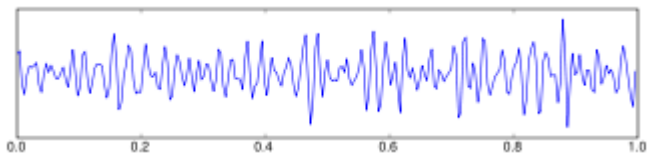
Alpha



Beta



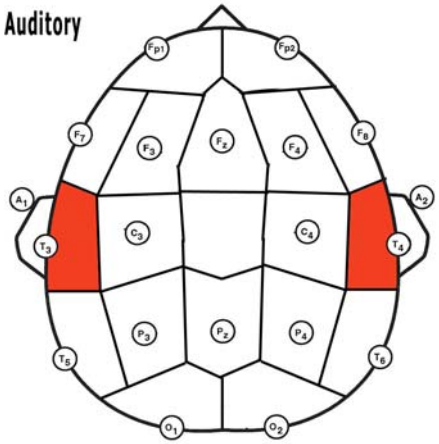
Delta



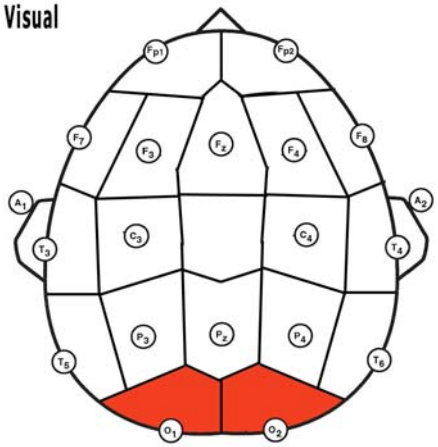
Gamma

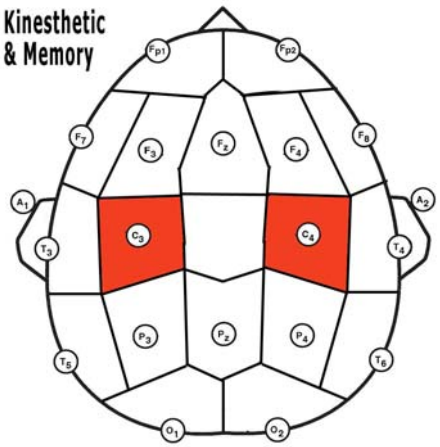
Sensory & Executive Areas

Auditory in T3 and T4.



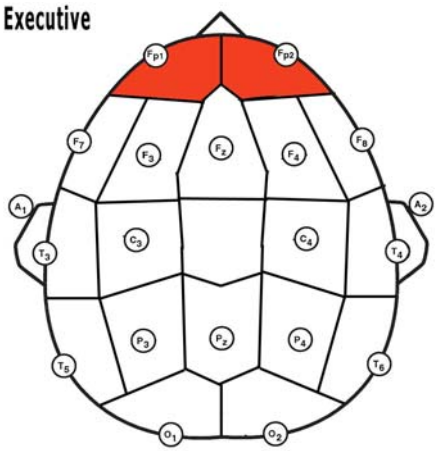
Visual in O1 and O2.



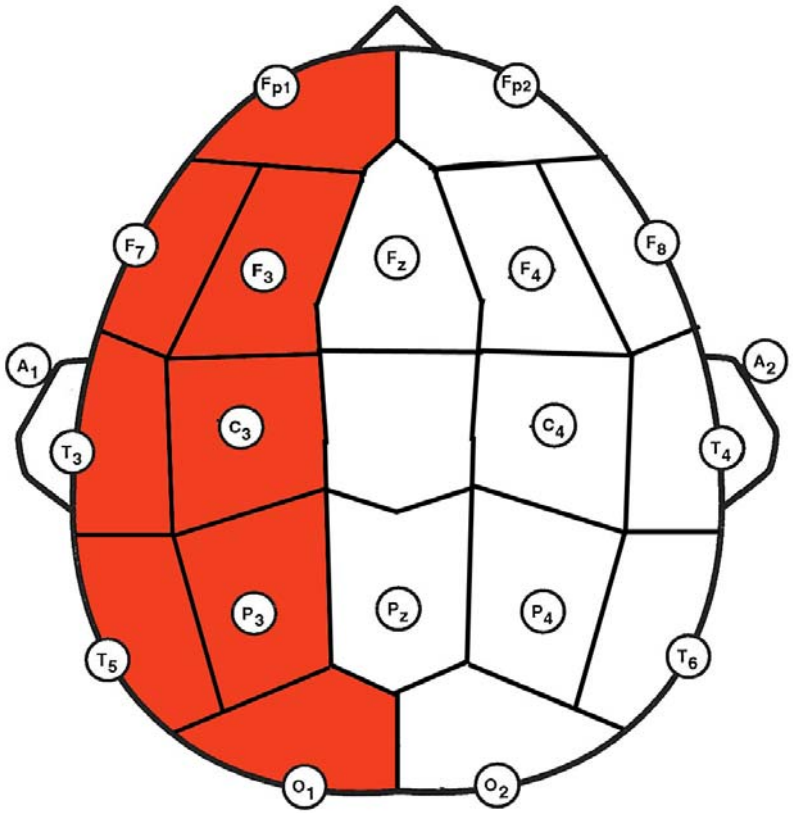


Kinesthetic and memory in C3 and C4.

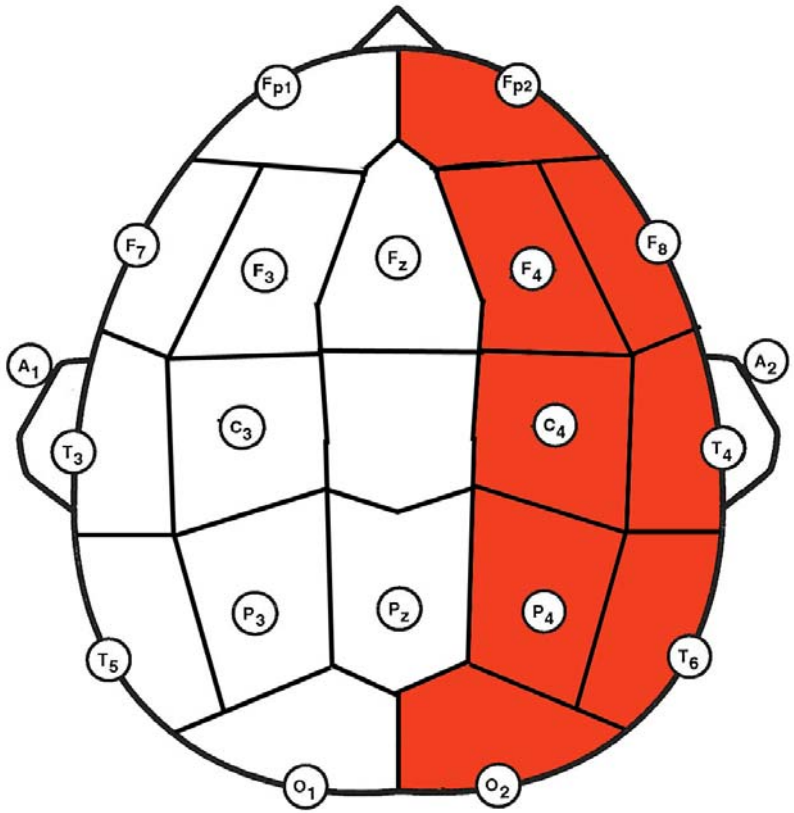
Executive decision-making in FP1 and FP2.



Two Hemispheres



Linear, words, numbers, facts, diagrams, steps, deductive decision-making



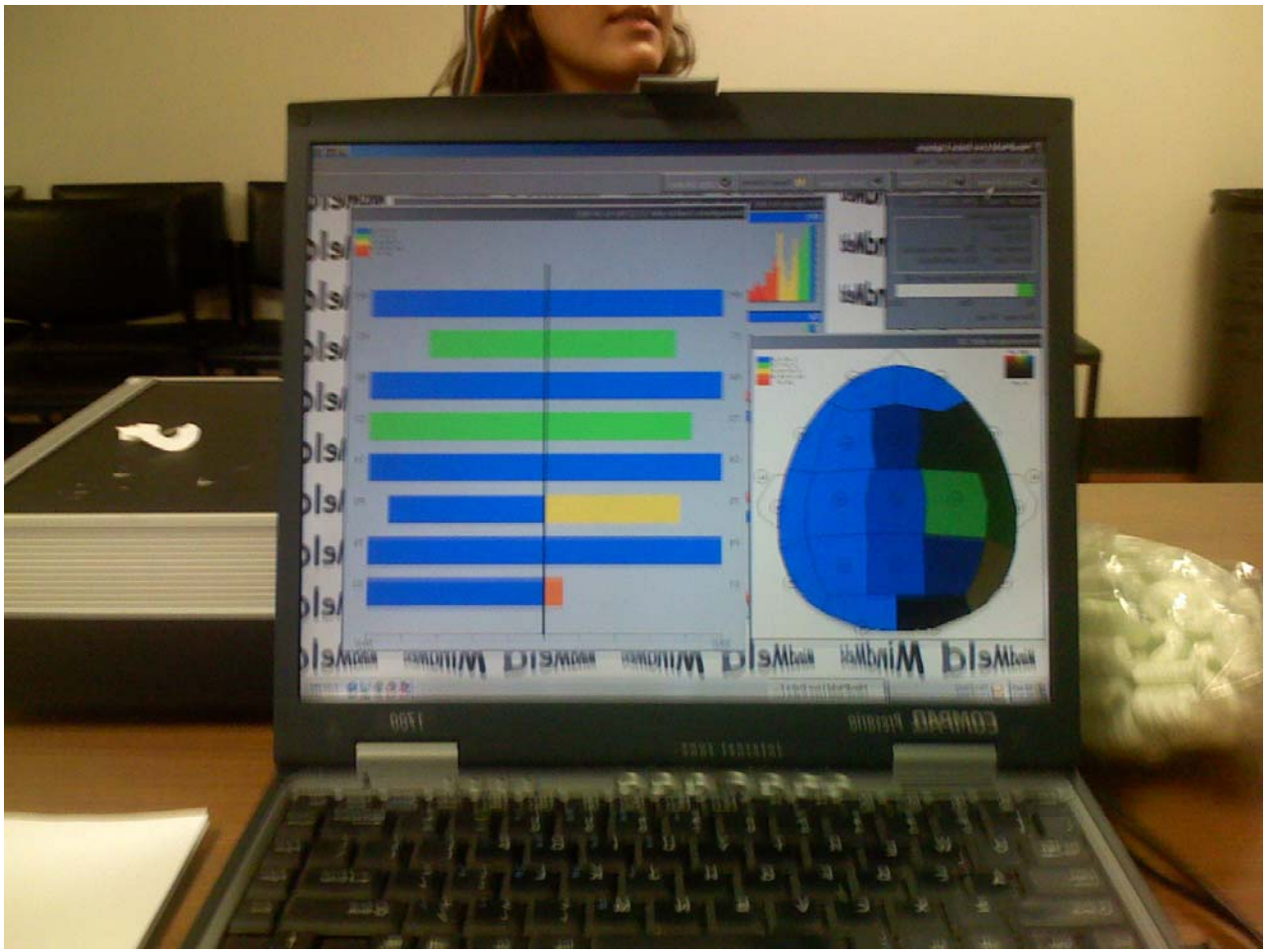
Holistic, tone, pattern, photo, impression, induction, process

Human Complex Systems Neuro-Imaging Lab

Social Neuroscience

- Small lab environment.
- 6-8 student researchers rotate roles.
- Subject takes 90 minutes to 2 hours to do a suite of tasks, such as solving math problems, playing cards, lying, and singing.
- Right now: open-ended exploration.
- Subjects take cognitive assessment.

Researcher POV



Exploring Together

Donning the “Red Cap”

“Hat Hair”, “Hat Brow”

Bully for Social Science!

Standard Research Paradigm

- Isolate the subject.
- Cognitive tests are computer automated.
- Non-qualitative.
- Results analyzed statistically over many subjects to find common region or sequence of activity.

Situated Research Paradigm

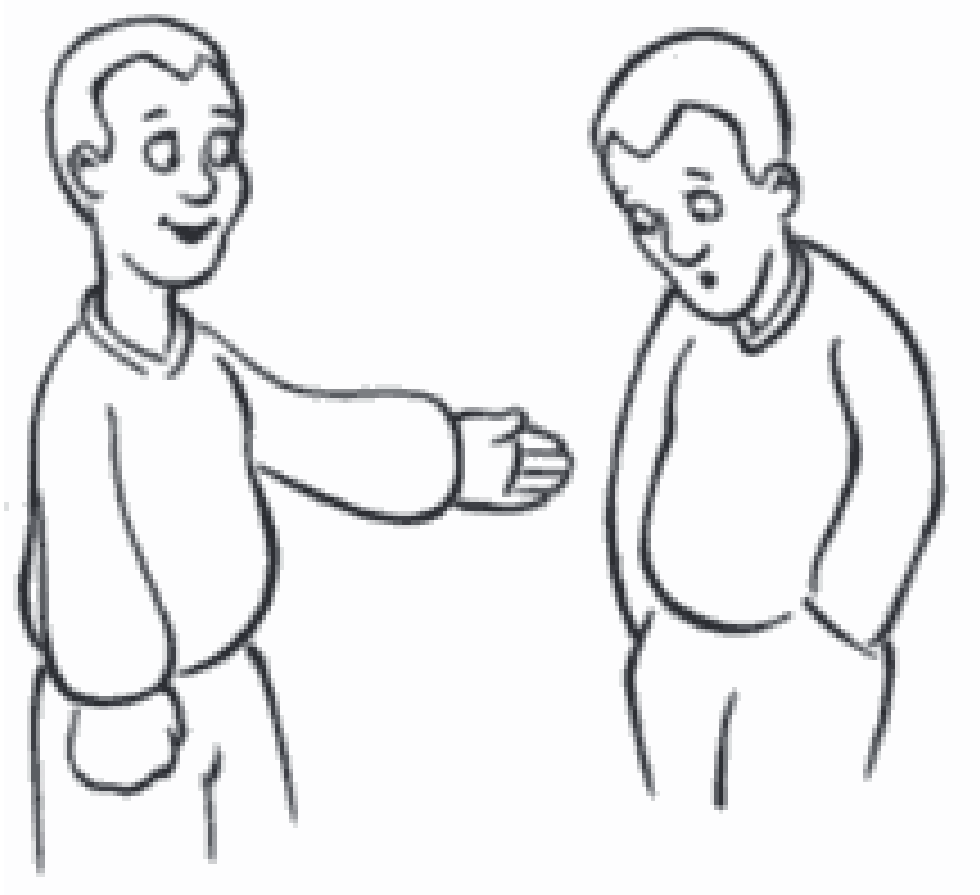
- Situate subject in a small (friendly) group.
- Include open-ended tasks with new, live people.
- Request that subject share self-reflections after each task.
- Note individual variety in regions and sequences.

Lab Demographics (S=35)

INFJ (4) Jonathan Stone, Kecia Nason, Alana Purcell, Manav Sidhu	**INFP (5)** Nanae Kido, Evan Shulman, Jesse Kobernick, Katie Ek, Amy Huang	**ISTJ (3)** Matt Atkin, Daniel Segal, Shek Wong	**ISFJ (1)** Toby Divine
ENFJ (1) Maher Abdel-Sattar	**ENFP (2)** Jacqui deBorja, Bryan White	**ESTJ (3)** Tania Farshi, Dana Shueller, Alex Crown	**ESFJ (1)** Carolina Romanelli
INTJ (2) Daisuke Imai, Brady Gibson	**INTP (1)** Gabriel Mizrahi	**ISTP (0)**	**ISFP (1)** Ali Ghandour
ENTJ (4) Hiroko Takahashi, Michael Thompson, Bo Han, Trevor Pratt	**ENTP (2)** Patricija Petrac, Robert Martin	**ESTP (1)** Oisin O'Connor	**ESFP (4)** Kareem Hammad, Alex Lovett, Mei Chen, Ardi Hakhamian

Research on Type To-Date

What comes to mind?



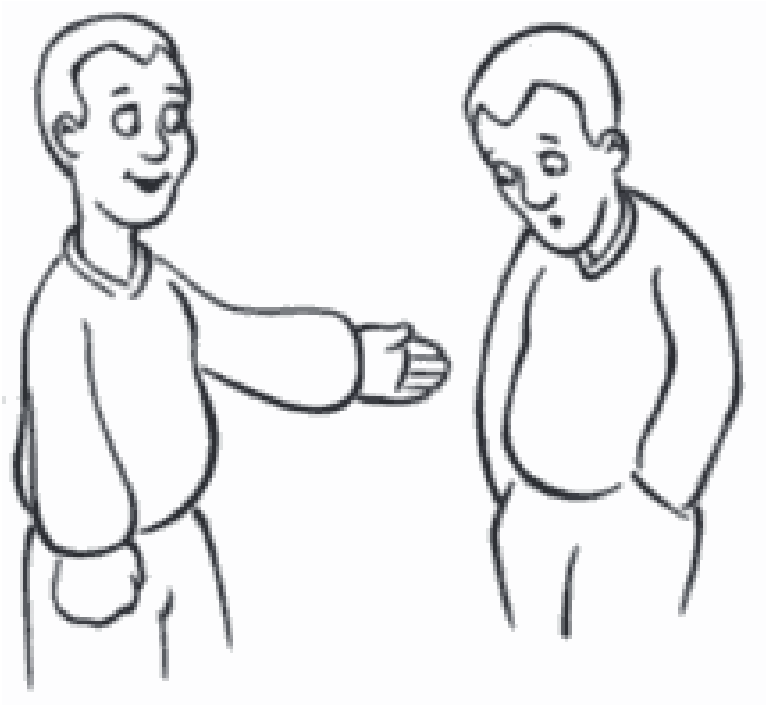
Personality 101

Extraverting:

Reaching out to initiate, working with what the world gives us, energized by interaction with others.

Introverting:

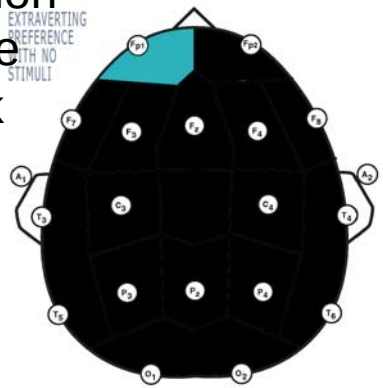
Reflecting and then responding, working from what we possess inside, energized when by oneself.



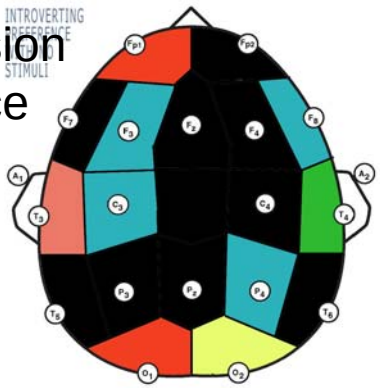
I FIRST HAD THE VISUAL IDEA FOR THIS IN 1974.
IT'S BEEN WITH ME EVER SINCE.

Neurological Links to E/I

Extraversion preference with blank screen

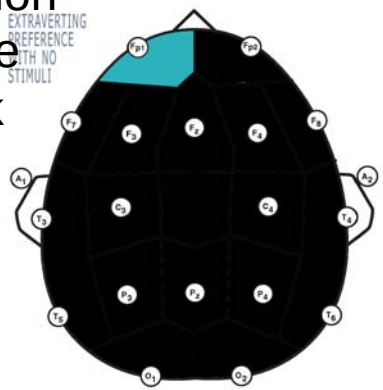


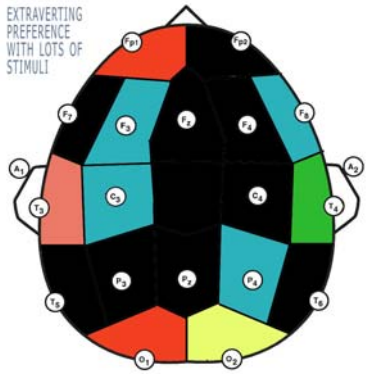
Extraversion preference with lots of stimuli



Neurological Links to E/I

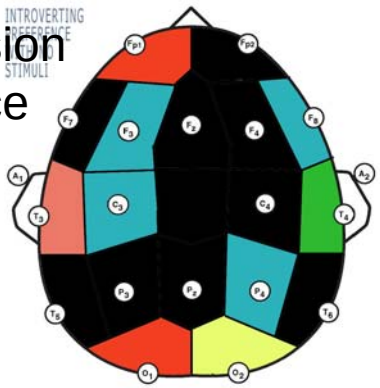
Extraversion preference with blank screen

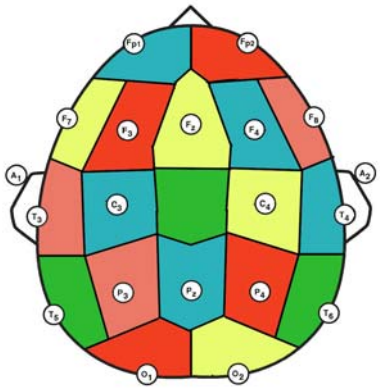




Introversion preference with blank screen

Extraversion preference with lots of stimuli





Introversion preference with lots of stimuli

Hypothesis: Introverts are actively cogitating even when no stimuli are present. In contrast, extraverts tend to go idle when no stimuli are present. But is this the full story?

Normalization Activity

The very first task every subject does is a series of simple exercises to achieve a ‘blank’ EEG:

- “Close your eyes, relax, breath, clear your mind.”
- “Pick a point ahead of you in your field of view and stare it for as long as you can.”
- “Draw one circle repetitively over and over.”
- “Close your eyes, pick a simple word and repeat it to yourself for as long as you can.”

Mind to Relax?

- Extroverts achieved blank EEG easiest when staring at external focus or (reportedly) watching television.
- Introverts with Judging preference (I__J-types) often achieved blank EEG easiest when staring at external focus or drawing / speaking repetitively. Their EEG gets MORE active when they closed their eyes to clear the mind.
- Introverts with Perceiving preference (I__P) often achieved blank EEG easiest with quiet, meditative activity.
- Lesson: Individual differences in how to relax and focus, some of which are counter-intuitive.

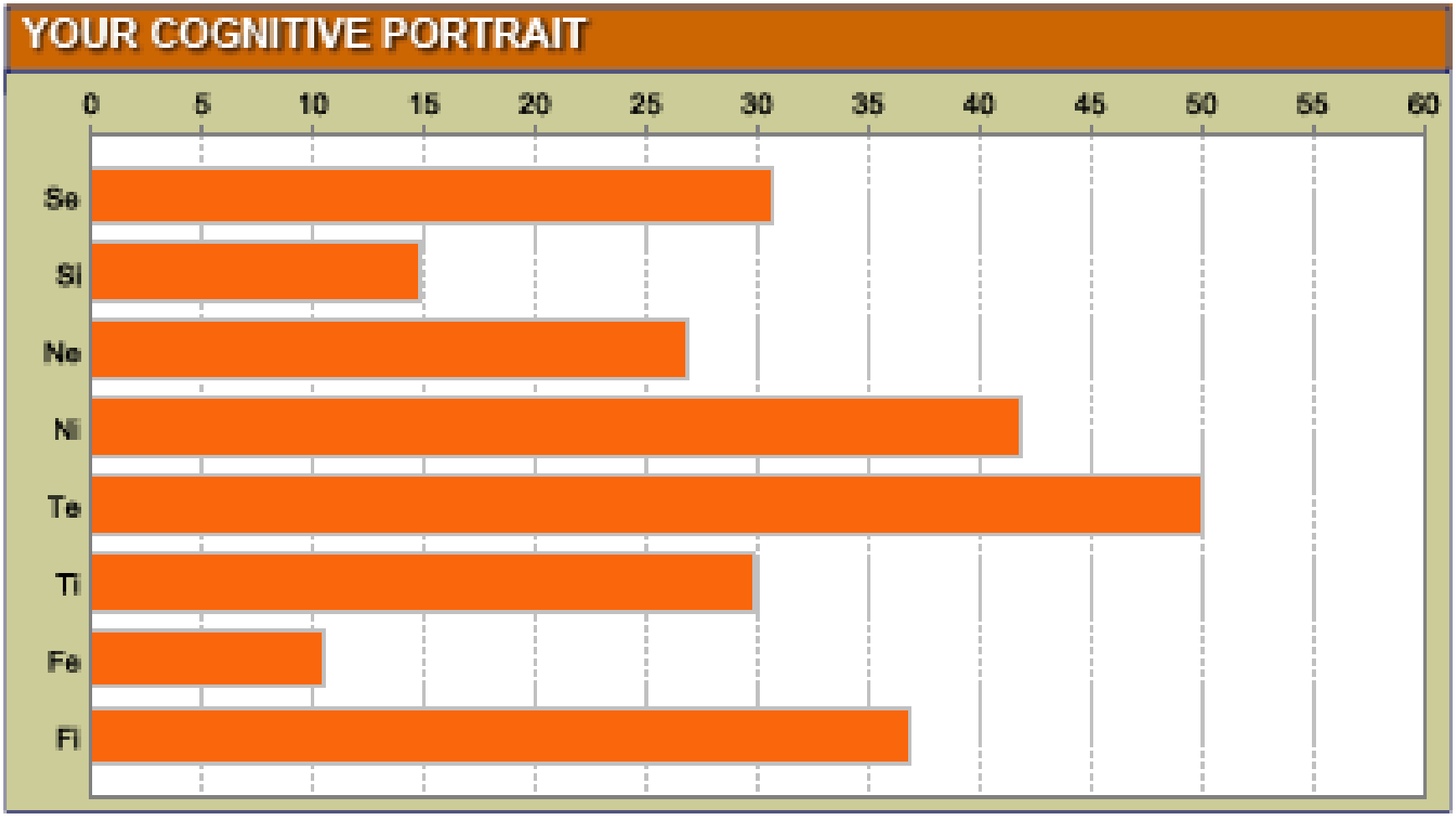
Jung's Model of Cognitive Processes

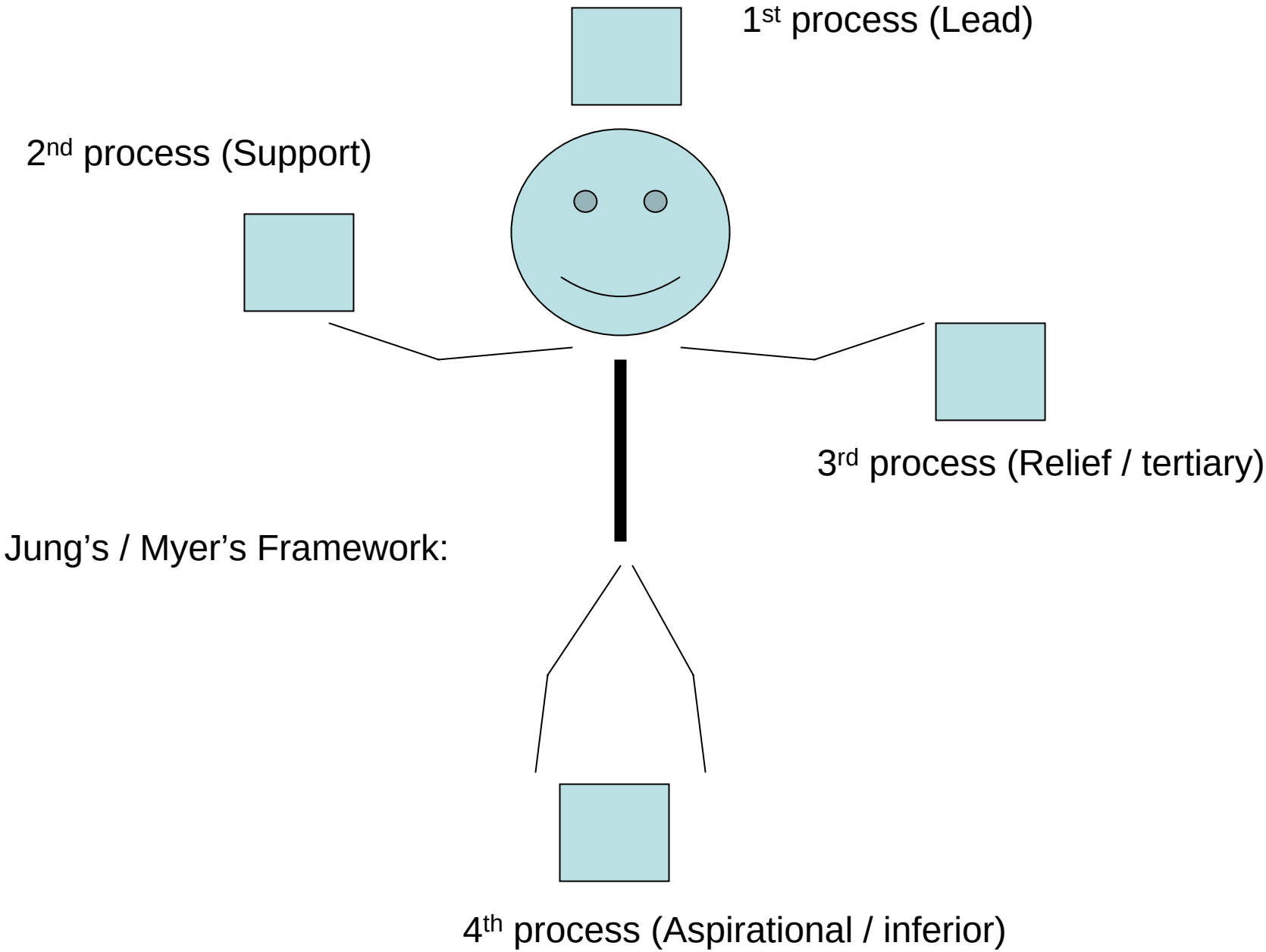
4 Jungian Functions

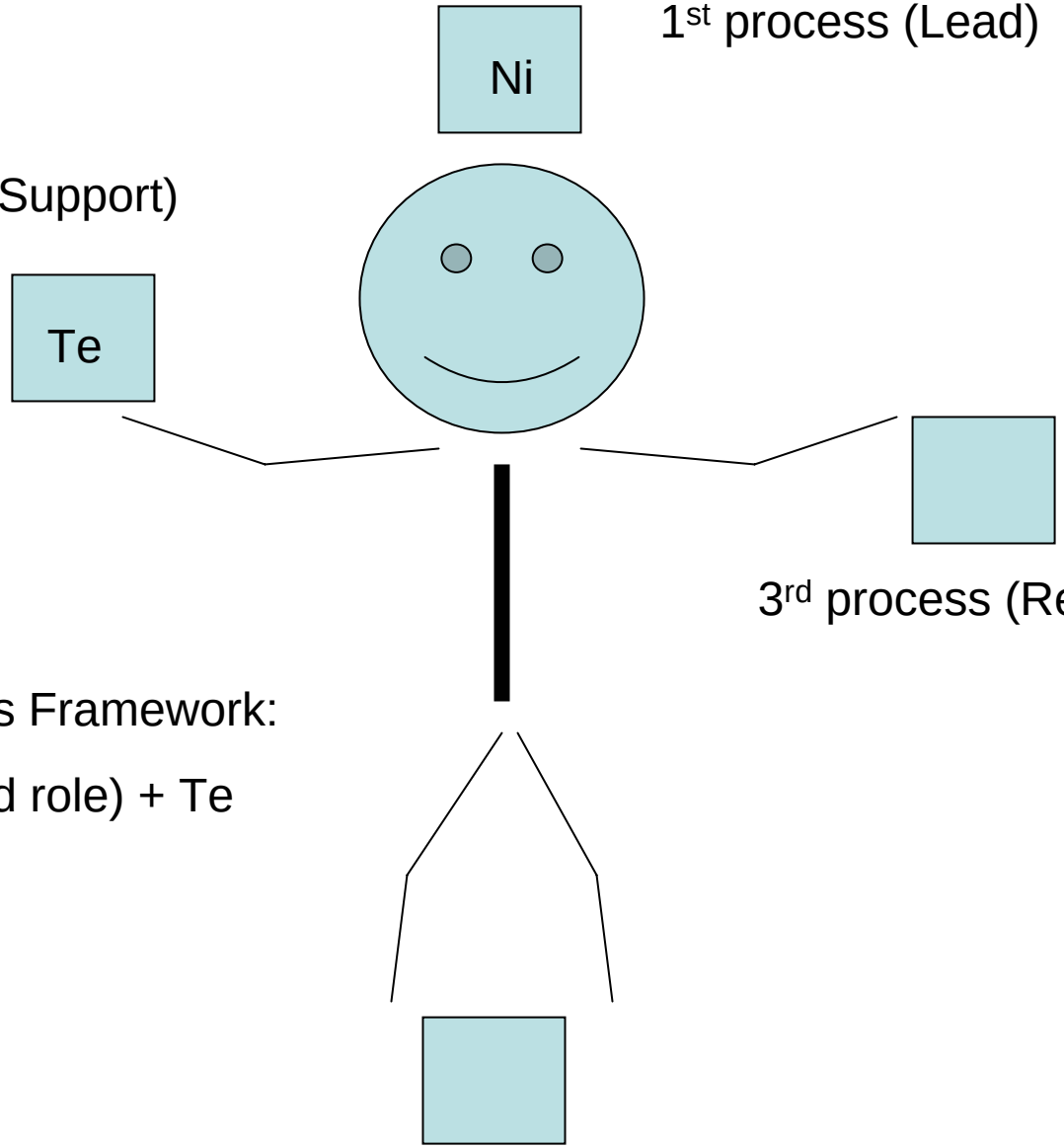
- Sensing (S): Focus on tangible data, what is known (past and now), practical means.
- Intuiting (N): Focus on concepts, patterns, potential (future or atemporal), what-if.
- Thinking (T): Decide / organize based on objective criteria, impersonal principles.
- Feeling (F): Decide / organize based on harmony with personal and group values.

4 Functions (S, N, T, F)
each expresses in 2 attitudes
(E / I) resulting in
8 cognitive processes
(Se, Si, Ne, Ni, Te, Ti, Fe, Fi)

Subjects took Interstrength Cognitive Assessment™ with feedback




1st process (Lead)
2nd process (Support)
3rd process (Relief / tertiary)
Jung's / Myer's Framework:
4th process (Aspirational / inferior)



1st process (Lead)

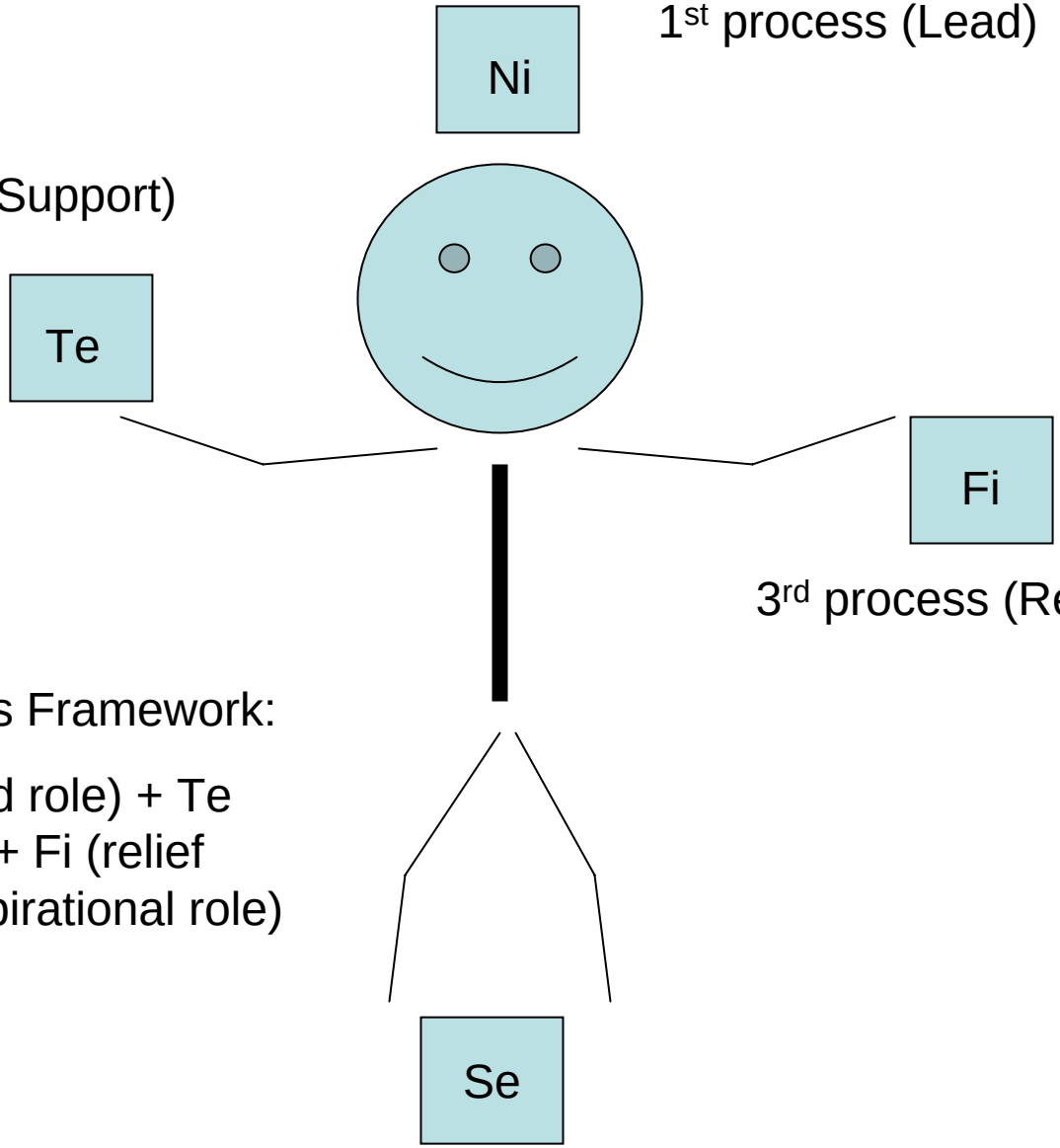
2nd process (Support)

3rd process (Relief / tertiary)

Jung's / Myer's Framework:

INTJ = Ni (lead role) + Te (support role)

4th process (Aspirational / inferior)

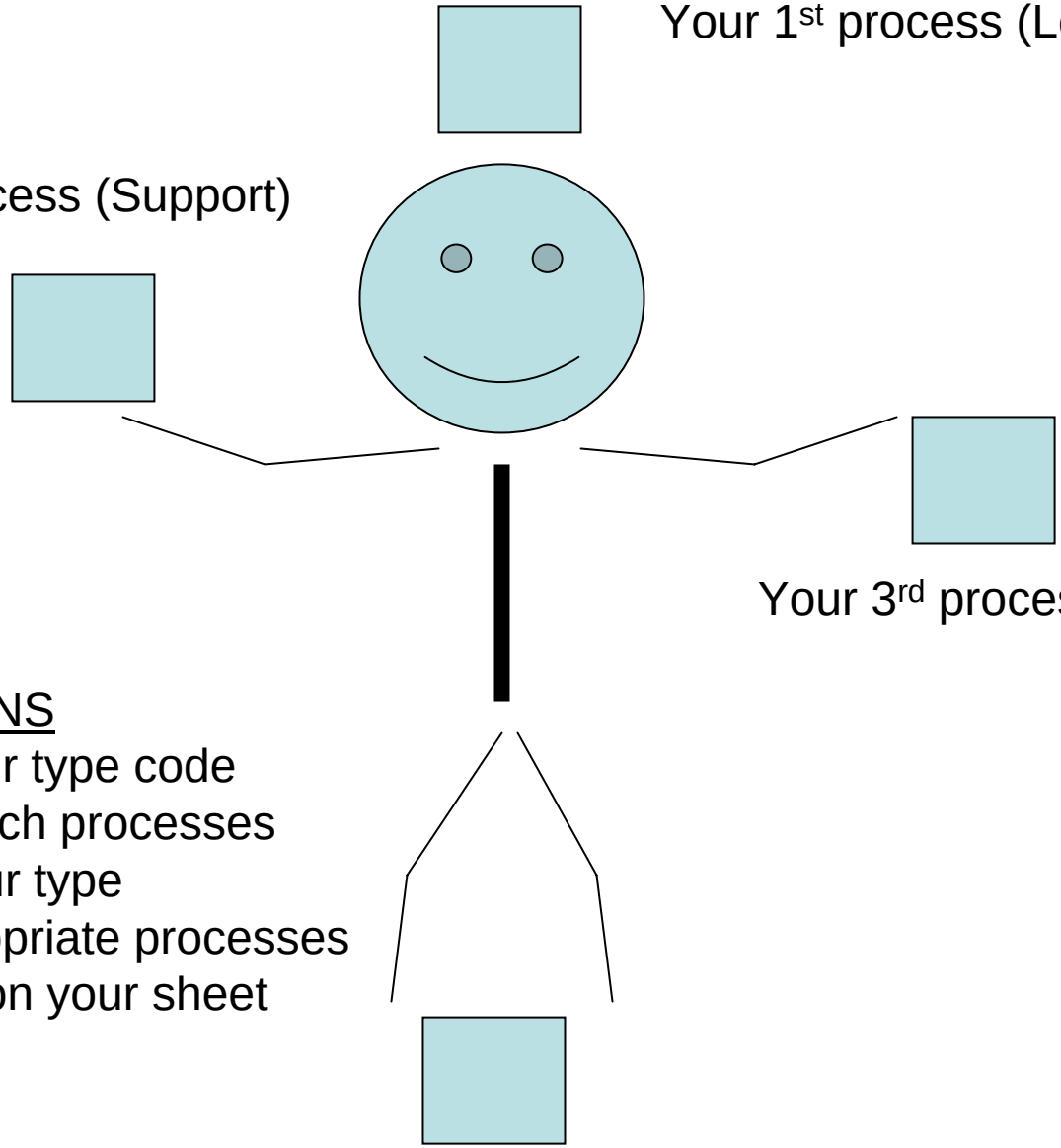


Jung's / Myer's Framework:

INTJ = Ni (lead role) + Te (support role) + Fi (relief role) + Se (aspirational role)

Your 1st process (Lead)

Your 2nd process (Support)



Your 3rd process (Relief / tertiary)

INSTRUCTIONS

1) Locate your type code
2) Locate which processes go with your type
3) Enter appropriate processes into boxes on your sheet

Your 4th process (Aspirational / inferior)

Assessing Competence

Signature Exercise

Sign your name here
Now sign your name again using your other hand:

2nd and 3rd Language Task

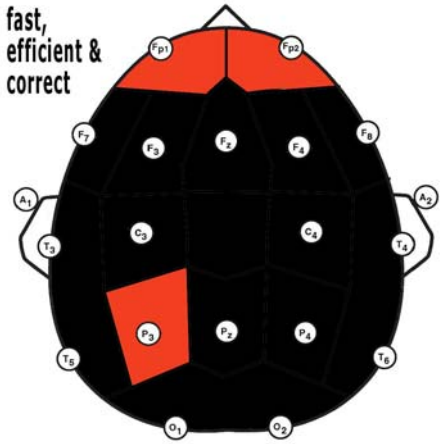
- Subjects sign their name and write “The quick brown fox jumped over the lazy dog” in each language they know, with their preferred and non-preferred hand.
- Signing name with preferred hand in native language evokes no EEG activity.
- Writing test sentence in 2nd or 3rd language with non-preferred hand evoked the most activity.

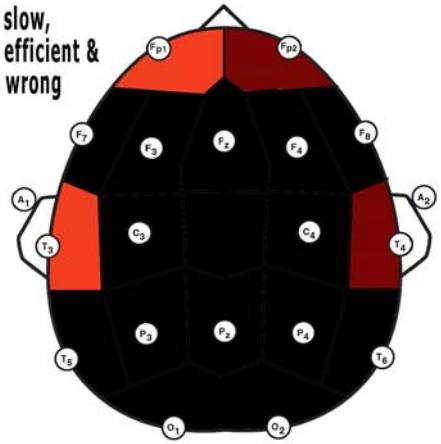
Mathematics Problems

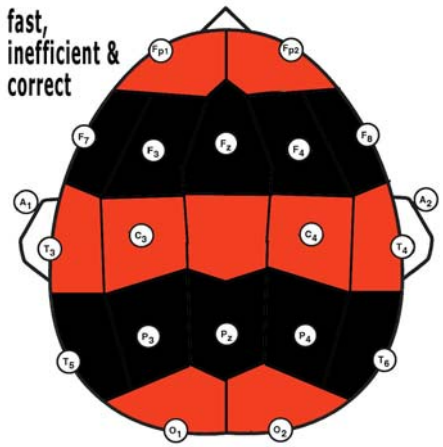
- 2 + 2 = ?
- 17 + 11 – 23 = ?
- 17 x 11 = ?
- 55 / 4 + 11.2 = ?
- (4325 + 67982) * 11768 = ?

Before testing, subjects reported where they were schooled and, after solving a simple math problem, asked to indicate how they solved it (visualized, said to themselves, had a sensation or feeling, recalled, etc).

EEG Activity Doing Math



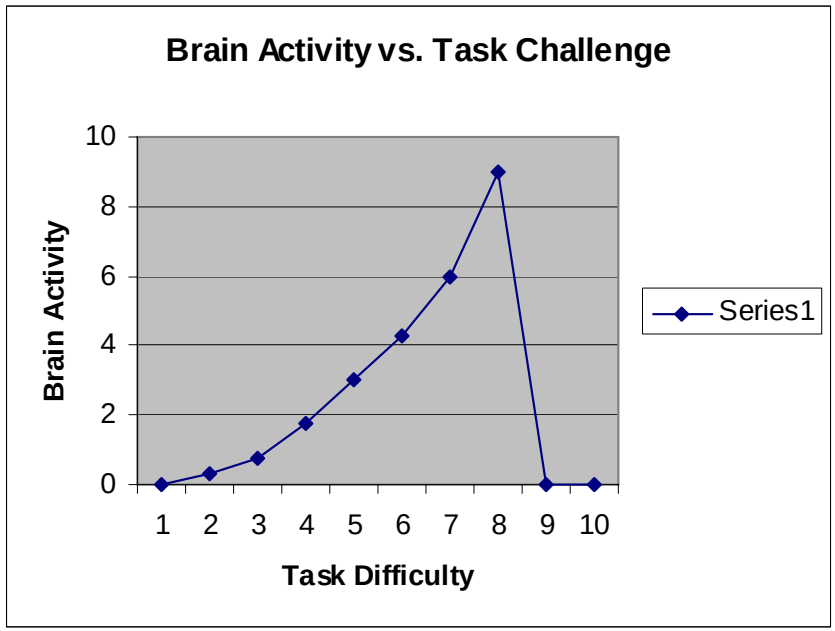




A subject's performance to do an acquired task, and the amount of brain activity required to do it, varies with educational method and practice.

The Competence Curve

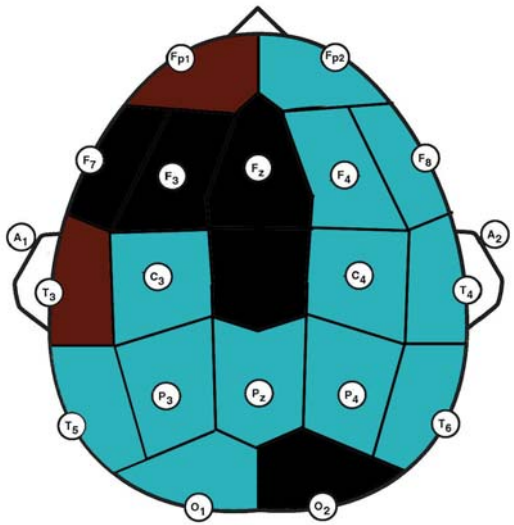
- High-competence tasks evoke minimal or no brain activity (e.g. write your name with preferred hand in native language).
- Activities requiring familiar info and skills evoke progressively more brain activity as challenge increases (e.g. write with your non-preferred hand).
- Unfamiliar tasks evoke no activity (e.g. write your name in Urdu)



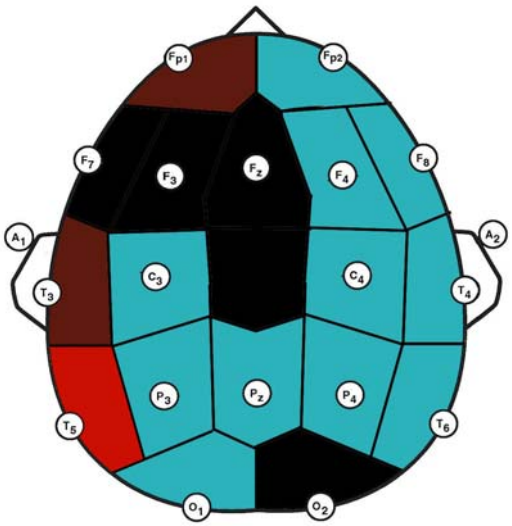
Me, You, Us, and Them

Affective Response to Social Feedback (T5 region)

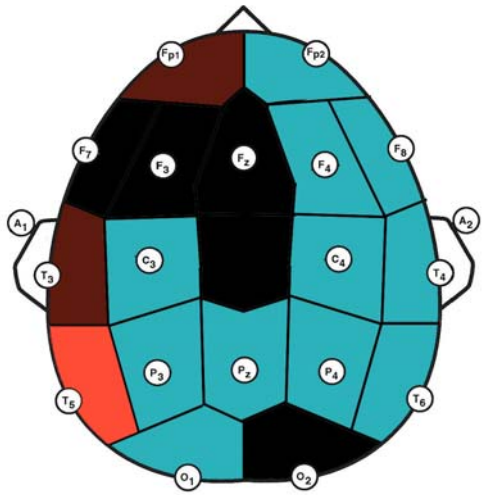
Embarrassment, concern with another's opinion, feeling of shame, etc.



Little affective response to social input

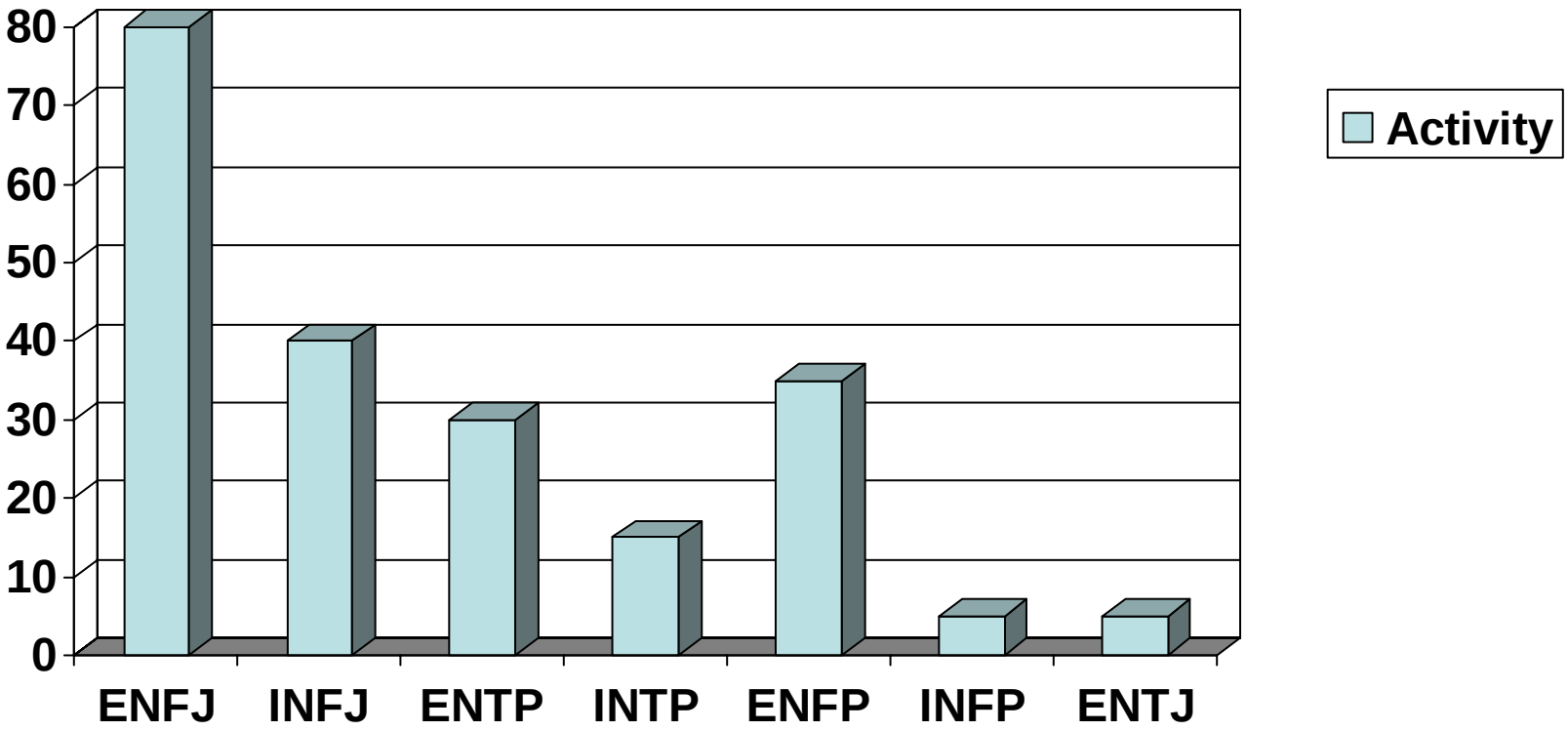


Moderate affective response to social input



Strong affective response to social feedback

Responsiveness to Social Feedback in T5

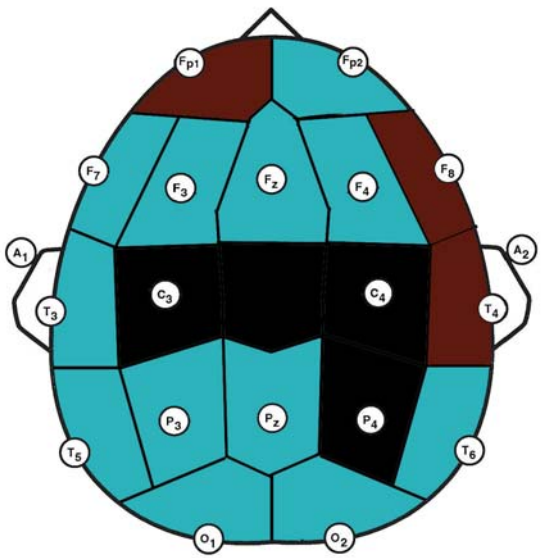


For INTP, this area lit up only occasionally, but when it did, it lit up very strongly.
Conclusion: Students with extraverted Feeling more likely to respond to social feedba

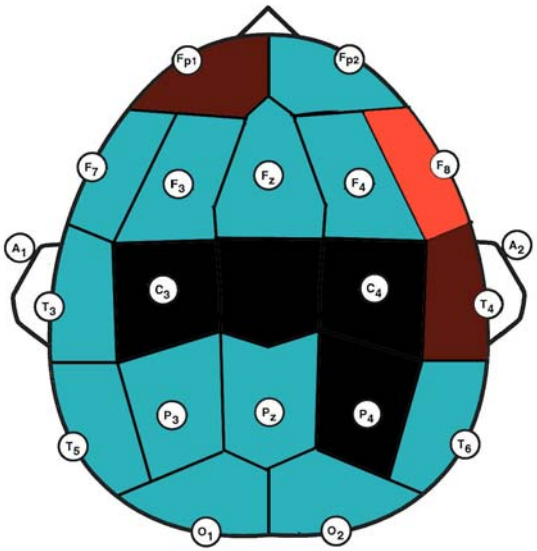
Affective Response to What's of Personal Value (F8 region)

"music is important", "it's good", "that's my favorite", "my car…", "I like Joe"

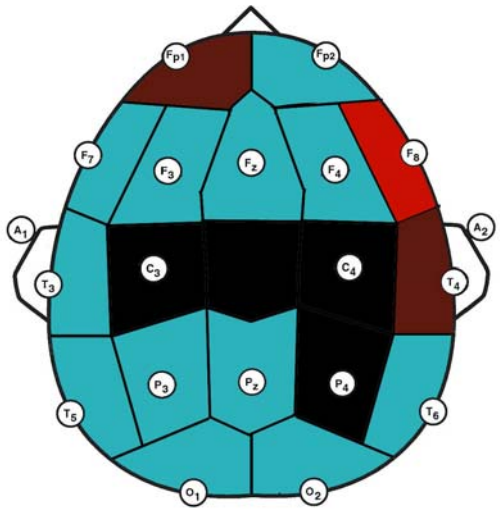
Which roommate does the subject value most?



Roommate A



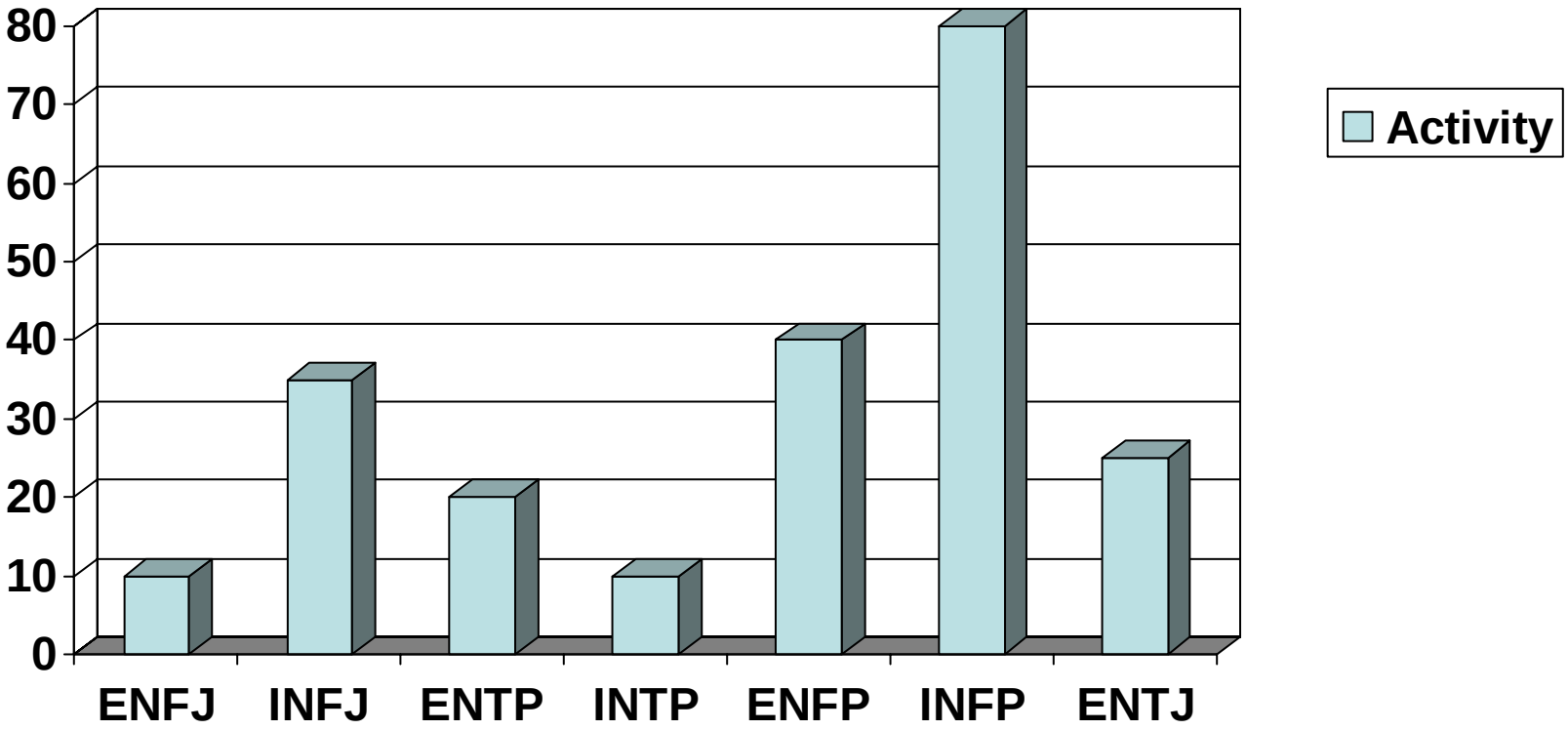
Roommate L



Roommate P

This region also alights when subject is consuming a favorite food.

High Emotional Importance in F8



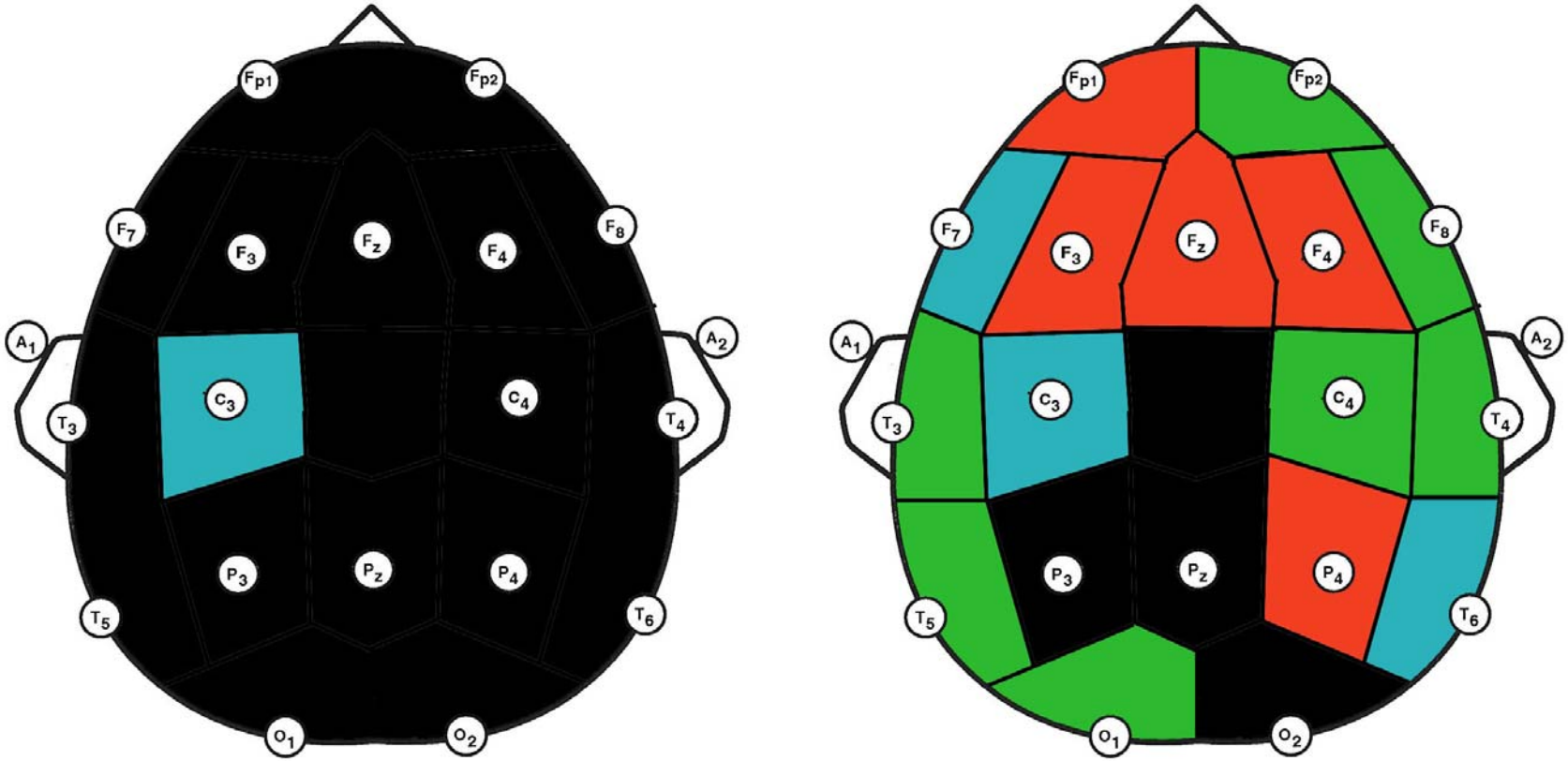
For ENTJ, this area lit up when saying negative words rather than positive ones.
Conclusion: Students with introverted Feeling more likely to place emotional importanc
on key words (people, places, ideas, activities, etc) of value to them.

Speed Dating: Do I Like You?

- Simulated speed-dating with male subject and series of 3 female dates and 1 male date.
- With Female #1: Black, blue before and after he spoke to her, green when she left.
- With Female #2: All green until she made him laugh, then solid blue for long period until she said her family was evangelical Christians, then immediate black until end.
- With Female #3: Blue to start, brief mild yellow, then black. O1 when he visualized stories she told him.
- With Male #1: All blue to start, mixed activity, O1 when asked, “what do you look for in a mate?”

Starting Hypothesis: black = low interest, blue = openness or comfort, green or yellow = anxiety.

Telltale Heart: Who's lying?

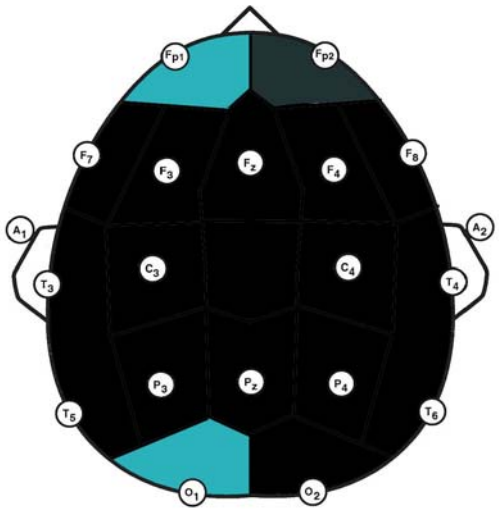


Lying Task

Please give 5 statements about yourself, at least two of which are lies. Begin now….

Who's a Good Liar?

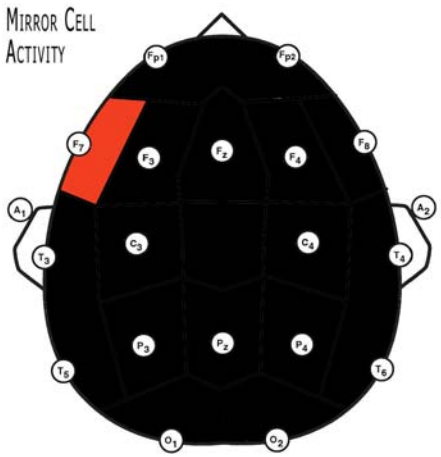
Eight subjects, who had very low Fe (ENTJ, ESTJ, INTP) generally had low brain activity in all regions except FP1 and O1 unless they were really "pushed to think." That is, activity was evoked only on the most difficult sections of tasks compared to other subjects. Two of these subjects voluntarily reported that they had "efficient thinking." And so they did! Even when they got tasks wrong.



Among these eight, 6 were excellent liars (all ESTJs and ENTJs), 1 was not tested for lying, and 1 (the INTP) was not a good liar. Also, males were better liars than females.

No other subjects (other types) were excellent liars.

Use of Mirror Cells (F7 region) to Simulate Experience of Behavior

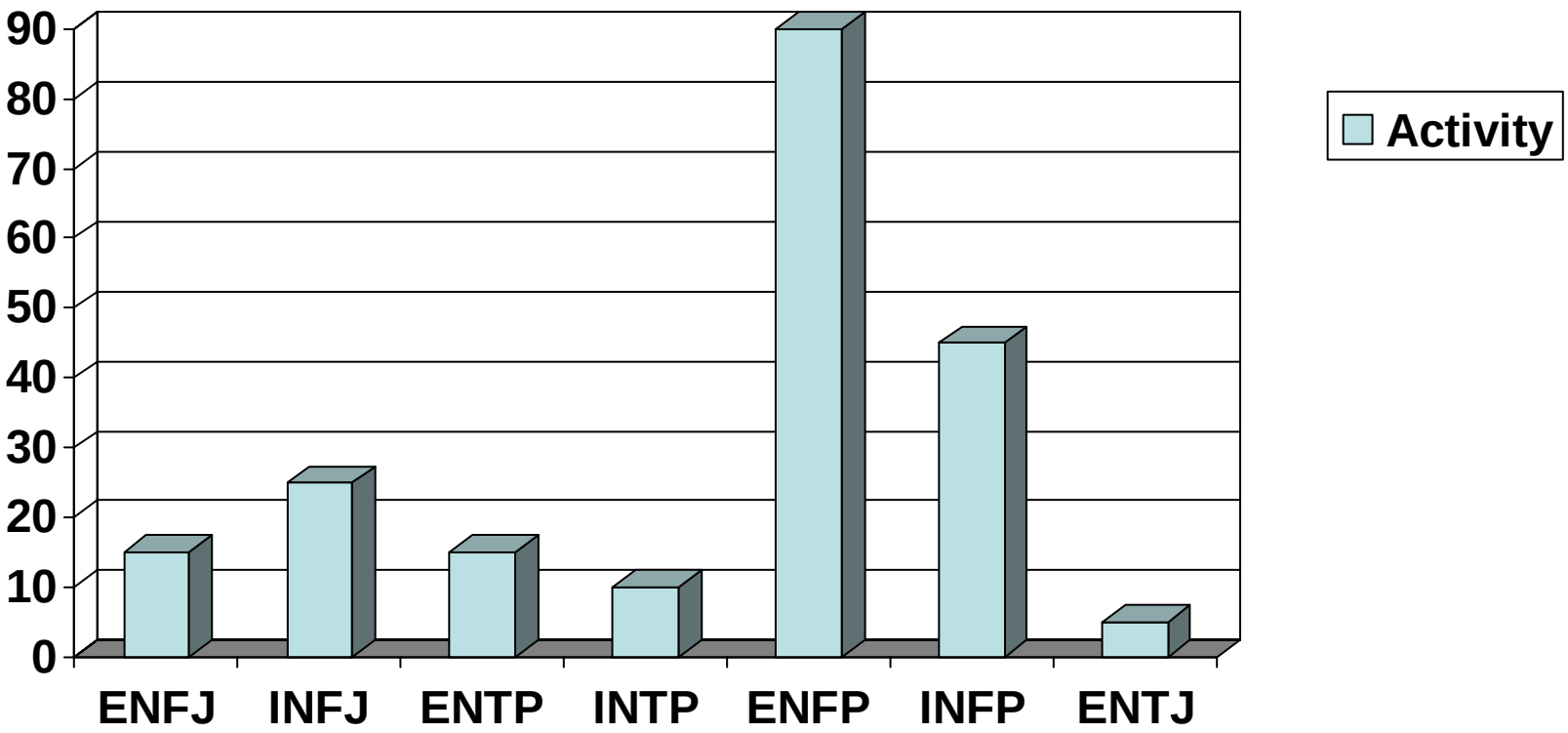


Examples: Imagining oneself playing tennis, imagining what it was like to be a homeless person, imagining life of nobles and peasants in the 17th century.

One subject (ENFP) had continuous activity in F7. She stated during debrief that she was thinking or "wondering and analyzing about the other students" the whole time, as she often does in her daily life. This subject was an obvious liar and had difficulty selecting truths as well as lies.

Other subjects with moderate to high F7 also were easy to spot as liars.

Activity of F7 Mirror Cells



Conclusion: Students with preference for Ne and Fi were more likely to mentally model and possibly imitate others' behavior.

So Who's the Better Liar?

- Two major factors influence lying: whether someone has time to prepare, and whether there is a context for the lie.
- Subjects X, Y and Z lied effortlessly with little brain activity overall (subjects reported there were no consequences for lying in an experiment, so it was easy to lie.)
- Subject A lied with great effort (subject reported that she didn't know what to lie about since there was no one to really lie to).
- Now compare: subjects X, Y and Z had little to no activity in region F7 (where mirror cells of others' behavior are located) while subject A had almost continuous activity in this area. If one relies on mirror cells to adjust behavior to others, then lying may be difficult if there is no one to lie to!
- Other subjects with intermediate levels of F7 activity were easier to gauge for lying.
- Hypothesis: A major aspect of lying is the use of mirror cells. Subjects who use the F7 region less are better liars when there is no one specific to lie to but they are far more obvious liars when there is someone specific to lie to, and vice versa.

Acting

- Various types (ENFP, ESFP, ENTJ, ISTJ) did rehearsed and improvisational acting.
- Several were theater students.
- Well-rehearsed acting resulted in solid blue pattern (indicating “flow” typical of expert activity).
- Cold reading of lines evoked T6 (future projection, estimating what line is next).
- Improvisation of high-drama scenes evoked regions relevant to the fictional situation.

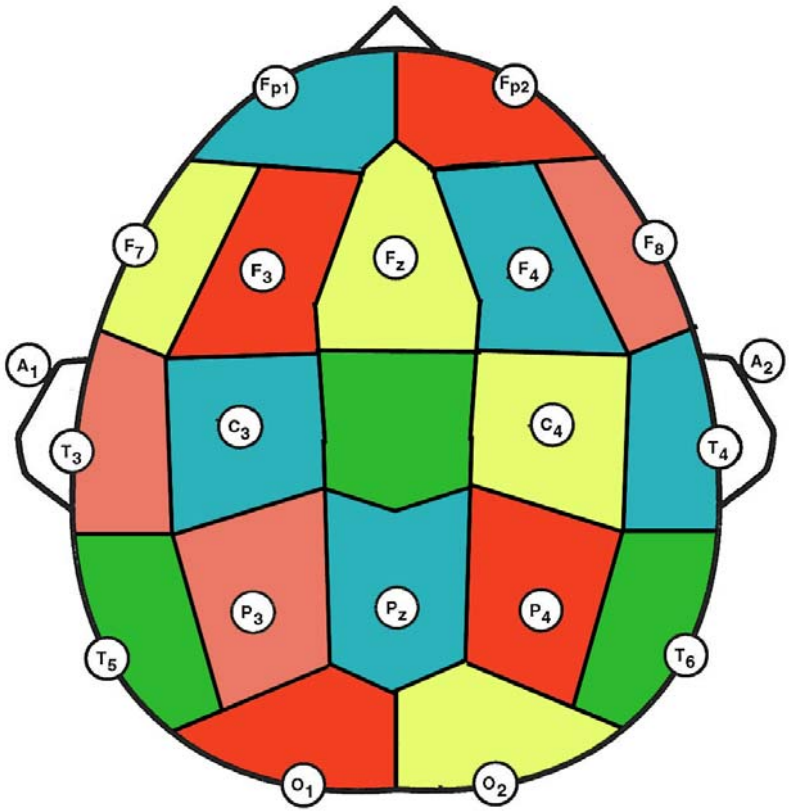
An Innocent-Looking Thespian

Drama! Nope.

- Two ENFP actors drew the female ESFP subject into irritation and argument; this evoked bright red F4 (normally associated with Ti).
- Actors simulated a situation with bullying and aggression. As drama heightened, the male ESFP subject when from bored (random EEG activity) to solid bright blue (highly focused and energized). He reported that he becomes calmer as stress increases.
- Two boys (ENFP and ISTJ) role-played a same-sex flirting scenario. The ISTJ subject remained calm and unflappable the whole time.

Let’s Get Creative

Trans-contextual Thinking



Trans-contextual thinking: linking elements that normally don't go together.

A few individuals showed much random activity – akin to "Christmas lights" – across all brain regions regardless of stimuli.

Certain trans-contextual activities (see coming slides) evoked this behavior in other subjects, but only when doing these activities.

Most other subjects rarely showed this pattern of activity.

Curiosity Task

Subjects were asked to do their best to answer the following questions.

1) What instrument was invented to sound like the human voice?
2) What is the name of the galaxy the Earth is a part of?
3) Was the world's first known romance novel written by a man or a woman?
4) Who was the first president of the United States?

Subjects with high TCT show higher activity overall with questions 1 and 3 (the "interesting" questions) compared to other subjects.

Verbal Ambiguity Task

Subjects asked to provide a meaning / definition to each phrase below.

- My son is a baby.
- All men are animals.
- The poor child's desk is a junkyard.
- Please turn to handle the door.
- I don't saw that.
- He was open to the window.
- She counted the changes in her hand.
- Peas in a pod are copious on revenge

Subjects with high TCT show notably less delay in their response to these items compared to other subjects.

Verbal Creativity Task

Instructions: Provide a coherent sentence for each phrase below.

- Dog leash
- Pumpkin seed
- Desktop computer
- Microwave oven
- Book shelf
- First-aid kit

- Fish leash
- Dream Seed
- Underwear computer
- Philosophy oven
- Karma shelf
- Conversation kit

Subjects with high TCT craft sentences from the right-hand column phrases more quickly, coherently, and creativity than other subjects.

Analogy Completion Task

Subjects asked to provide an appropriate analogy.

- Black is to white as…
- Typewriter is to computer as…
- Milk is to glass as…
- Clock is to desk as…
- Chocolate is to love as...
- Sunday is to sleep as…
- Bicycle is to freeway as…
- Mouse is to hat as…

Subjects with high TCT show notably less delay and more richness in their response to these items compared to other subjects.

Variations in Response

Subjects crafted more or less sophisticated sentences for the fabricated word pairs.

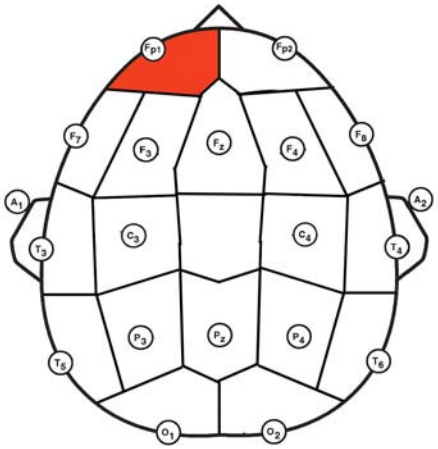
- "That's not real."
- "I don't know what that is."
- "A philosophy oven is a difficult term to understand."
- "I used the philosophy oven to get some nourishing ideas."
- "This lab course is an entrée in the philosophy oven of life."

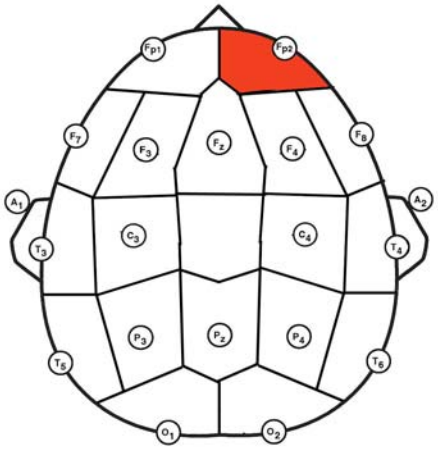
Exposure vs. Practice

- Two students observed TCT tasks done on others before they themselves did them.
- Both gave quick responses on the TCT tasks but neither gave “interesting” responses and both said, “I wouldn’t have done well on this except that I saw it done earlier, so I got the idea of what to say.”
- Neither had a classic TCT EEG pattern; instead they had Fp1.
- **Hypothesis**: Prior exposure may allow the apparent competence of a cognitive skill without actually evoking the cognitive process/es needed for it.

Objectified Decision-Making

Executive Decision Making (Fp1 vs. Fp2)





FP1 active when a person gives an explanation, picks among options or objects, or explains a meaning.

FP2 active when a subject must deal with novel information or when noting that s/he had reach a point in a process. E.g., when asked to brainstorm, subject generated ideas; then FP2 lit up just before the subject said, “I can’t think of any more.”

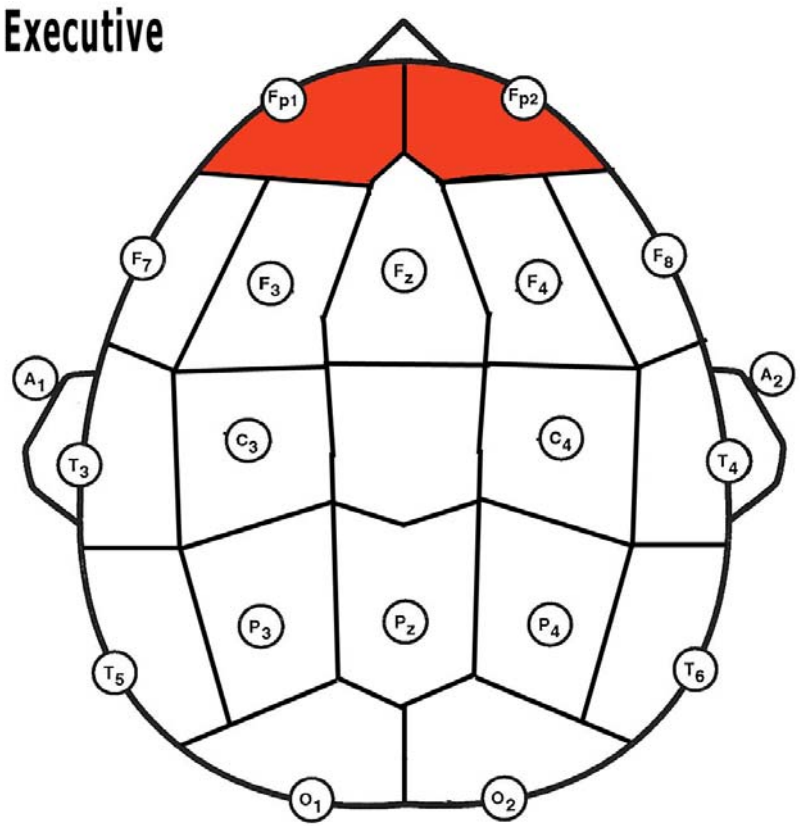
All but 1 subject has had a clear preference for more Fp1 or more Fp2.

Deep Support for Jung's Theory

Dominant Judging types	Dominant Perceiving Types
ESTJ, ENTJ	ISTJ, INTJ
ESFJ, ENFJ	ISFJ, INFJ
ISTP, INTP	ESTP, ENTP
ISFP, INFP	ESFP, ENFP

Dominant Judging types showed more Fp1 activity ("decision making"), while dominant Perceiving types showed more Fp2 activity ("process management").

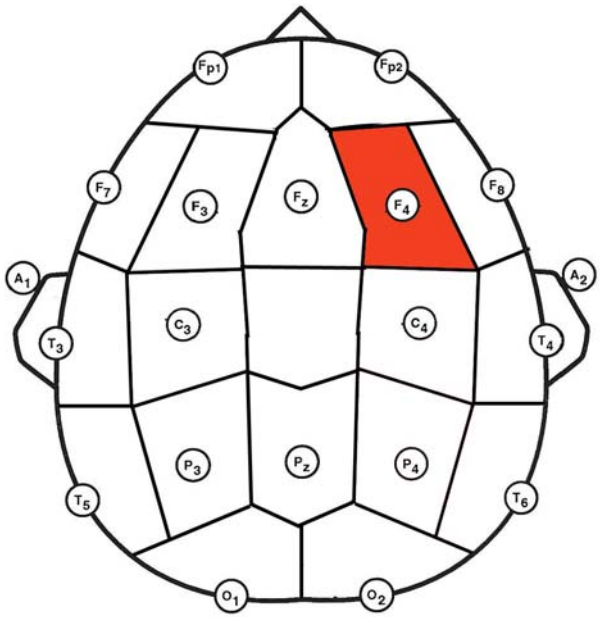
Full Pre-Frontal Activity



Subjects showed full pre-frontal activity when engaged in complex problem solving requiring coordinating, deciding, monitoring, etc.

An INFP role-played counseling a student. She was solid Fp1 and Fp2 almost the entire time as she juggled many tasks focused on the “client.”

Categorize & Define



Region F4 highly active when subject defines a term or categorizes an observation.

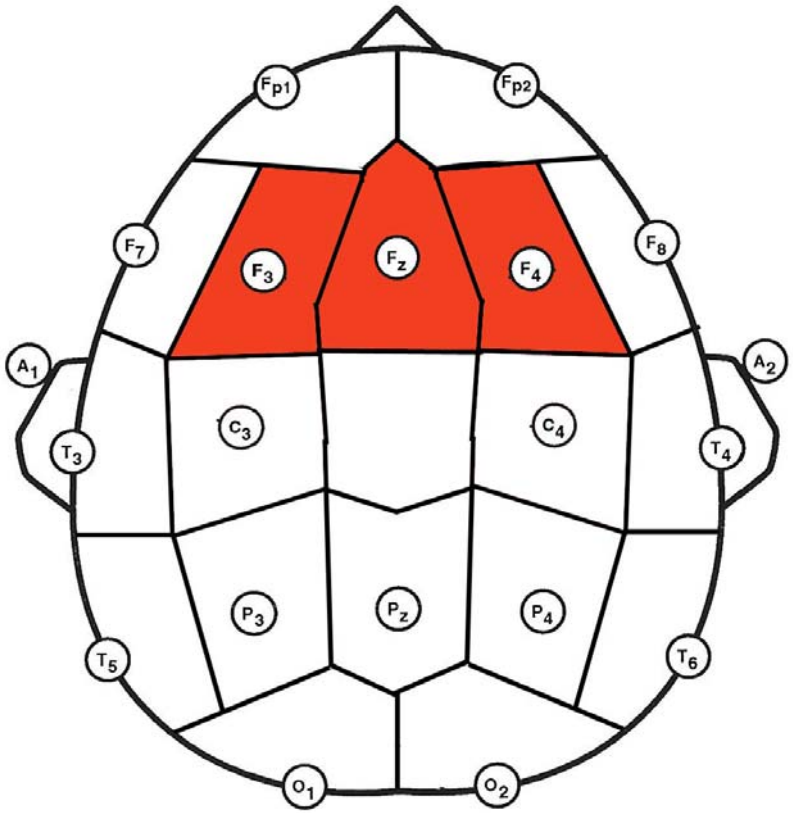
• Trying to figure out whether a particular animal is an aquatic mammal.

• “Egyptian War [a card game] is like War except that…”

• “Is this a grape?” (when blindfolded and asked to figure out a random assortment of objects)

• What (assigned) meaning does a particular tarot card have?

Thinking & Back-Tracking



- Sensing-Thinking folks tend to evoke F3 and verbalize their thought processes as they work a problem.
- Verbalizing occurs as quick sequential conclusions followed by backtracking to re-do answer.
- Example: “So if A is true, and B and C are not, then D; no wait, C could mean that E is… yes, then E not D.”
- For Ti folks (ESTP, ENTP, INTP, and presumably ISTP), regions F3 and F4 are highly active when engaging in problem solving. Sometimes all of Fp1, Fp2, F3 and F4 light up.
- For Te folks, only Fp1 and maybe O1 (visualize problem and decide) are evoked, almost never F3 or F4.

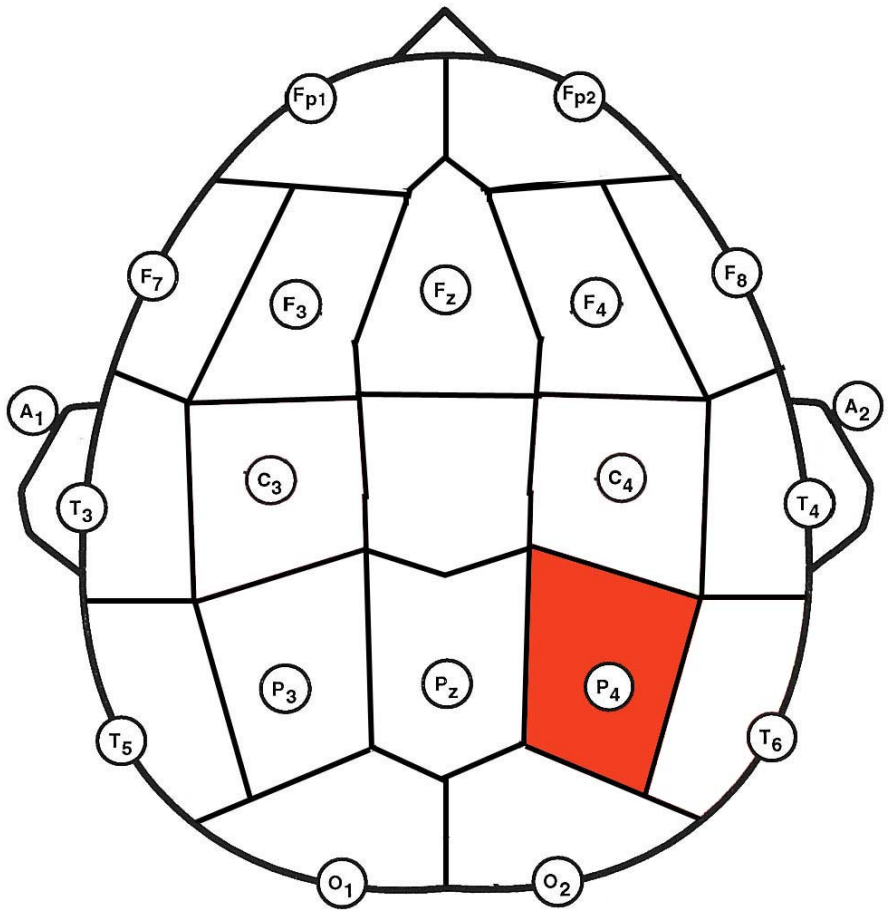
Weighing Risk & Uncertainty

Each day in various cities there is a chance of rain. You can choose to place a bet to win money whether it rains or not. Which game below do you prefer to play?

City	Chance of rain	Reward if it rains
a)	1%	$200
b)	10%	$75
c)	25%	$50
d)	50%	$20
e)	76%	$10
f)	99%	$5
g)	100%	$2

Research Suggests P4 Region

when weighing risk and uncertainty



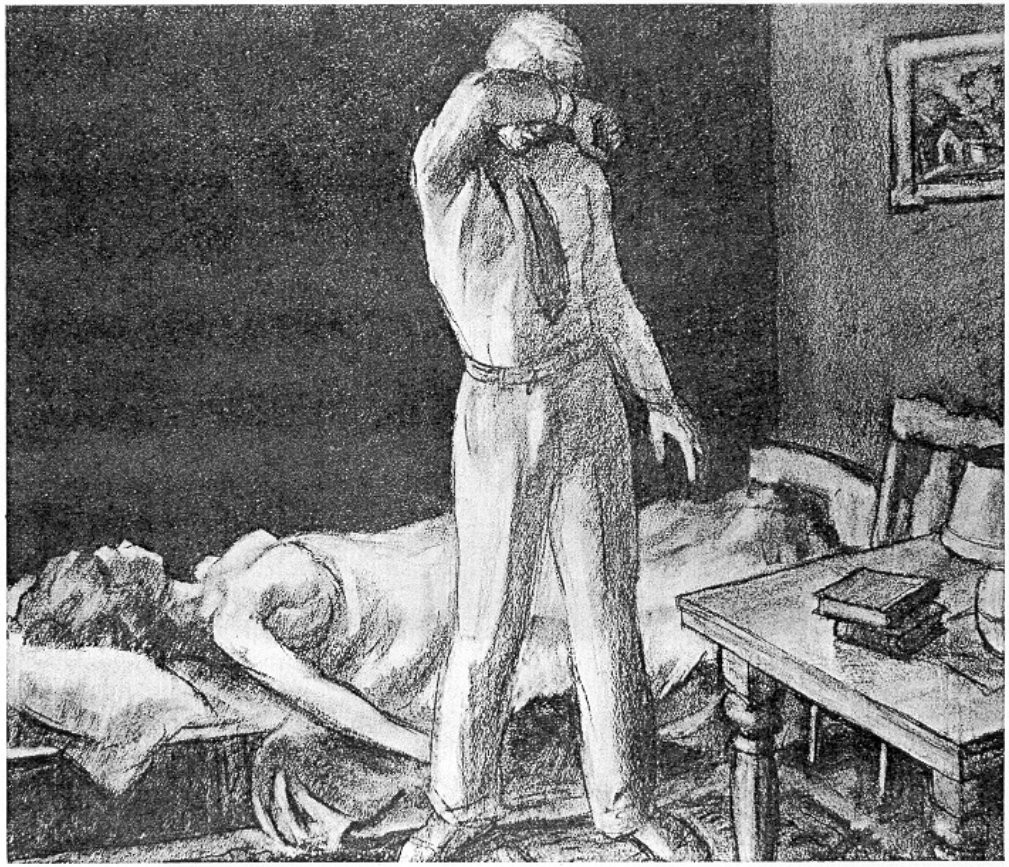
Value of Introspection

- Valuable to ask, “What were you thinking when you did the activity?”
- Only the ESTP Business-Economics student showed P4 activity when solving the problem using economic theory.
- One subject (ENTP) used risk & uncertainly decision-making region (betting, etc) to evaluate whether to talk about her mother’s death.
- Another subject (ENFP) used visual region to solve risk and uncertainly (betting, etc) problems by visualizing himself as a casino owner.
- One time this area lit up strongly in a subject just before she disclosed that her mom died. Why?
- Learning this required asking after the task!

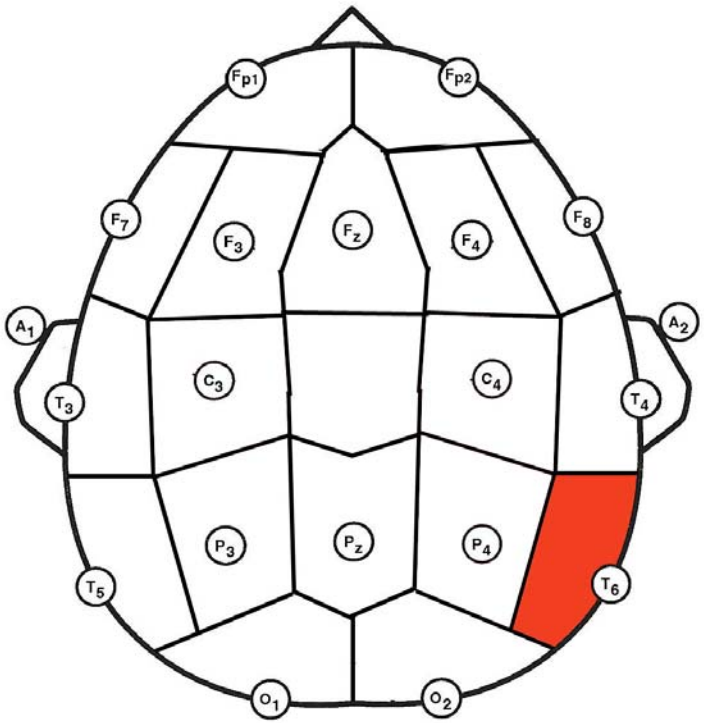
Symbols & Interpretation

What Do You See?

Thematic Apprehension



Foresee & Interpret



Region T6 most active when subjects asked to interpret TAT images (these display a situation that can be interpreted several ways).

Also active when subjects asked to foresee the future or imagine what an outcome of an action will be.

“When I get my new stereo system I will…”

“If that happened, that would cause…”

“Ten years from now I will be…

Brainstorm All Possible Stories Implied in this Image

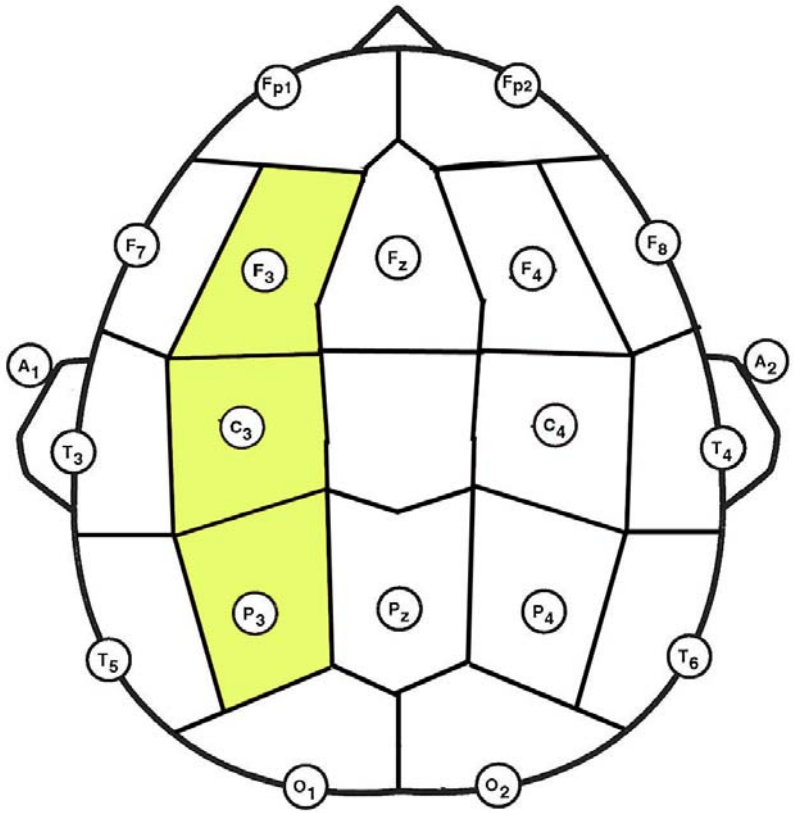
Storytelling

- Subjects presented with Tarot cards, iconic dice, or fantasy miniature figures.
- Asked to craft a story, alone or with another person.
- Asked to tell one story or possibly as many stories as possible.
- People of all types are good at storytelling, each utilizing their own strategies.
- Sensors tend to rely on known meaning of symbols, while Intuitors tend to use symbols as spring board.
- NTs develop strategy to craft stories.
- An INFP and ENFP worked wonderfully together and revealed their “informing” communication style.

Kinesthetics & Details

Cards, Jacks, Juggling, and Pencils

- F3, C3, and P3 for most people (mainly F3) plus plenty of yellow EEG when doing physical tasks.
- Different regions active compared to more mental, emotive, and social activities. Suggests that exercise and movement are vital to the brain, not just “body.”
- One female subject did poorly at juggling, yet this was the first time O1 (left visual) was active for her. Also active was F7. She reported trying to track the items visually in real time and model herself doing it, with a poor result.
- SP types (ESTP, ESFP) do physical tasks such as juggling and jacks almost effortlessly, even if for the first time.



Yay For Video Games!

- Subjects play various video games on a hand-held game console.
- All subjects show the same kinds of activity, regardless of type.
- Mario cart (car racing simulator) evokes low-level asynchronous activity. Similar to the “tennis hop” strategy of being ready for anything.
- Brain Age evokes Fp1 and Fp2, as advertised!
- Majong type games provoke periods of intense activity followed by severe lulls as player searches for matches / solutions.

Winning & Losing

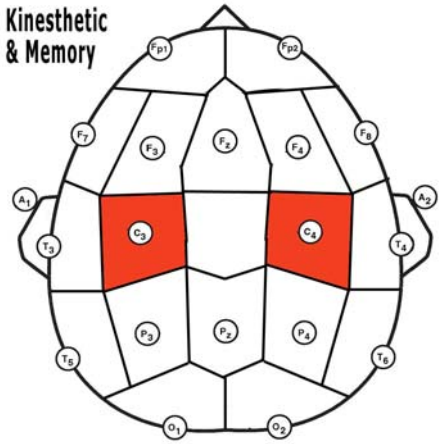
- Often black when just shuffling cards.
- Often, all BLUE when win / succeed
- Often, all GREEN when lose / fail.
- Plenty of RED when learning a new game.
- In general, learning games is the MOST taxing activity I have seen people do.

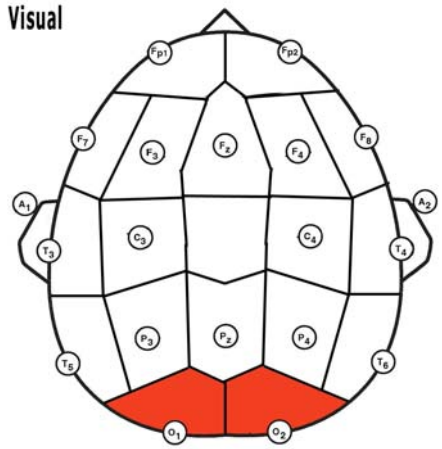
Seen? Recalled? Constructed?

- C3 = recall factual (digital) data
- C4 = recall aesthetic (analog) data
- Both: Batch retrieval. Memory is found and then brain moves on.

- O1 = constructed imagery
- O2 = non-constructed
- Both: continuous processing. Images are seen / manipulated as needed.

- SP types (ESTP, ESFP, etc) do almost perfect on recall of details in recently seen images; SJ types (ESTJ, ISFJ, etc) do moderately well; other types do terribly.





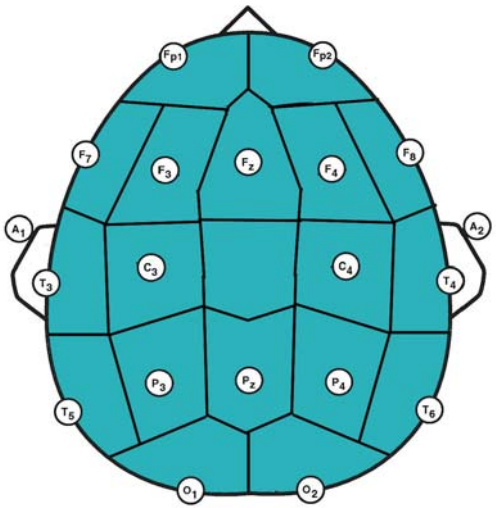
The Stranger & the Editor

For one subject (ENFJ), O1 was never active until / unless a strange person or unexpected movement entered the field of view.

Another subject (ISFJ), a professional film editor, was asked to imagine the most beautiful place he could recall. Instead of C4 active like most people, O1 was active. He took a skydiving incident and “edited it” into a montage with close ups, far shots, and special effects and musical scoring.

Adaptive Expertise

When the Entire Brain is In-sync



• When visualizing dancing (ENFP subject was a dancer for 15 years)

• When singing his own song (ENTJ subject is a professional singer). When singing someone else's song, didn't get the same effect at all.

• When just won a card game (everybody!).

• Acting by following a highly rehearsed scene.

A solid, bright blue EEG through-out indicates that every region is in sync with every other region and the person as a whole is calm but also energized.

Expertise of the 16 Types

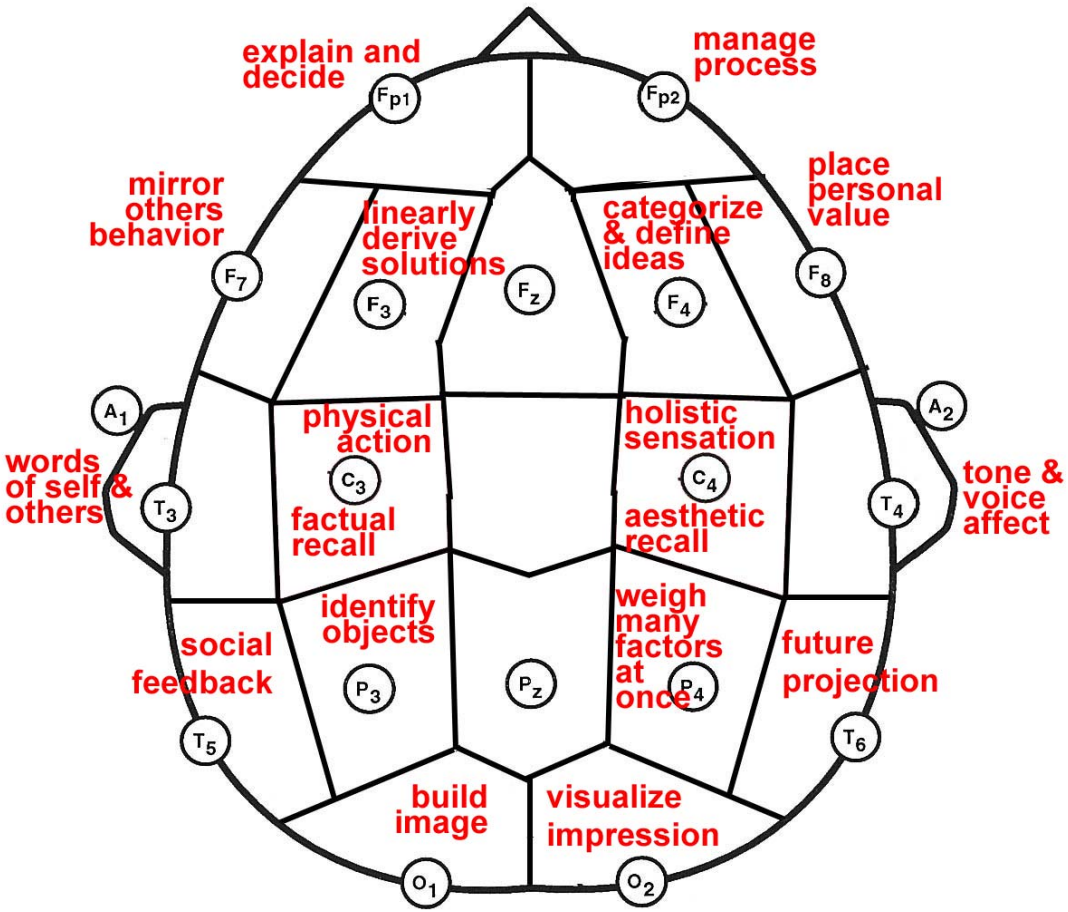
INFJ Imagine future life, remain calm in social situation	INFP Listening, pointing while talking	ISTJ High-pressure situation, recalling the past	ISFJ
ENFJ	ENFP	ESTJ	ESFJ
INTJ Imagine future life, solve new problem	INTP	ISTP	ISFP
ENTJ Pointing while reading	ENTP	ESTP Physical activity	ESFP Dramatic crisis, Physical multi-tasking

The Limits of Expertise

- Among 20 subjects, 4 (all INFPs) had a clear solid-blue pattern when listening to others give instruction, offer reasons, share information, etc.
- Question: What does it take for an “expert listener” to stop listening?
- Engaged INFP subject with an ESTJ on issue of gun control.
- After 8 minutes the INFP moved from all blue while listening to Fp1 activity, to formula counter-arguments while the ESTJ was speaking.

Visual Portraits of Type

Map In Progress



Clarifying Jung's Functions

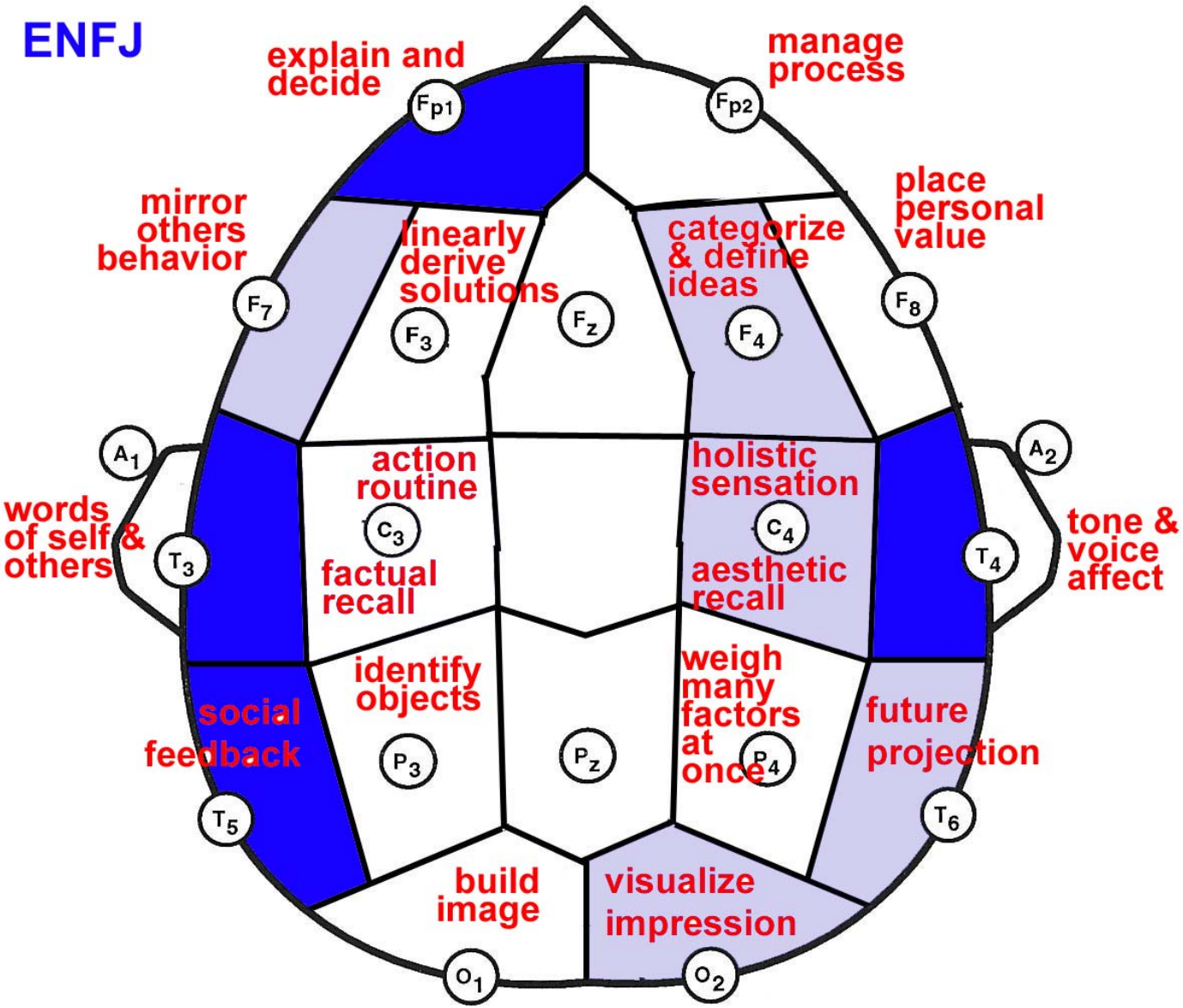
- Ne: Transcontextual thinking (linking contexts), analogizing, mirror others, mental what-if simulation.
- Ni: Project into future, draw upon entire mind to foresee or determine an answer, weight many factors at once.
- Fi: What is of personal value to oneself, listening with the whole mind, tone of voice.
- Fe: Attend to how other people are responding to you, social appropriateness, attend to words.
- Te: Decision-making, explanation, construct visual images, minimal / optimized use of brain (when dominant function), fabricate / lie.
- Ti: Define, categorize, derive solution logically, minimal / optimized use of brain (when dominant function).
- Se: Recall details of recent data with high fidelity, identify objects, smooth body motion, calm in tense situations.
- Si: Access narrative past, use whole mind to review past events, other… (need more data!)

Confounding Factors

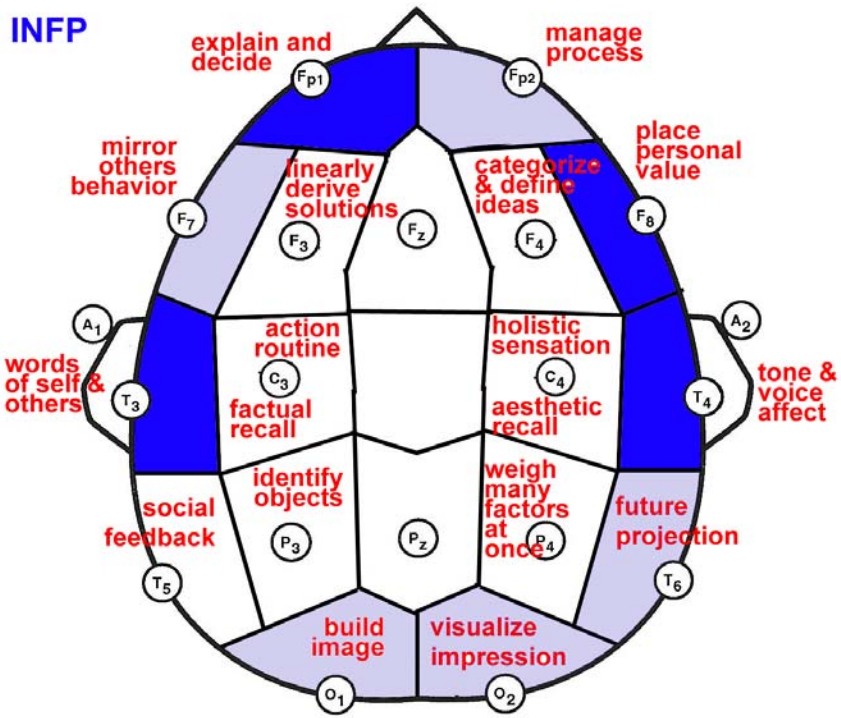
- May not be best-fit type
- Time of day and variations in testing
- Age (in this case, all but 2 were 20-23)
- Equipment calibration
- Other?

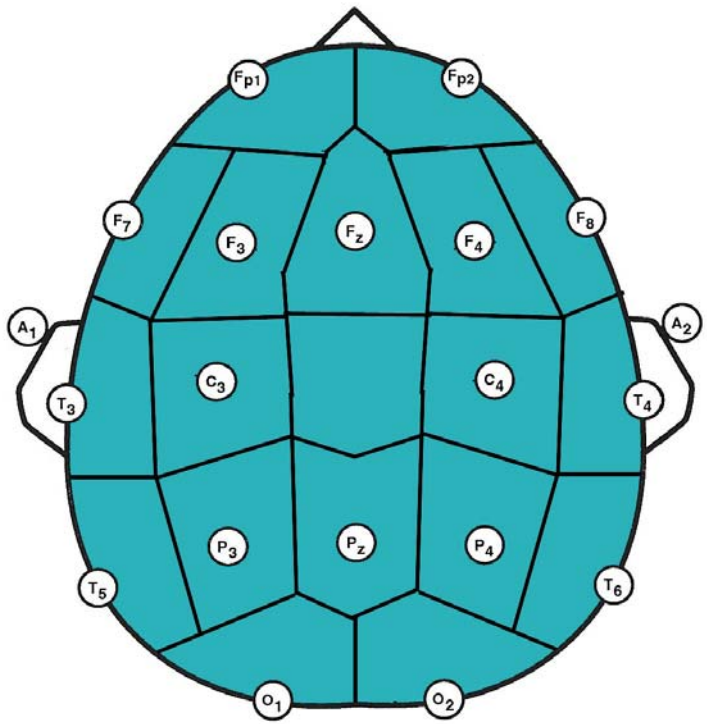
Individual Variation

- Many cognitive functions are located in the same areas for all individuals.
- But… the amount of stimuli needed to activate an area easily varies by individual.
- Most individuals have 1 or 2 low-threshold functions, and 1 or 2 high-threshold functions.
- An individual may utilize a low-threshold function even if it produces suboptimal results.
- Lots of brain activity for a low-threshold function indicates skilled / considered use.
- Linguistic or behavioral tag/s may belie use of a notably low/high-threshold function.

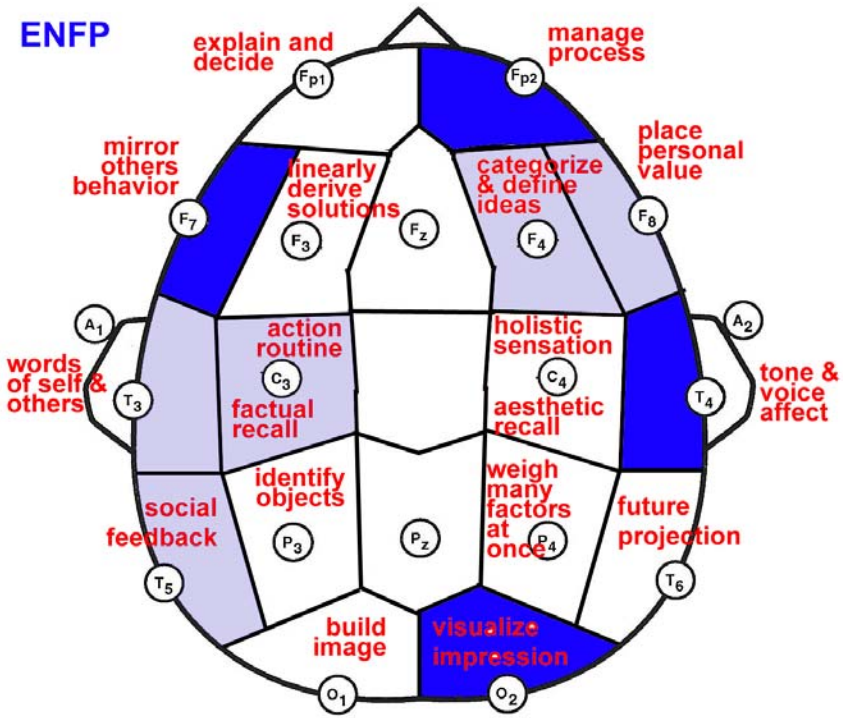

ENFJ
explain and decide
manage process
mirror others behavior
linearly derive solutions
categorize & define ideas
place personal value
words of self & others
action routine
holistic sensation
tone & voice affect
factual recall
aesthetic recall
social feedback
identify objects
weigh many factors at once
future projection
build image
visualize impression
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
T3
C3
C4
T4
P3
Pz
P4
T5
T6
O1
O2

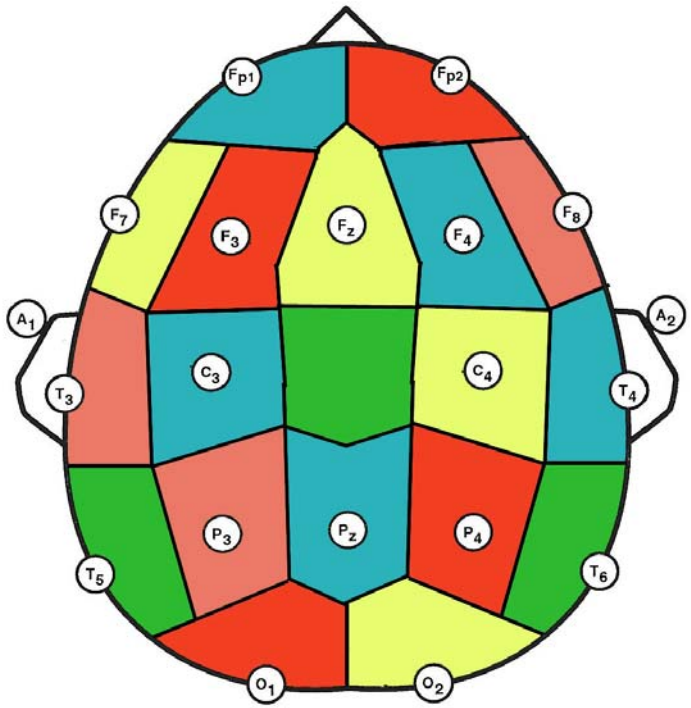
INFP

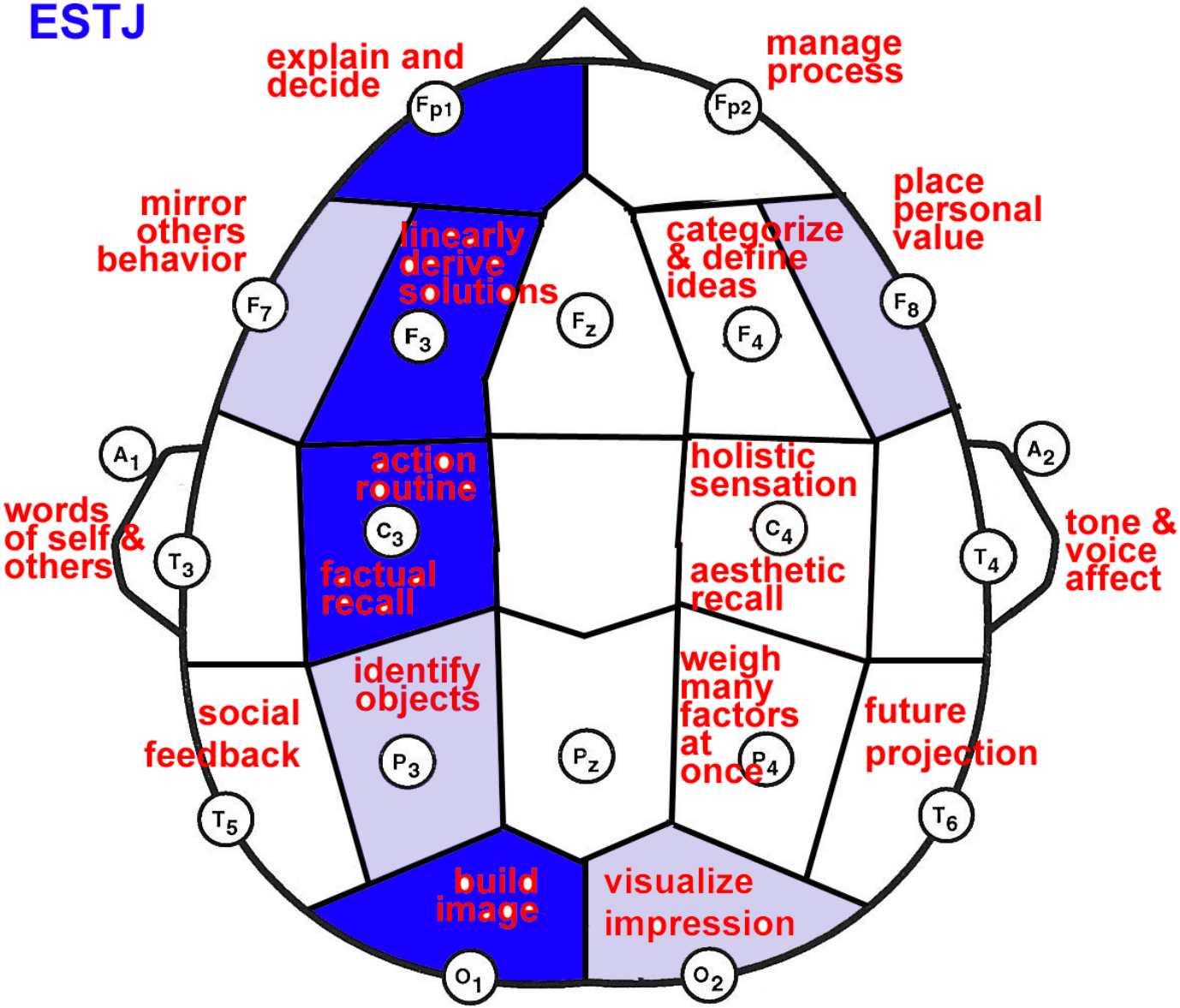

INFP
explain and decide
manage process
mirror others behavior
linearly derive solutions
categorize & define ideas
place personal value
action routine
holistic sensation
words of self & others
tone & voice affect
factual recall
aesthetic recall
identify objects
weigh many factors at once
social feedback
future projection
build image
visualize impression
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
C3
C4
T3
T4
P3
Pz
P4
T5
T6
O1
O2


Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
C3
C4
T3
T4
P3
Pz
P4
T5
T6
O1
O2

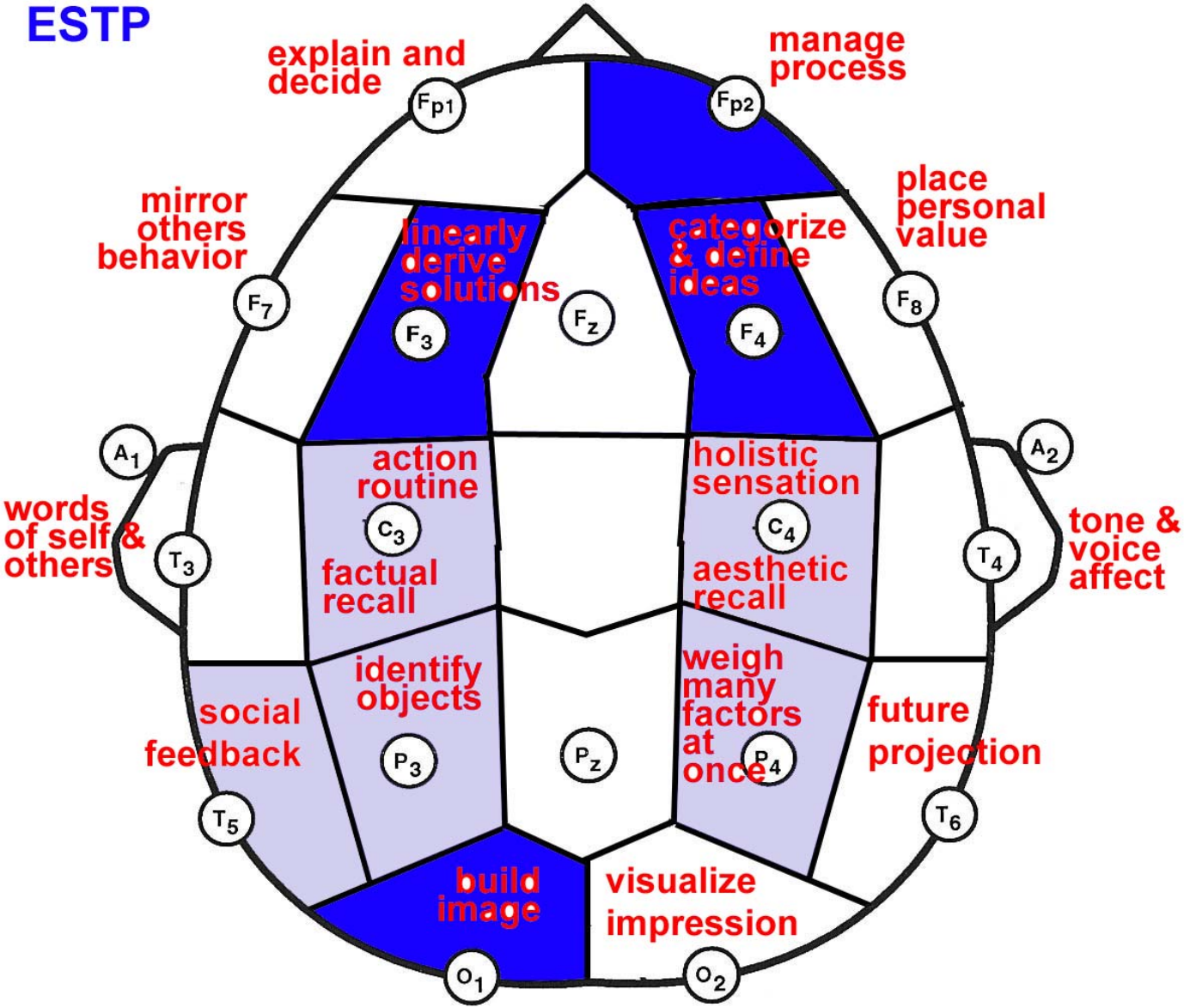
ENFP

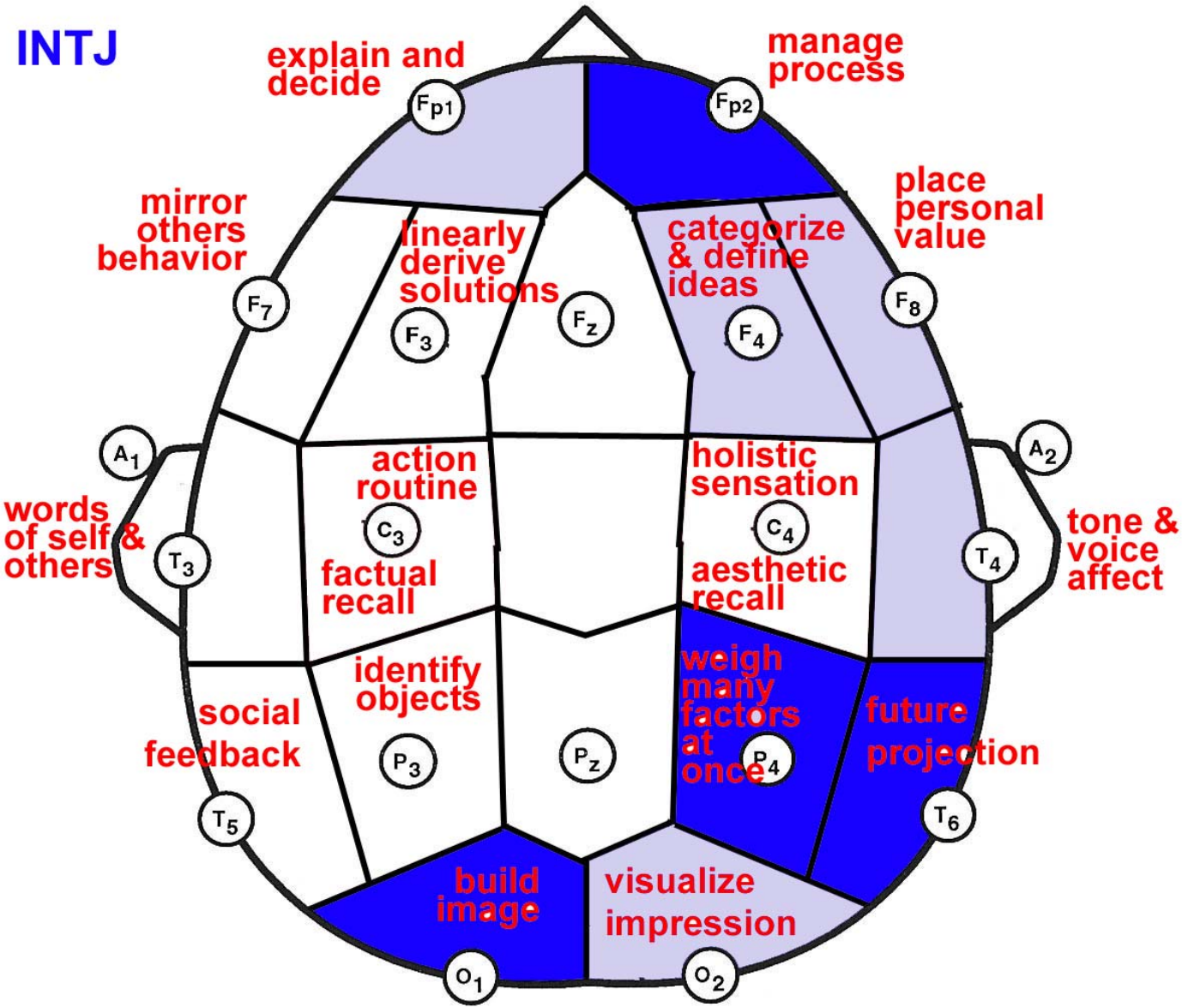

ENFP
explain and decide
manage process
mirror others behavior
linearly derive solutions
categorize & define ideas
place personal value
action routine
holistic sensation
words of self & others
tone & voice affect
factual recall
aesthetic recall
identify objects
weigh many factors at once
social feedback
future projection
build image
visualize impression
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
T3
C3
C4
T4
P3
Pz
P4
T5
T6
O1
O2


Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
T3
C3
C4
T4
P3
Pz
P4
T5
T6
O1
O2


ESTJ
explain and decide
manage process
mirror others behavior
linearly derive solutions
categorize & define ideas
place personal value
words of self & others
action routine
holistic sensation
tone & voice affect
factual recall
aesthetic recall
identify objects
weigh many factors at once
social feedback
future projection
build image
visualize impression
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
C3
C4
T3
T4
P3
Pz
P4
T5
T6
O1
O2

ESTP


explain and decide
manage process
mirror others behavior
linearly derive solutions
categorize & define ideas
place personal value
words of self & others
action routine
holistic sensation
tone & voice affect
factual recall
aesthetic recall
social feedback
identify objects
weigh many factors at once
future projection
build image
visualize impression
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
T3
C3
C4
T4
P3
Pz
P4
T5
T6
O1
O2


INTJ
explain and decide
manage process
mirror others behavior
linearly derive solutions
categorize & define ideas
place personal value
words of self & others
action routine
holistic sensation
tone & voice affect
factual recall
aesthetic recall
social feedback
identify objects
weigh many factors at once
future projection
build image
visualize impression
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
A2
T3
C3
C4
T4
P3
Pz
P4
T5
T6
O1
O2

More Lessons Learned

- Emotional response linked to cognitive response.
- Encountering another agent or task for the first time differs from encountering something familiar.
- Cognition varies whether extemporaneous or prepared.
- Subjects can learn to do unusual tasks from exposure without practice, but that doesn’t evoke regions linked to optimal results.
- Many others…

Thank you for your mind’s attention today!

Dario Nardi, UCLA

darionardi22@gmail.com