System 1 Methods Best Practices

Questions to Ask Your Provider

NIQ BASES

EEG – electro-encephalography

What it is: Measurement of brain's electrical activity from the scalp

- What's good about EEG: Valid & granular brain function measure
  - Highly sensitive, direct from brain, great timing information, quantitative, grounded in academic & medical research
- What to consider about EEG: Many ways to do it "wrong"
  - Given its sensitivity, many sources of "noise" can contaminate signal
  - Requires neuroscience and analytical expertise
- What EEG is well suited for: Quantitative deep dives into various consumer touchpoints, including advertising, packaging, product
- What EEG is not as good a tool for (yet): individual measurement, large-scale screening, precise location information in brain
- Need to haves
  - Adequate sensor density, Adequate sampling rate, Consistent electrode placement, Control of testing environment, Data cleaning procedures
- Really nice to haves
  - PhD neuroscience expertise, expertise with specific protocol, scientific consensus basis for metrics, reliability & validity data
- One more thing: There are different types of EEG research. A supplier should be able to share what they use, for what and why

Questions to ask:

- How many sensors do you use?
- What's your sampling rate?
- What practices do you have for dealing with electrical noise?
- What do you do for artifact removal?
- What neuroscience expertise do you have?
- What reliability & validation data can you share?
- When do you NOT recommend using EEG?

fMRI – functional magnetic resonance imaging

What it is: Measurement of brain's blood flow to active brain areas

- What's good about fMRI: Valid, granular brain mapping method
  - Precise spatial measurement, direct from brain, highly studied in academia.
- What to consider about fMRI: not very scalable
  - Very expensive (needs an MRI facility), not precise timing information, very motion sensitive (no movement allowed), respondent is supine, inferences can be difficult as brain location may not indicate function
- What fMRI is well suited for: mapping brain networks, proof of concept studies
- What fMRI is not as good a tool for (yet): scalable regular commercial testing, detailed timing information
- Need to haves
  - Scientifically based protocol and analysis plan, motion control plan during study and motion artifact processing plan, safety plan (highly magnetized environment)
- Really nice to haves
  - PhD neuroscience expertise, radiologist / physicist support, expertise in specific protocol, published work guiding hypotheses and analysis plan
- One more thing: fMRI is often used to discover new pathways, so each study often has custom aspects, and quality can vary. Ask!

Questions to ask:

- What previous research is your protocol and analysis based on?
- How will you control for motion artifacts?
- What post-processing motion data cleaning tools will you use?
- What is the basis for your inference of specific mental state studied?
- How will you control for multiple comparisons?
- What is your safety plan?
- How do you handle claustrophobic respondents?
- How much will it cost?

FACS: facial action coding system

What it is: Identifying emotional expression from facial movements

- What's good about FACS: Measures outward emotional expression
  - Enables assessment of outward emotional expression to compare across experiences, cultures and even species; easy for people to understand
- What to consider about FACS: Your face doesn't show everything
  - Facial expressions are not a rich signal and do not reflect all the internal emotions, high variability across people in strength and frequency of expressions, video quality impacts results (lighting, resolution, adjustments for skin types), reliability and validity questioned
- What FACS is well suited for: Questions related to how people express their emotion outwardly
- What FACS is not as good a tool for (yet): internal emotional response to passive stimuli
- Need to haves
  - Established algorithms for emotion identification, guidelines for video quality, protocols shown to be appropriate for different skin colors
- Really nice to haves
  - Reliability & validity data, inference guidelines ahead of data collection
- One more thing: Facial coding was not originally developed as a tool to measure the full internal emotional response

Questions to ask:

- What are your video collection guidelines in terms of lighting, resolution (and bandwidth, if online)?
- What is the source of your coding algorithms?
- Have your protocols and analysis tools been optimized for different skin types and colors?
- What can you share about reliability and validity?
- What is the threshold you require for repeatable findings?
- What are the limitations?

IRT: implicit reaction time

What it is: Measure speed of response to incidental question

- What's good about IRT: cheaper, faster System 1 tool
  - May be more "right size," requires less specific equipment, often more appropriate for screening than higher touch tools like EEG
- What to consider about IRT: The devil is in the details
  - IRT is not one thing. It includes myriad approaches, and not all of them are as robust as others. The small details of protocol make a difference in repeatability. Because effects are very small (msec), many sources of noise can obscure effects (especially online)
- What IRT is well suited for: Faster, simpler System 1 reads that don't need a lot of "why"
- What IRT is not as good a tool for (yet): Detailed optimization
- Need to haves
  - Task details and basis for using them, reliability information (especially if effect is small), noise control (e.g., computer speed, internet speed, refresh rate, participant compliance)
- Really nice to haves
  - Academic research validating protocol, theoretical underpinning to guide inference, hypotheses ahead of data collection
- One more thing: All reaction time studies aren't *implicit!* Fast explicit reaction time studies aren't System 1 but System 2

Questions to ask:

- Is the method fast explicit or implicit? What are the respondents asked to do?
- How are you controlling for noise variables like computer speed, multi-tasking, internet speed (if online), etc.?
- What is the protocol you used based on and how do you infer what changes in response time mean?
- How reliable is the method? Have you done repeatability experiments?
- How long is the experience, and do you see signs of fatigue? What guardrails do you have to guard against fatigue?

Biometrics: autonomic nervous system measurement

What it is: "Fight or flight" biological responses like heart rate, galvanic skin response (sweat), breathing rate

- What's good about biometrics: Relatively cheap & easy
  - Most tools can be administered easily without experienced technician, automatic non-conscious responses
- What to consider about biometrics: Fight or flight is not very precise
  - Involves many systems (nervous, endocrine, etc.), very imprecise in timing, not specific, only very strong responses are highly repeatable, debated in academia
- What biometrics are well suited for: questions of general arousal
- What biometrics are not as good a tool for (yet): biometrics has not been shown to have applicability to many consumer neuroscience questions. Use with caution.
- Need to haves
  - Stated plan of analysis and inference ahead of data collection, baselining & normalization procedures
- Really nice to haves
  - Published research explaining theory for what each metric means, reliability & validity data
- One more thing: "Fight or flight" evolved to be redundant, biometrics are highly correlated, and more data does not solve issues.

Questions to ask:

- What types of measures are you terming "biometrics"?
- What inferences are you making and why?
- How do you control for arousal (if this is not primary question)?
- How do you control for motion artifacts?
- What are the limitations?
- If multiple measures are gathered, why and what incremental value does each add?
- What is your pre-study analysis and inference plan?
- What will we NOT be able to learn with this data?