

MEASURING EMOTIONAL ENGAGEMENT

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Introductions

- Bentley UXC, HFID, and JUS
- Data-driven UX research
- My motivation in “emotional engagement”
- You?



Agenda

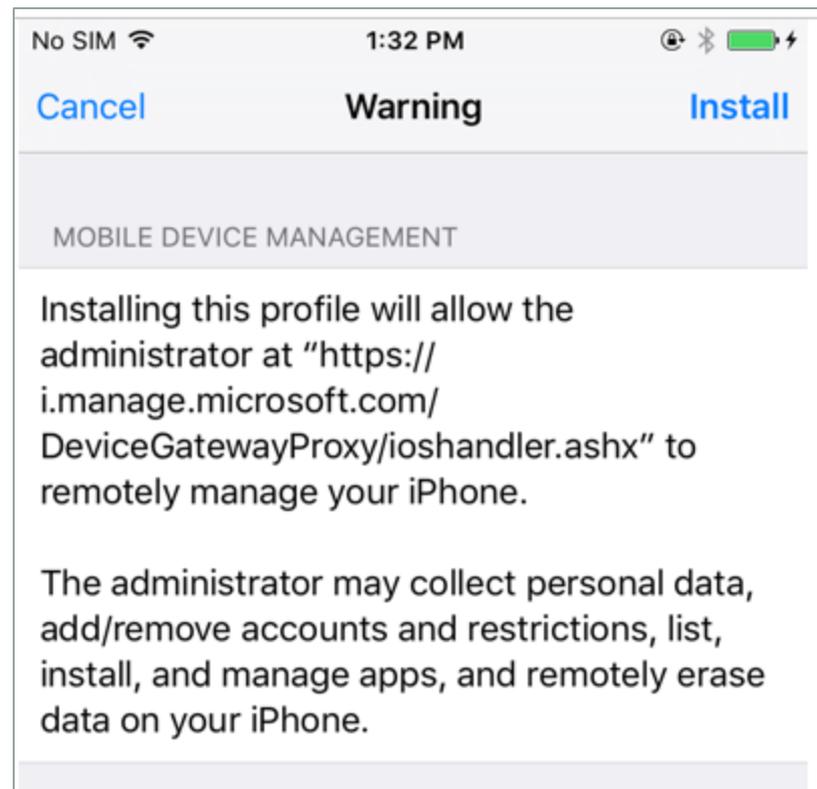
- Background
- Self-reported metrics
- Eye tracking
- Physiological metrics
- Bringing it all together



Background

Recent Example

- Client interested in the usability of the installation of an enterprise application on mobile devices
- The usability of the installation was not the issue – linear path
- The BIG issue was on their comfort level related to data privacy
- So, how would you measure this to know how big an issue? What “emotions” come into play?



Other Examples

- How would you measure emotional engagement in the following examples?
 - The use of a financial mobile application?
 - The use of a new online game?
 - The use of a new healthcare website?
- What are some of your examples where you have measured emotional engagement?



Goals of Quantifying UX

- Many different goals depending upon the stage of development of the product:
 - Determine if it's ready to launch.
 - Help identify problem areas or issues that need to be addressed.
 - Get an overall sense of how good or bad things are.
 - Determine how your product compares to competitors.
 - See if things are getting better across iterations, releases, quarters, years, etc.
 - Help convince management or others of the need to fix something.



Types of UX Metrics

- Performance metrics (e.g., time, errors, task completion)
- Self-reported metrics (e.g., ease of learning, ease of use, confidence)
- Issues-based metrics (e.g., number of problems, severity of problems, number of users encountering)
- Combined and comparative metrics (e.g., z-scores, comparisons to goals or “expert” performance)
- Behavioral and physiological metrics (e.g., eye-tracking data, GSR, facial expression coding)



Formative Study

- Objective is to improve the design of the product as part of an iterative process.
- Typical goals for a formative study:
 - Identifying design features that are causing task failures or inefficiencies.
 - Identifying design features that are working well.
 - Identifying ways to improve user satisfaction.
- Commonly fewer than 10 participants per iteration.



Summative Study

- Objective is to evaluate the user experience of the product/service overall.
- Typical goals for a summative study:
 - Did it meet the goals of the project?
 - How does it compare to the competition?
 - How does it compare to previous releases of the product?
- Commonly 20+ participants.

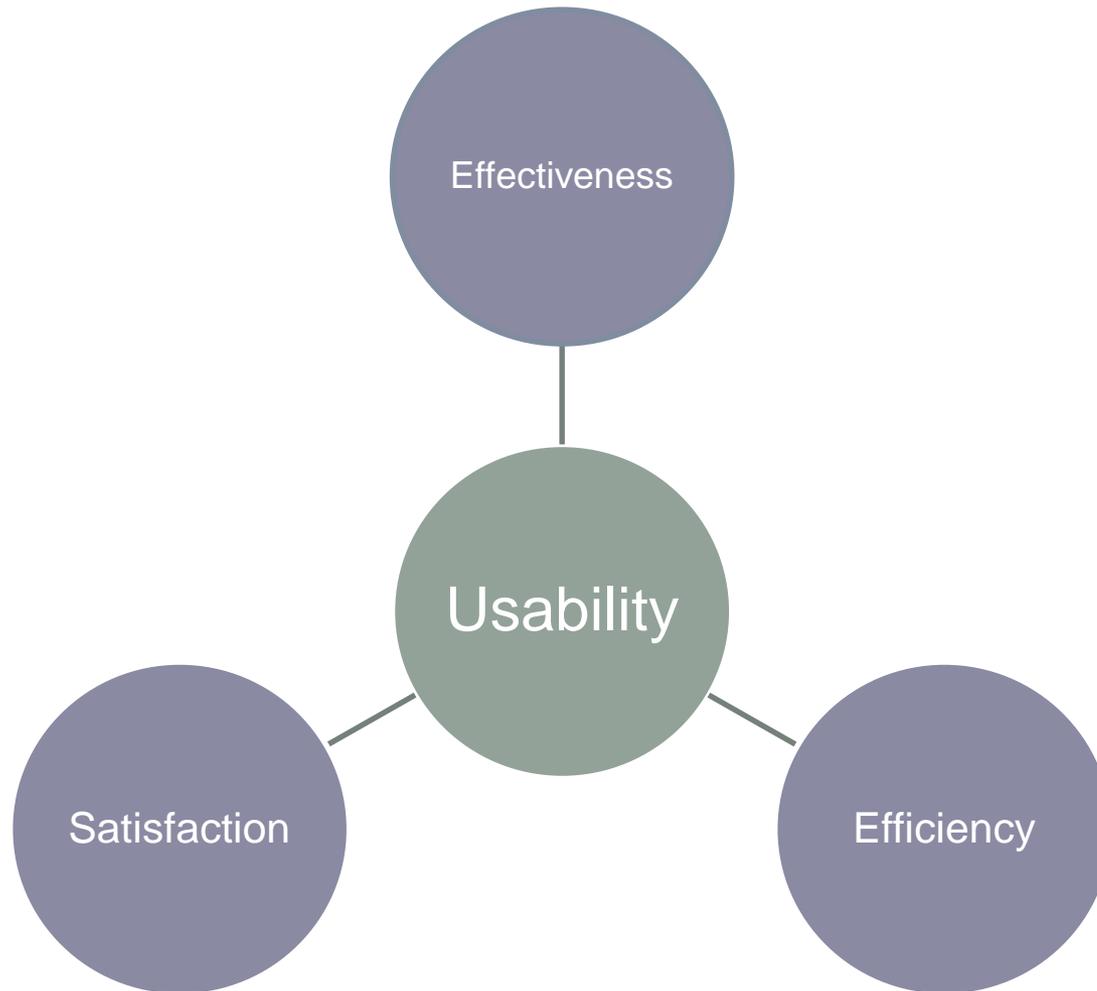


Principles of UX Measurement

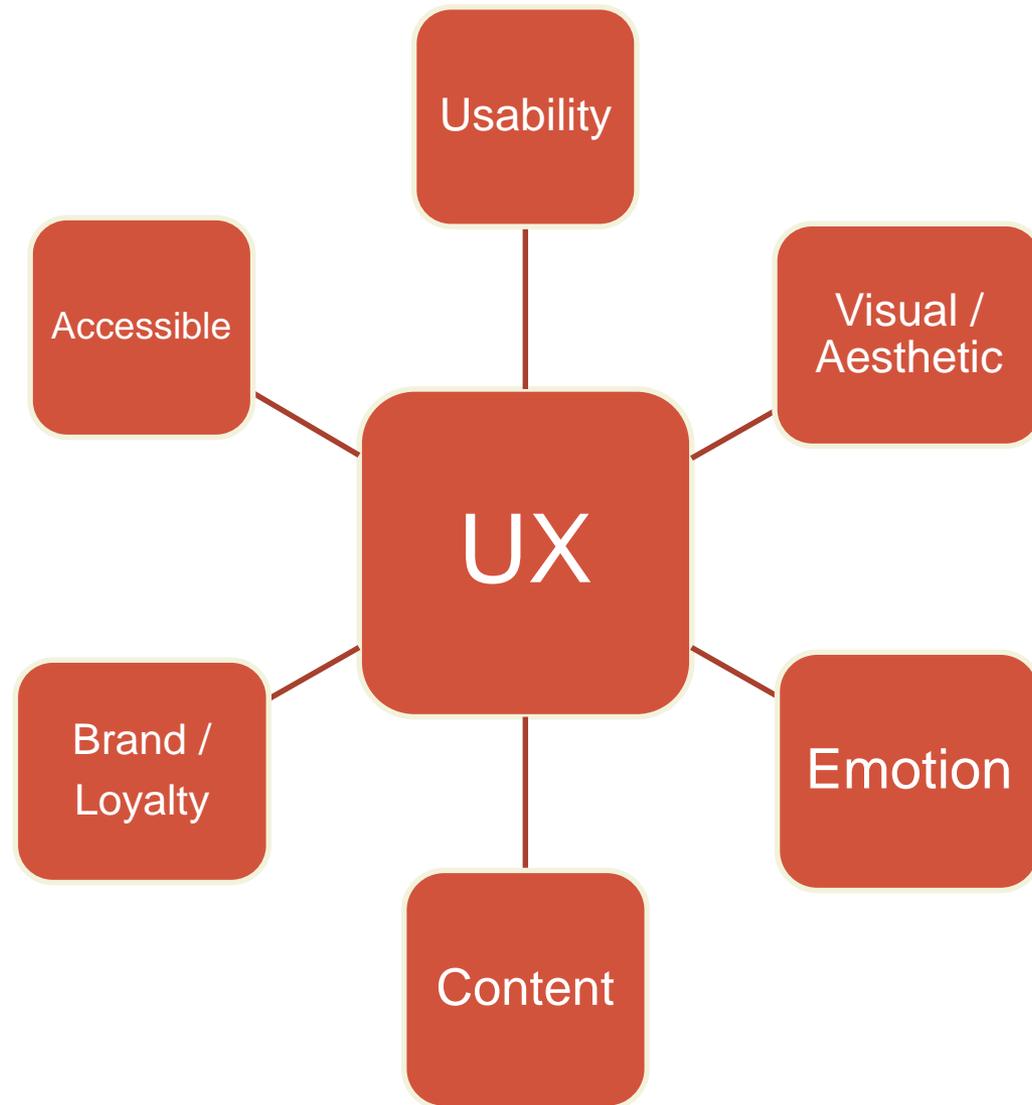
- No single metric tells the whole story
- There is always “noise” in the data
- Reliability and validity are critical
- Metrics and confidence
- Many ways to collect and analyze UX data



Classic Definition of Usability

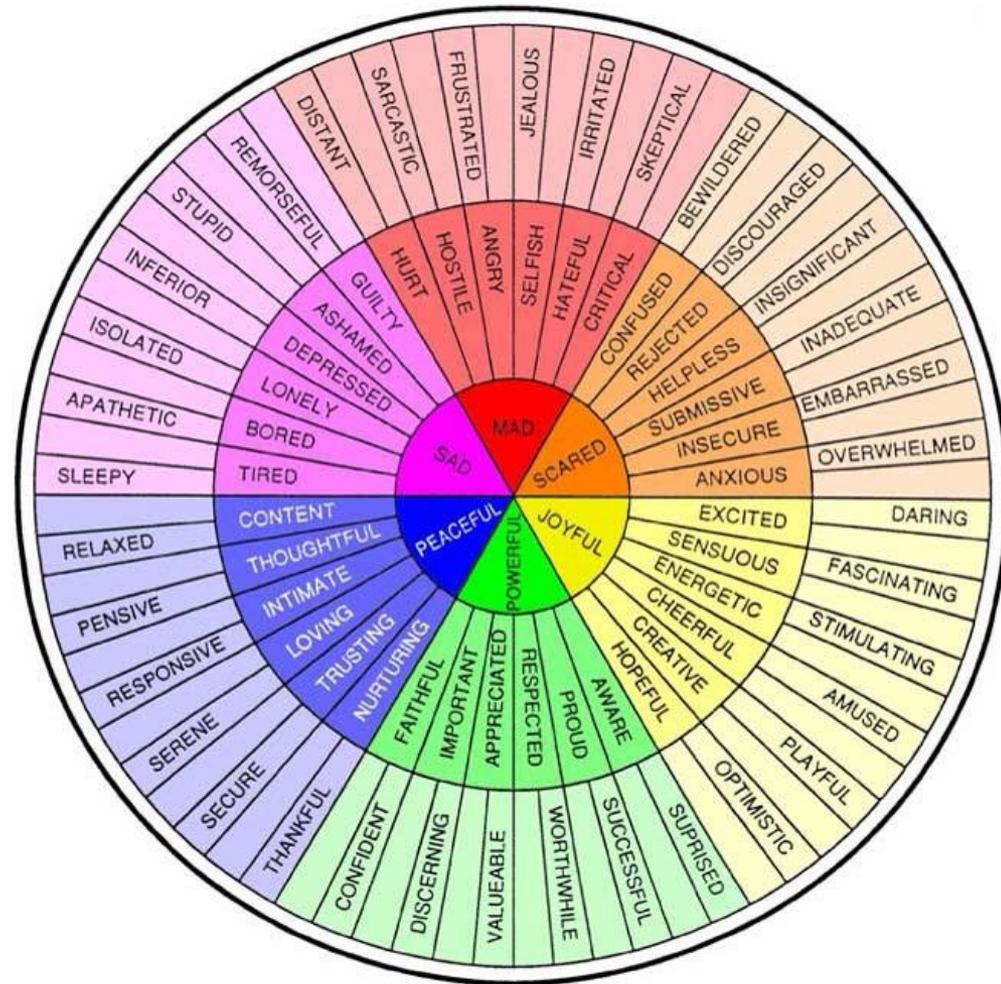


What is UX?



Frequent Emotions in UX

- Frustration
- Surprise
- Delight
- Excitement
- Stress
- Interest
- Bored
- Disappointed
- Trust
- Neglect
- Confident
- Others?



Identifying Relevant Emotions

- Field research
- Personas
- Usability testing
- Focus groups
- In-depth interviews
- Diary studies

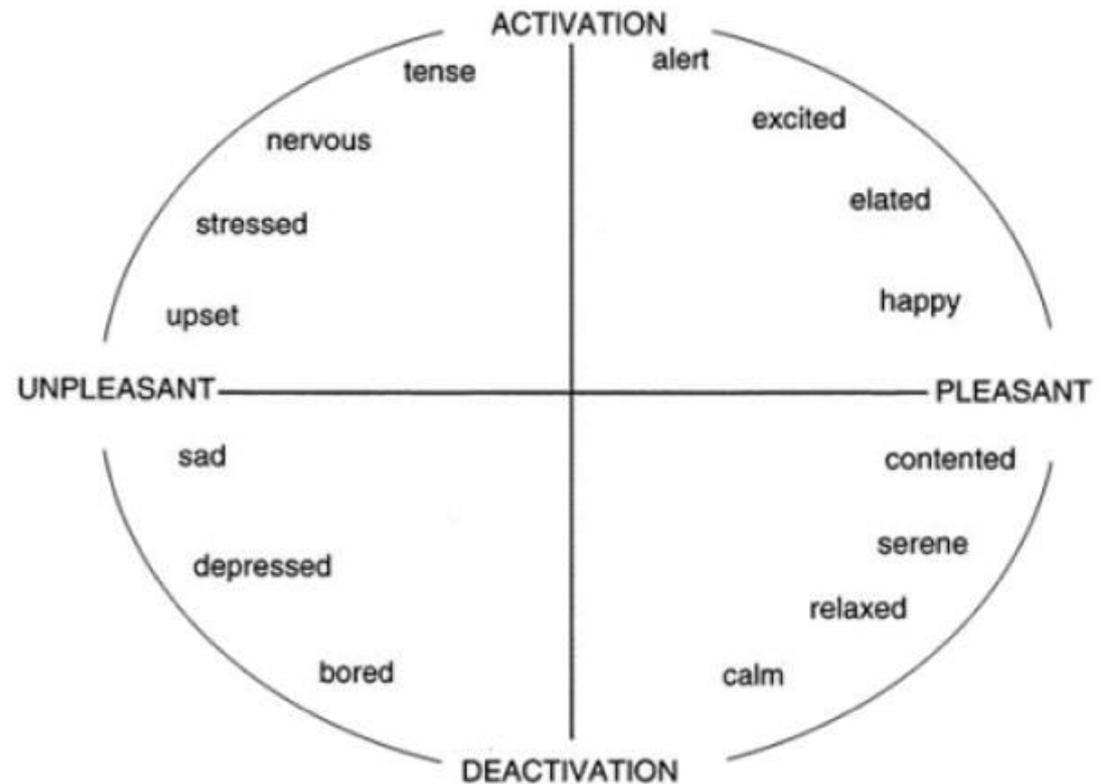


Most of all, listen, be open minded, and look at the data



Two Dimensions of Emotion

- Arousal (stress)
 - Calm to excited
- Valence (affect)
 - Positive to negative



(Posner, Russell, & Peterson, 2005)



Examples

Tense



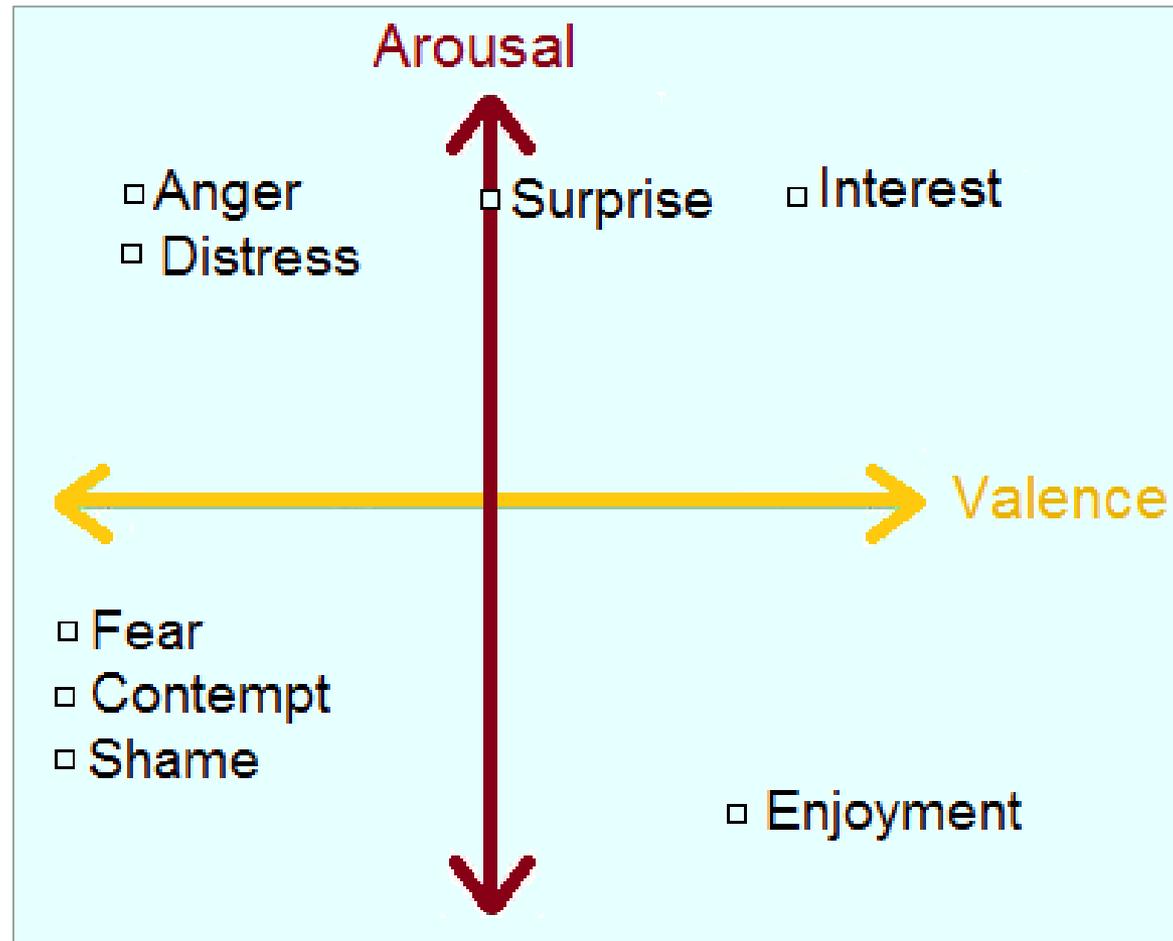
Happy



Where would put frustration, surprise, and boredom on these two spectrums?

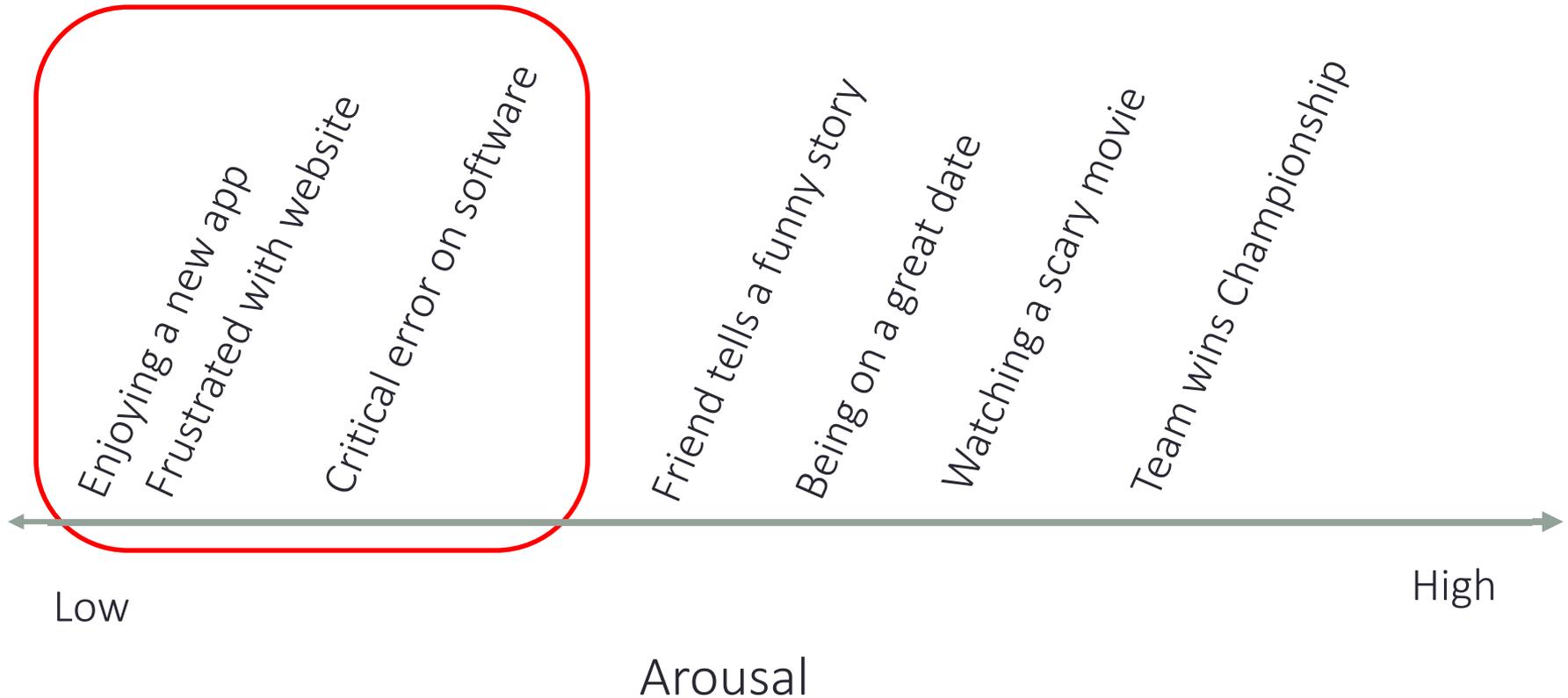


Arousal and Valence



<https://superagonist.wordpress.com/2013/07/13/lovheim-cube-of-emotion/>

Range of Emotion in UX



Emotional Engagement Metrics

- Engagement is the degree/range of emotional involvement a user feels in their use of a product/service
- It may also involve other feelings such as stress, attention, and cognitive workload
- Limited range of “arousal” – how do you measure at one of the spectrum?
- What metrics are sensitive enough to detect reliable results?
- Issue with reliability – are the metrics measuring the “thing” you think they are measuring?



Group Discussion

- Form into small groups and discuss some of the different types of emotions that are relevant in the user experience of the products/services you work on
 - What types of products/services?
 - Which emotions are most relevant?
 - How would you collect data and measure them?
 - What are your concerns?

Share!



Self-Reported Metrics

Self-Reported Metrics

- Also called satisfaction, subjective, or preference metrics.
- You're *asking* the users what they think about the system being evaluated.
 - Sometimes you care more about their *reactions* to the system than how effectively they can actually use it.
- Usually measured with various types of rating scales, such as:
 - Likert scales
 - Semantic differential scales
- Other types of self-reported metrics:
 - Yes/No (awareness, success, etc)
 - Perception of current or future behavior (time estimates, actions, etc)
 - Metrics derived from verbatim comments



Data Collection: Online Surveys

- Lack of representative sample
 - Trend is younger, more educated, higher income
 - Online Panels (0.25% of US population take 30% of all online studies)
- Fraudulent participants
 - Screeners
- Satisficing (weak and strong)
 - Speed traps
- Survey length
 - After 10 minutes, completion rates drop significantly
- Survey design
 - Basic designs have higher completion rates



Data Analysis Tips

- Confidence intervals (90%, 95%, 99%)
- Tests of significance (t-tests, ANOVA)
- “degrees of intervalness” and data types (nominal, ordinal, ratio, and interval)
 - Poor ○ Fair ○ Average ○ Good ○ Excellent
 - Poor ○ ○ ○ ○ ○ Excellent
- Averages and top 2/bottom 2 boxes
- Segmentation



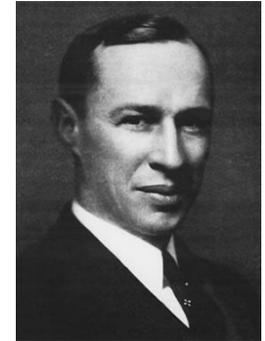
Types of Self-Reported Metrics

- Likert scale
- Semantic differential
- Expectation metrics
- QUIS
- WAMMI
- NPS
- SMEQ
- SUPR-Q
- NEV
- Kano Method
- Emoji's
- Product Reaction Cards
- Verbatims



Likert Scale

- Named for Rensis Likert who created it in 1932
- Pronounced “lick-ert”, not “like-ert”
- A typical item in a Likert scale:
 - A statement (may be positive or negative)
 - To which the respondents rate their level of agreement
 - Direction should go from “strongly disagree to strongly agree”
 - Commonly on a 5-point scale or 7-point scale, but almost always an odd number (to allow for neutral response)



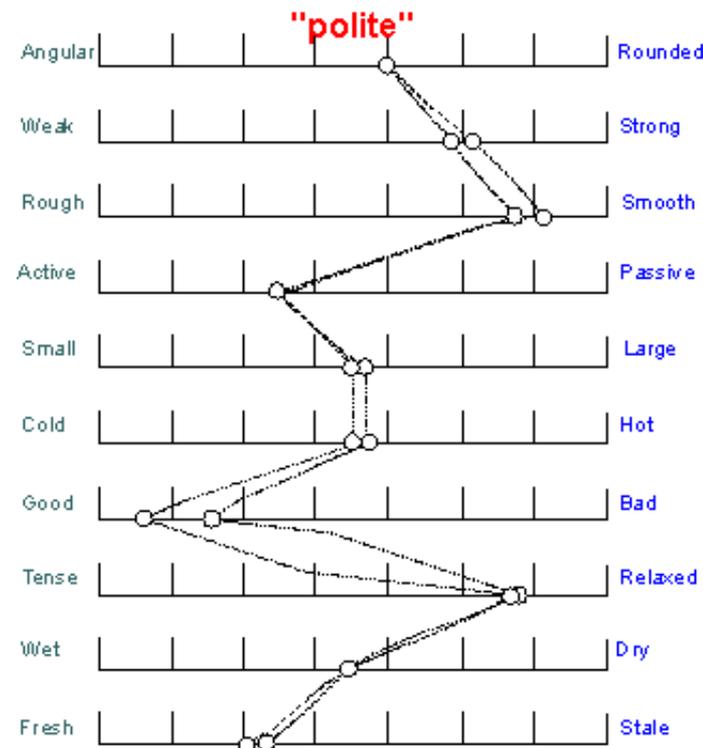
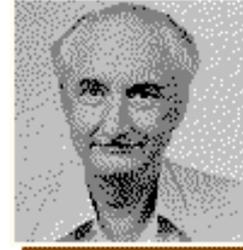
This workshop is useful

Strongly Disagree Strongly Agree



Semantic Differential

- Developed by Charles Osgood in 1957
- The scales use bi-polar or opposite words at the ends, such as: Easy/Difficult, Beautiful/Ugly, Bright/Dark, Fast/Slow, etc.
- Avoid “very”
- Original use was to map connotations of words.



Common Issues with Ratings

- Possible biases (e.g., social desirability bias)
 - Users may give more honest responses when anonymous.
- Number of points to the scale
 - Use an odd number (probably 5 or 7) unless there's a good reason not to allow a neutral response.
- Wording of anchors
 - “Friendly/Unfriendly” will likely give different results from “Friendly/Hostile” as anchors.
- Reliability
 - Can be increased by asking for basically the same rating in a few different ways and averaging them.



Expectation Measure: Before/After

Before:

Task 1. Find out how many people report to Jeremy George's manager. (Include Jeremy in this number.)

How Difficult or Easy do you expect this task to be?

Very Difficult Very Easy

Task 2. You need to return a notebook to someone but only know that he works on the 4th floor of 245 Summer St (building code V, floor 4), and that his manager's name is Tom. Find this man and report his corpID.

How Difficult or Easy do you expect this task to be?

Very Difficult Very Easy

Task 3. You remember talking with someone named John and want to contact him, but don't remember his last name. You only know that his last name starts with S. You also remember that he works at 500 Salem St. in Smithfield (Building code OS) and works in FISC. Find this man and report his corpID.

How Difficult or Easy do you expect this task to be?

Very Difficult Very Easy

Task 4. You know a woman who works in FISC whose first name is Edyta and you need to call her. What are the last four digits of her phone number?

How Difficult or Easy do you expect this task to be?

Very Difficult Very Easy

After:

Tasks1 - Microsoft Internet Explorer

Task 1 of 7: Find out **how many people** report to Jeremy George's manager. (Include Jeremy in this number.)

Enter answer:

Overall, this task was:

Very Difficult Very Easy

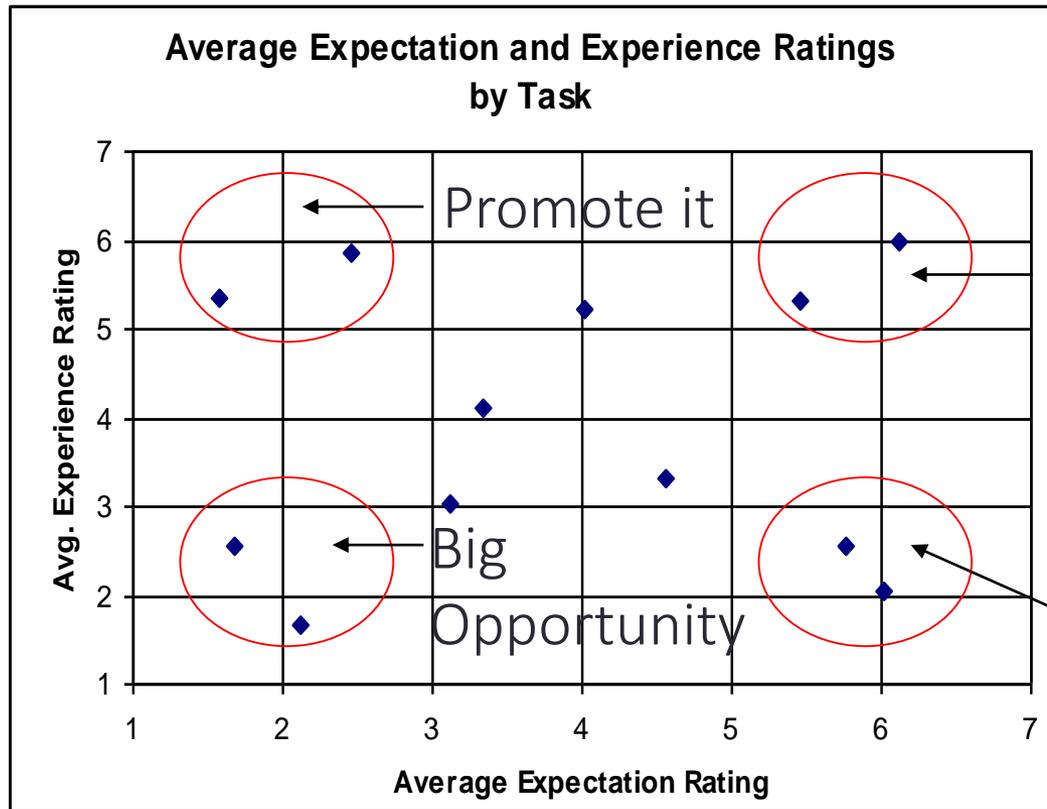
NEXT Task >>

Expectation Measure

1=Difficult

...

7=Easy



Don't Touch It

Fix it Fast

1=Difficult;

7=Easy

QUIS

- QUIS = questionnaire for user interaction satisfaction
- Developed at the University of Maryland
- Each question is a rating on a 9-point scale with appropriate (validated) anchors
- Use of semantic differential scales
- Includes dimensions such as ease of use, terminology, performance, error recovery, support, and learnability
- Access to normative database to compare within industry

See <http://www.lap.umd.edu/QUIS/index.html> for licensing



QUIS

Overall Reaction to the Website		0	1	2	3	4	5	6	7	8	9	NA
Learning		0	1	2	3	4	5	6	7	8	9	NA
15. Learning to use the website	difficult	<input type="radio"/>	easy <input type="radio"/>									
16. Exploring new features by trial and error	difficult	<input type="radio"/>	easy <input type="radio"/>									
17. Performing tasks is straightforward	never	<input type="radio"/>	always <input type="radio"/>									
18. Help messages on the screen	unhelpful	<input type="radio"/>	helpful <input type="radio"/>									
19. Supplemental reference materials	confusing	<input type="radio"/>	clear <input type="radio"/>									
Website Capabilities		0	1	2	3	4	5	6	7	8	9	NA
20. Website speed	too slow	<input type="radio"/>	fast enough <input type="radio"/>									
21. Website reliability	unreliable	<input type="radio"/>	reliable <input type="radio"/>									
22. Sounds associated with this website	detracts value	<input type="radio"/>	adds value <input type="radio"/>									
23. Correcting your mistakes	difficult	<input type="radio"/>	easy <input type="radio"/>									
24. Designed for all levels of users	never	<input type="radio"/>	always <input type="radio"/>									
14. Error messages	unhelpful	<input type="radio"/>	helpful <input type="radio"/>									

WAMMI

- WAMMI = **W**ebsite **A**nalysis and **M**ea**s**ure**M**ent Inventory
- A commercial service: www.wammi.com
- Your site's results are compared to the results from over 200 site evaluations done around the world
- 20 statements with associated 5-point rating scales
- Analyzes five dimensions: attractiveness, controllability, efficiency, helpfulness and learnability
- Generates a “Global Usability Score” to get a single metric



WAMMI Example

Statement 1-10 of 20

This web site has much that is of interest to me

It is difficult to move around this web site.

I can quickly find what I want on this web site.

This web site seems logical to me.

This web site needs more introductory explanat

The pages on this web site are very attractive.

I feel in control when I'm using this web site.

This web site is too slow.

This web site helps me find what I am looking fo

Learning to find my way around this web site is

Statement 11-20 of 20

I don't like using this web site.

I can easily contact the people I want to on this web site.

I feel efficient when I'm using this web site.

It is difficult to tell if this web site has what I want.

Using this web site for the first time is easy.

This web site has some annoying features.

Remembering where I am on this web site is difficult.

Using this web site is a waste of time.

I get what I expect when I click on things on this web site.

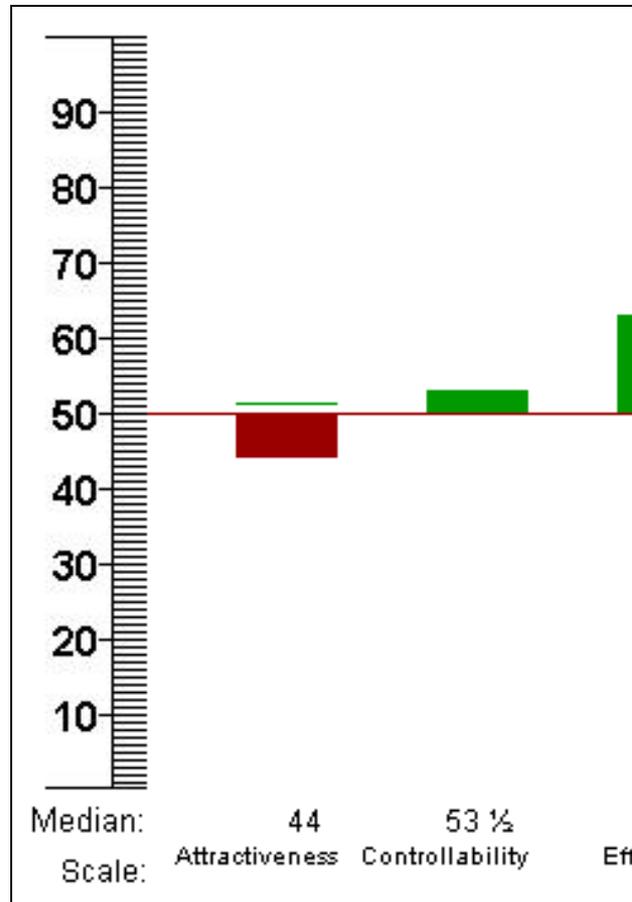
Everything on this web site is easy to understand.

Strongly
Agree

Strongly
Disagree



Sample WAMMI Data



Users' ratings, statement by statement (0% = same as database average)

This web site is too slow.

Using this web site is a waste of time.

This website has much that is of interest to me.

The pages on this web site are very attractive.

It is difficult to tell if this web site has what I want.

I can easily contact the people I want to on this web site.

I get what I expect when I click on things on this web site.

This web site helps me find what I am looking for.

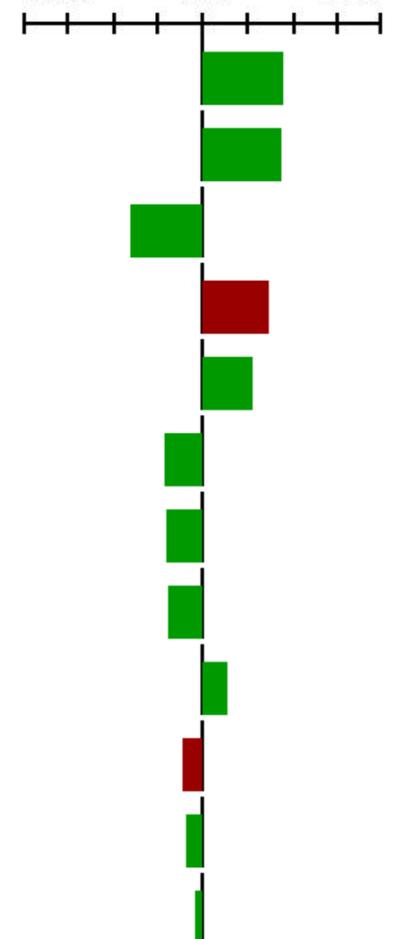
This web site needs more introductory explanations.

This web site has some annoying features.

Using this web site for the first time is easy.

I feel efficient when I'm using this web site.

More Agreement More Disagreement
100% 0% 100%



NPS (Net Promoter Score)

- Based on just one question: “How likely is it that you would recommend [Company X] to a friend or colleague?”
- With a 0-10 rating scale:
 - 0 = Not at all likely
 - 5 = Neutral
 - 10 = Extremely likely
- Not recommended when users do not have a choice, such as using an enterprise application
- Possible issues: cultural insensitivity, low motivator, and poor correlation with financials

http://blogs.forrester.com/richard_evensen/11-04-18-stop_using_nps_net_promoter_score_but_please_save_the_question

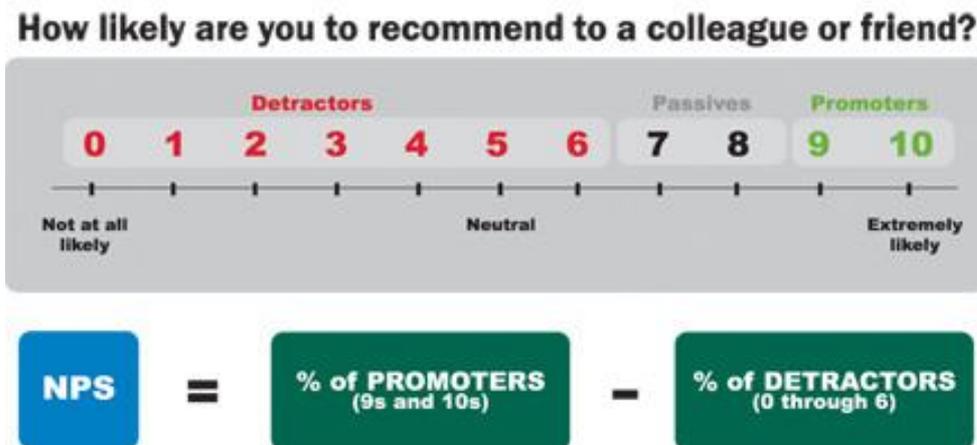


Calculating NPS

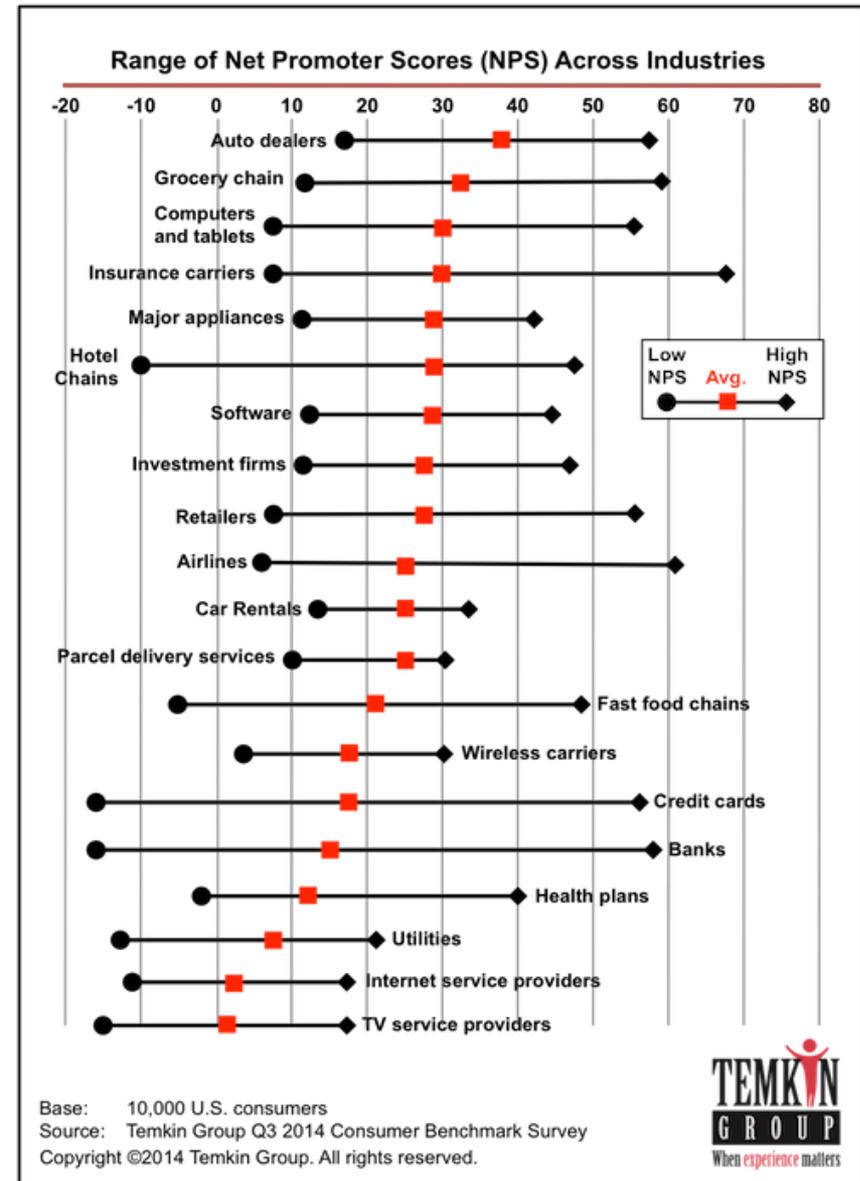
Promoters (score 9-10) are loyal enthusiasts who will keep buying and refer others, fueling growth

Passives (score 7-8) are satisfied but unenthusiastic customers who are vulnerable to competitive offerings

Detractors (score 0-6) are unhappy customers who can damage your brand and impede growth through negative word-of-mouth



Sample Net Promoter Scores



<http://temkingroup.com/research-reports/net-promoter-score-benchmark-study-2014/>

SMEQ

- SMEQ = Subjective Mental Effort Questionnaire
- Ranges from 0 – 150
- Participants draw a line to indicate mental effort
- Required to measure point along the scale
- Validated metric

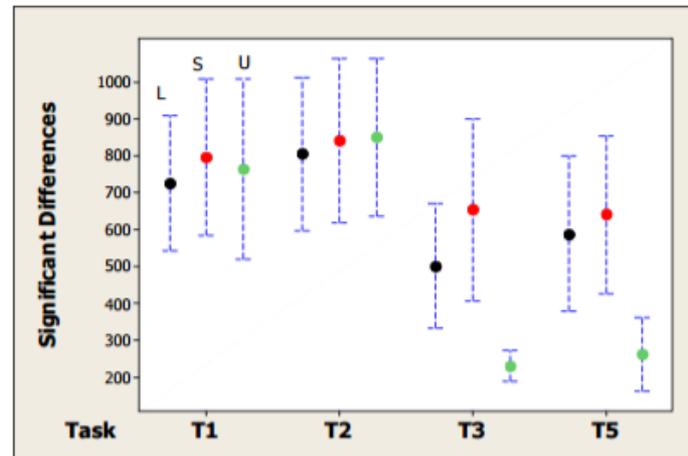
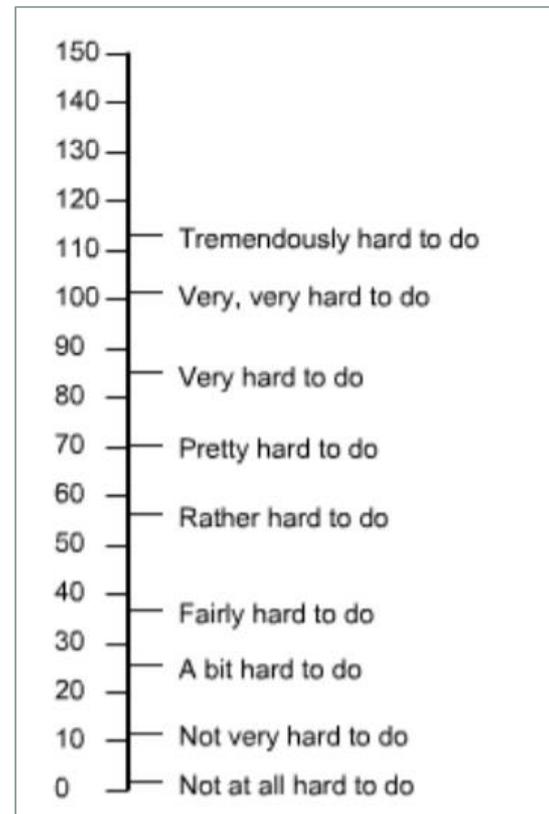


Figure 12. Difference between tasks. Graph shows the mean and 95% confidence intervals (L=Likert, S=SMEQ, U=UME) for the 4 tasks that had a significant difference for the full dataset.



SUPR-Q

- SUPR-Q = Standardized User Experience Percentile Rank Questionnaire
- Four factors:
 - Usability, trust/credibility, loyalty, and appearance
- Average first seven questions, and add to half the score of the loyalty question (0-10)
- Normative database, represented as a percentile
- Highly correlated with SUS

Usability

- This website is easy to use.
- It is easy to navigate within the website.

Credibility (Trust, Value & Comfort)

- The information on the website is credible.
- The information on the website is trustworthy.
- I feel comfortable purchasing from this website. (Alternate for eCommerce websites)
- I feel confident conducting business with this website. (Alternate eCommerce websites)

Loyalty

- How likely are you to recommend this website to a friend or colleague?
- I will likely visit this website in the future.

Appearance

- I found the website to be attractive.
- The website has a clean and simple presentation.



SUPR-Q - Analysis

	Strongly Disagree			Neutral			Strongly Agree			
	1	2	3	4	5	6	7	8	9	10
I will likely return to the Amazon website in the future.	<input type="radio"/>									
It is easy to navigate within the Amazon website.	<input type="radio"/>									
The information on the Amazon website is credible.	<input type="radio"/>									
I find the Amazon website to be attractive.	<input type="radio"/>									
The information on the Amazon website is trustworthy.	<input type="radio"/>									
The Amazon website has a clean and simple presentation.	<input type="radio"/>									
The Amazon website is easy to use.	<input type="radio"/>									

<http://uxpajournal.org/supr-q-a-comprehensive-measure-of-the-quality-of-the-website-user-experience/>

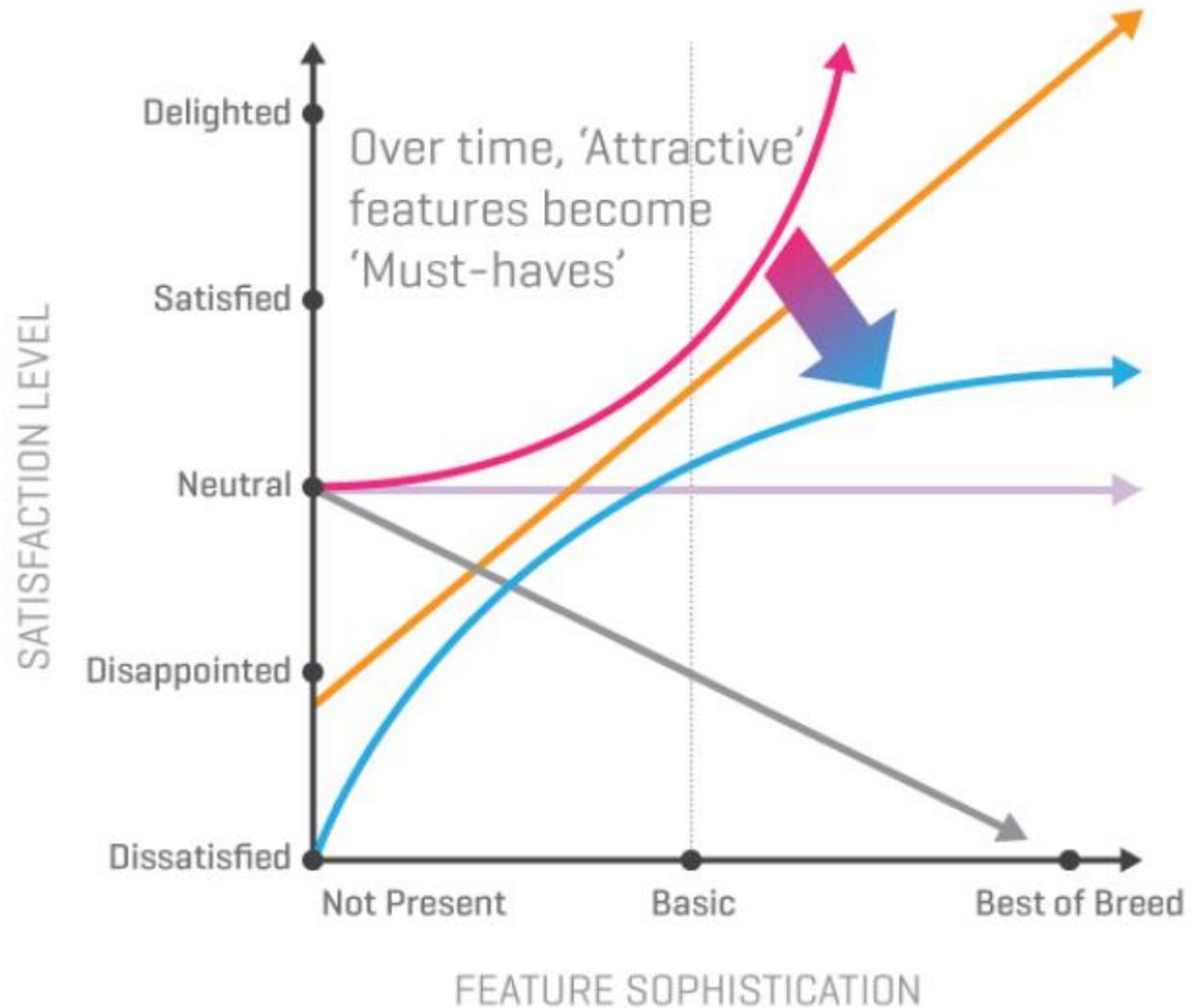


Kano Method

- Method to evaluate the desirability of different features
- Based on five dimensions:
 - Attractive features – trigger delight if present, but do not disappoint if absent
 - One-dimensional features – trigger delight if present, dissatisfaction if not present
 - Must-have features – dissatisfaction if not present, neutral if present
 - Unimportant features – neutral reaction if present or absent
 - Undesired features – Neutral reaction if absent, trigger dissatisfaction if present



Kano Method



Kano Method - Analysis

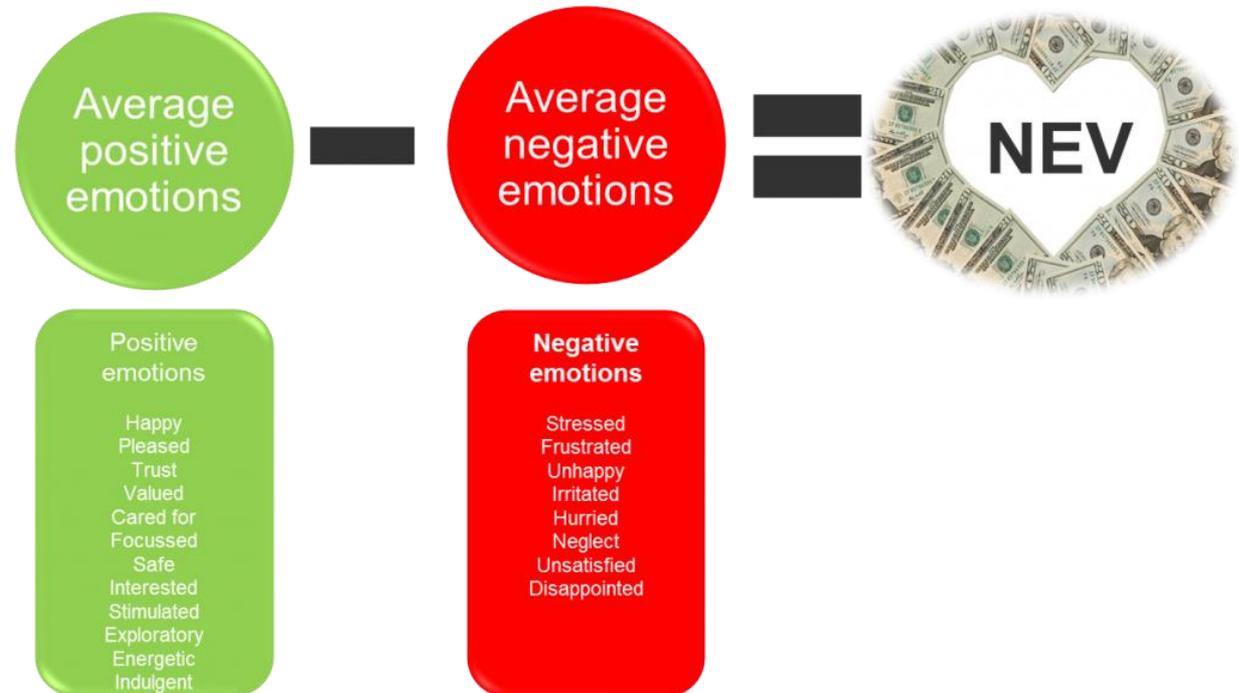
- Demonstrate each feature, ask two questions:
 - “how would you feel if this feature were present?” (positive question)
 - “how would you feel if this feature were absent?” (negative question)
- Participant responds:
 - I like it
 - I expect it
 - I’m neutral
 - I can tolerate it
 - I dislike it

		Negative Question				
		LIKE	EXPECT	NEUTRAL	TOLERATE	DISLIKE
Positive Question	LIKE	-	Attractive	Attractive	Attractive	One Dimensional
	EXPECT	Undesired	Unimportant	Unimportant	Unimportant	Must-be
	NEUTRAL	Undesired	Unimportant	Unimportant	Unimportant	Must-be
	TOLERATE	Undesired	Unimportant	Unimportant	Unimportant	Must-be
	DISLIKE	Undesired	Undesired	Undesired	Undesired	-



NEV (Net Emotional Value)

- Calculated similar to NPS
- Correlates with NPS and customer satisfaction
- License required

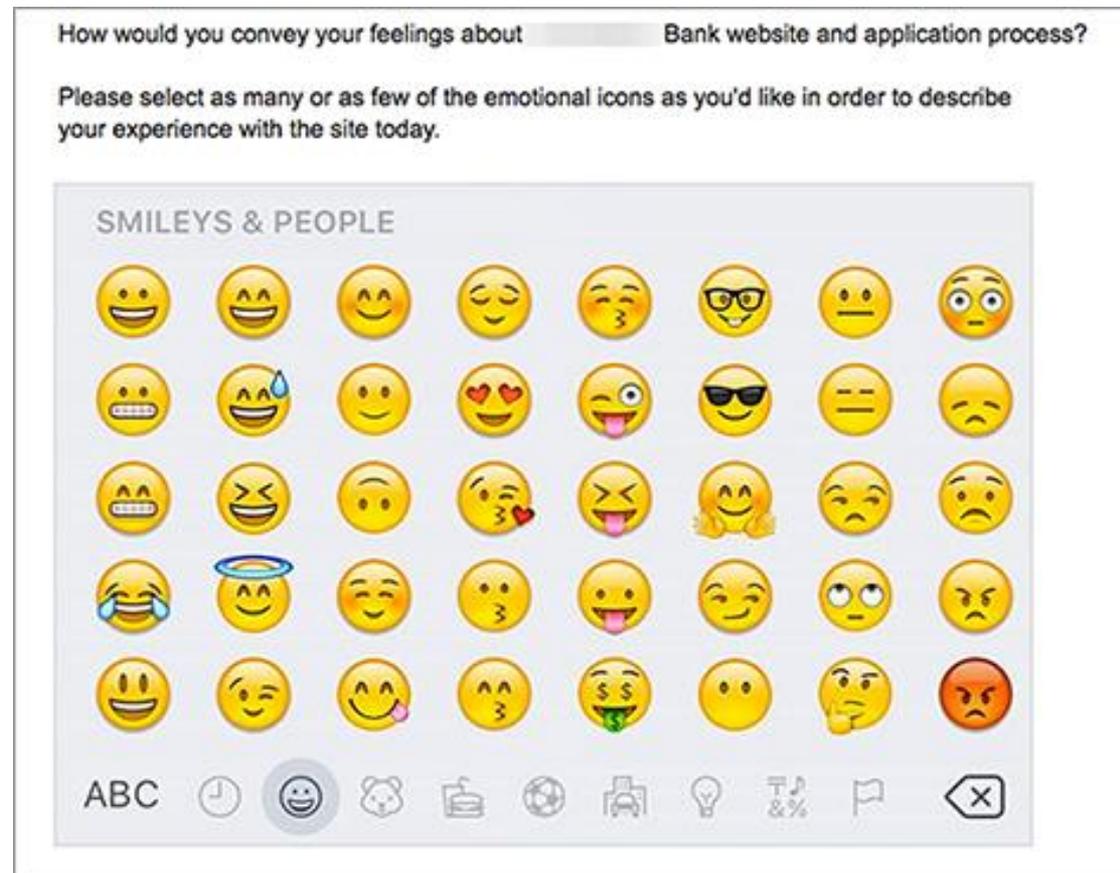


<http://customerthink.com/new-cx-measure-to-compliment-nps-net-emotional-value/>



Emoji's

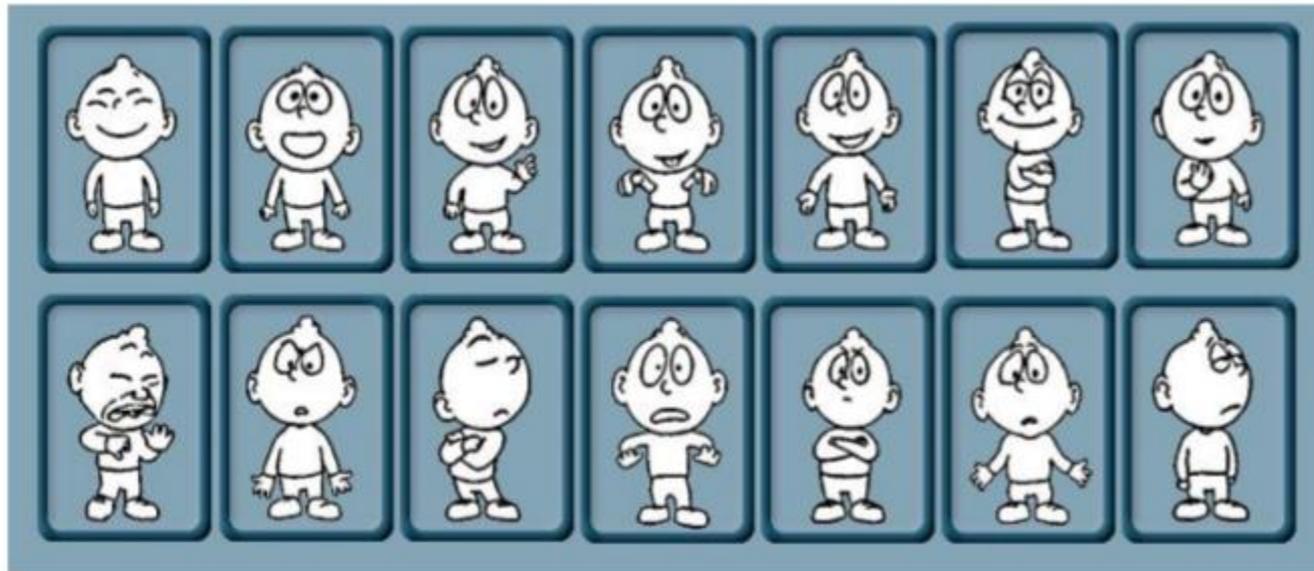
- Let participants chose from a range of emoji's to represent their experience
- Excellent for starting a discussion, however analysis is limited (frequency only)
- Not everyone has the same understanding of the same emoji
- Excellent with kids or special populations



<http://www.uxmatters.com/mt/archives/2016/09/beyond-the-lab-gathering-holistic-qualitative-user-experience-data.php>



Emoji's - PrEmo



- Creative use of face/body – perhaps more accurate?
- License arrangement
- Validated
- Integrated with online survey tool

Microsoft Product Reaction Cards

- Provide participants a choice of 118 “cards” expressing various emotions (60% positive, 40% negative)
- Participants choose up to 5 cards that represent their experience (post-session)
- Cards are used to generate a discussion and to analyze
- Some UX researchers provide a subset of cards



Microsoft Product Reaction Cards

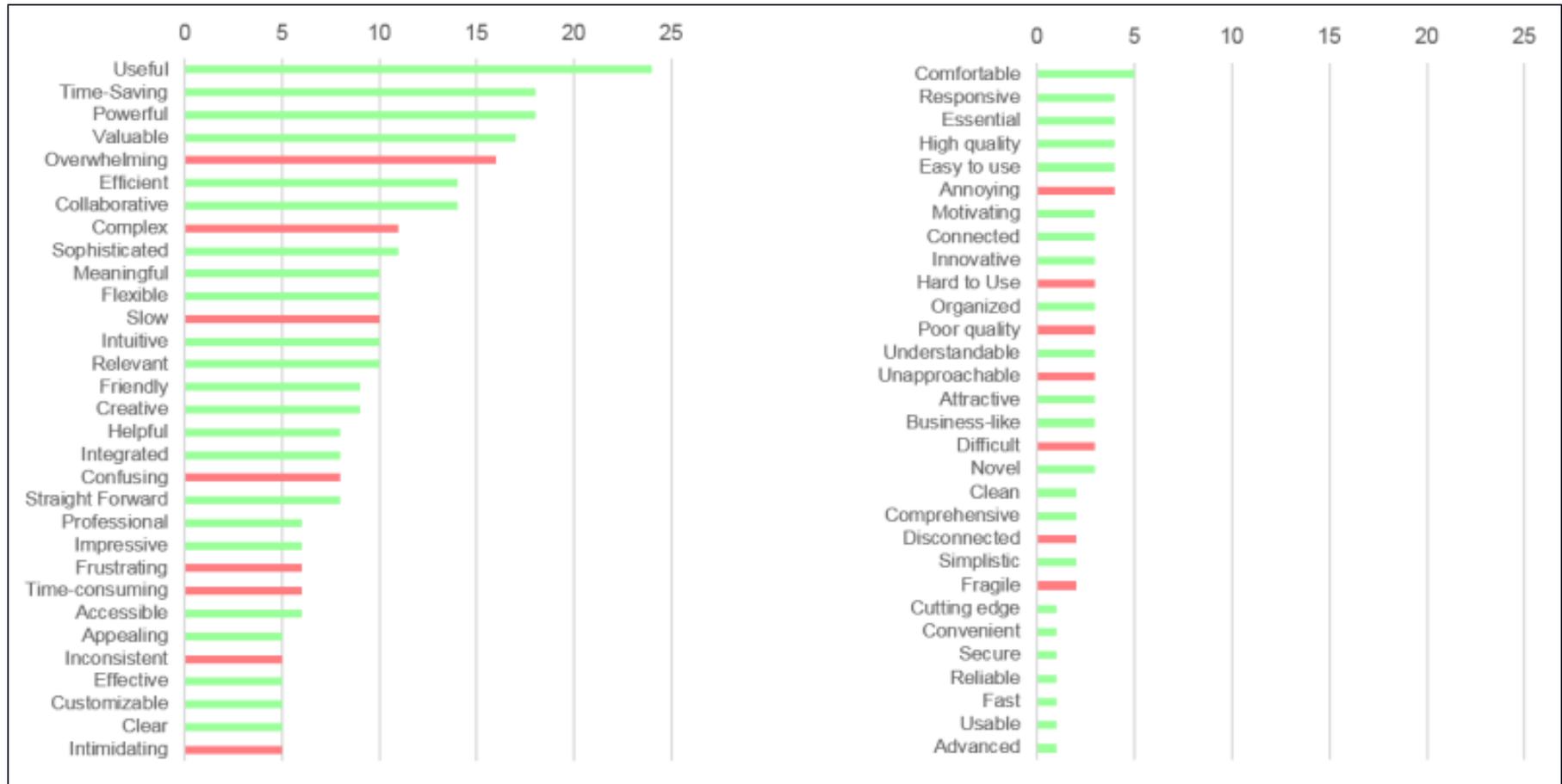
The complete set of 118 Product Reaction Cards				
Accessible	Creative	Fast	Meaningful	Slow
Advanced	Customizable	Flexible	Motivating	Sophisticated
Annoying	Cutting edge	Fragile	Not Secure	Stable
Appealing	Dated	Fresh	Not Valuable	Sterile
Approachable	Desirable	Friendly	Novel	Stimulating
Attractive	Difficult	Frustrating	Old	Straight Forward
Boring	Disconnected	Fun	Optimistic	Stressful
Business-like	Disruptive	Gets in the way	Ordinary	Time-consuming
Busy	Distracting	Hard to Use	Organized	Time-Saving
Calm	Dull	Helpful	Overbearing	Too Technical
Clean	Easy to use	High quality	Overwhelming	Trustworthy
Clear	Effective	Impersonal	Patronizing	Unapproachable
Collaborative	Efficient	Impressive	Personal	Unattractive
Comfortable	Effortless	Incomprehensible	Poor quality	Uncontrollable
Compatible	Empowering	Inconsistent	Powerful	Unconventional
Compelling	Energetic	Ineffective	Predictable	Understandable
Complex	Engaging	Innovative	Professional	Undesirable
Comprehensive	Entertaining	Inspiring	Relevant	Unpredictable
Confident	Enthusiastic	Integrated	Reliable	Unrefined
Confusing	Essential	Intimidating	Responsive	Usable
Connected	Exceptional	Intuitive	Rigid	Useful
Consistent	Exciting	Inviting	Satisfying	Valuable
Controllable	Expected	Irrelevant	Secure	
Convenient	Familiar	Low Maintenance	Simplistic	

<http://www.uxforthemasses.com/product-reaction-cards/>

www.microsoft.com/usability/UEPostings/ProductReactionCards.doc



Microsoft Product Reaction Cards



<http://www.uxforthemasses.com/product-reaction-cards/>

www.microsoft.com/usability/UEPostings/ProductReactionCards.doc



Microsoft Product Reaction Cards

- Easy to administer
- Too many cards – may have order and fatigue effects
- Different understandings of the same card
- Participants picking a different number of cards
- Good way to start a conversation – analysis is limited – frequencies only



Verbatims

- Open-ended questions, usually in surveys
- Provide incredible insights, but hard to measure
- Most verbatims don't reveal very much – but a few are real gems
- Verbatims better for insights, and less useful as a metric
- The more specific question, the more specific the answer



Verbatim Analysis

- Code each verbatim, or sample of verbatims
- Remove the noise
- Coding based on different schemes
 - Positive/negative/neutral
 - Issue-based (specific problems, suggestions, etc.)
 - Others?
- Frequency analysis
 - Overall or segments
- Word clouds are not quantitative, and often misleading



Group Discussion

- Form into different small groups and discuss some of the different types of emotions that are relevant in the user experience of the products/services you work on
 - What types of products/services?
 - Which emotions are most relevant?
 - How would you collect data and measure them?
 - What are your concerns?

Share!



Eye Tracking

What is Eye Tracking?

- Technology used to measure and analyze eye movements (i.e., where people are looking in real-time)
- Eye movements happen very quickly, and respond to visual stimuli
- Millions of data points in a single study
- Only technology available to ascertain where participants are looking, in real-time
- Becoming more commonplace in UX research and marketing



Eye Tracking and Engagement

- What is noticed first?
- What is ignored?
- What is most interesting?

How does it work?

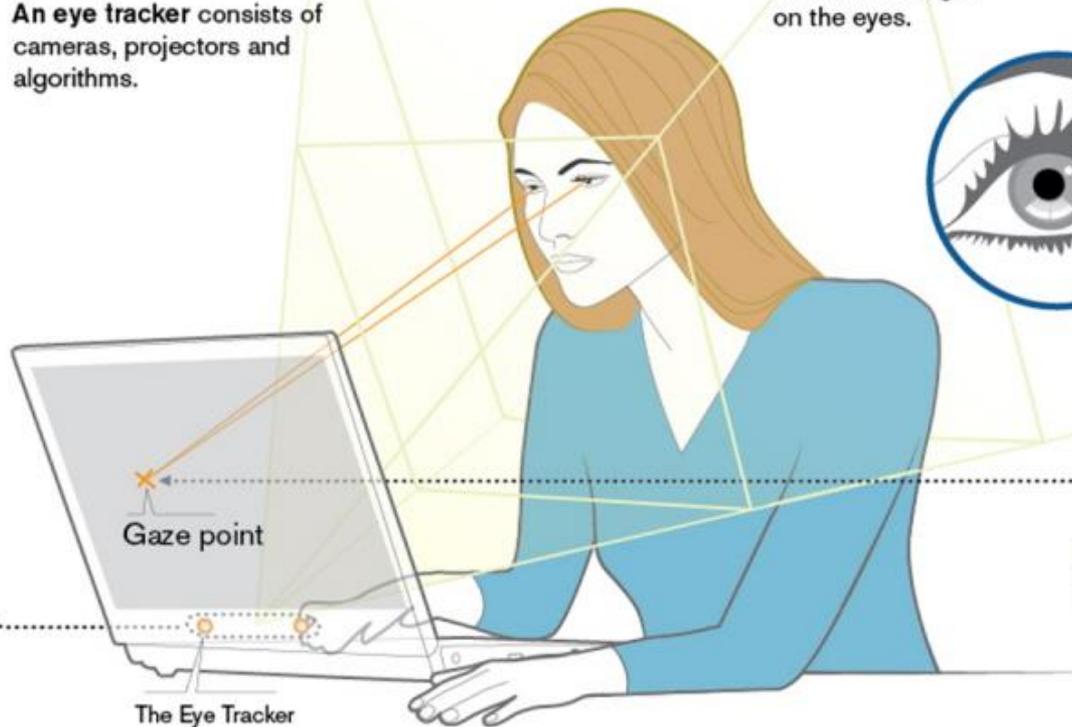
1 An eye tracker consists of cameras, projectors and algorithms.

2 The projectors create a pattern of near-infrared light on the eyes.

3 The cameras take high-frame-rate images of the user's eyes and the patterns.

4 The image processing algorithms find specific details in the user's eyes and reflections patterns.

5 Based on these details, mathematical algorithms calculate the eyes' position and gaze point, for instance on a computer monitor.



<http://www.tobii.com/group/about/this-is-eye-tracking/>



Fixations and Saccades

- A visual fixation is focusing on a specific location (object/word)
 - Fixations last 50ms - 350ms
 - Relatively stationary
 - Fixations happen in sequences
- Saccades are very fast movements of the eyes in between fixations
 - Typically 20-30ms when reading, longer when you need to move your eye further away
 - You cannot process any visual information during a saccade



When to Use Eye Tracking

- Answering specific research questions:
 - How is visual attention influenced by stimuli?
 - How much time is spent looking at various objects/designs?
 - How long does it take to notice certain objects?
 - How does visual attention correlate to brand recognition, or some desired behavior?
- Common types of evaluations:
 - Compliment usability findings
 - Online advertisements
 - Packaging and shelf displays
 - Others?



Context Matters

- Eye movements are HIGHLY context dependent
- Eye movements based on:
 - Tasks drive behavior!
 - Visual stimuli
 - Animation
- Very difficult to draw generalities about eye movements, however:
 - People tend to draw to faces/bodies
 - Images
 - Beginning of sentences (scanning)
 - Animation (movement)



Eye Tracking as a Selling Point

- Only way to answer specific questions about visual attention and engagement
- “High tech” feel of the lab
- Still quite novel (outside of UX)
- Provides qualitative insight without any analysis
- Easy to demonstrate and use as regular part of lab studies (no extra effort)



Mind-eye Hypothesis

- Where people look is what they are thinking about
 - Usually true, but not always
 - Inherent limitation of eye tracking studies
- Using Think-aloud (or RTA) can help provide insight
- Verify with their behavior – don't solely rely on eye movement data



Downsides to Eye Tracking

- Fairly expensive (\$30K +)
- Analysis may be time consuming/complicated
- Potential impacts in testing
 - Difficulty in calibrating
 - Participants can't move too much

Challenge in dealing with content that is dynamic

- Involves time-consuming analysis
- Change AOI for each frame



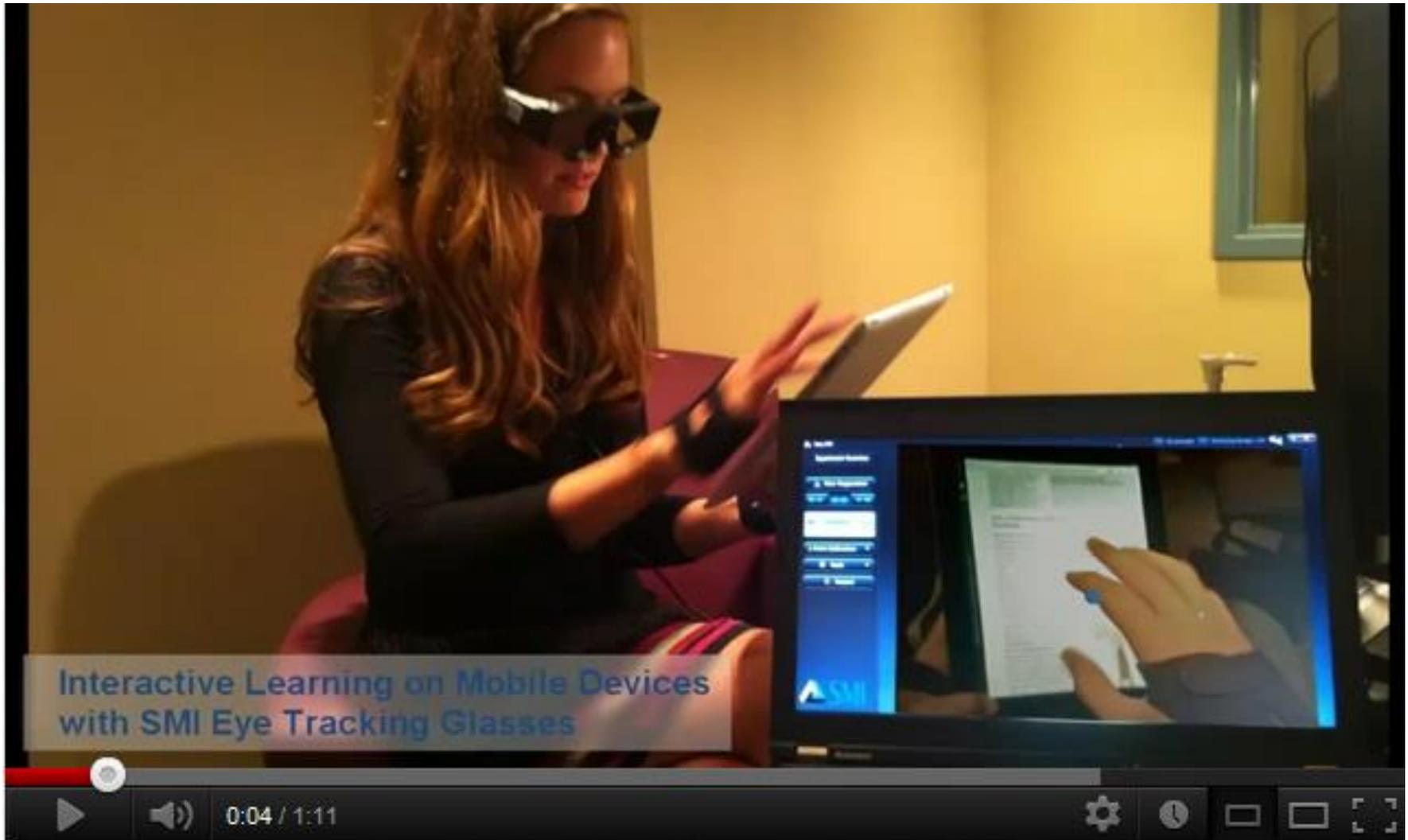
Vendors



Webcam-based Eye Tracking



Eye Tracking and Mobile Example



Interactive Learning on Mobile Devices
with SMI Eye Tracking Glasses



BENTLEY
UNIVERSITY

User Experience Center

Common Eye Tracking Metrics

- Number of Fixations
- Fixation Duration
- Gaze Duration
- Fixation Order or Sequence
- Time to First Fixation (TTFF)
- Number of visits to an AOI
- % of participants who fixated within an AOI
- Average % of time spent within an AOI
- Pupil diameter within an AOI



Videos

[Gaze Plot](#)

[Bee Swarm](#)

Scanpaths

Google eye tracking

Results 1 - 10 of about 6,590,000 for eye tracking (0.08 seconds)

EyeTracking www.eyetracking.com Save in eye-tracking services - Market Research and Usability

Eye tracking - Wikipedia, the free encyclopedia
Eye tracking is the process of measuring either the point of gaze ("where we are looking") or the motion of an eye relative to the head. An **eye-tracker** is a ...
History - Tracker types - Technologies and techniques
en.wikipedia.org/wiki/Eye_tracking · 10 hours ago · Cached · Similar

EyeTracking Inc. Home
Eye tracking technology to test users' responses to websites and other promotional material.
Located in California, USA
www.eyetracking.com · 1 day · Similar

Eyetracking - Usability findings from an eye tracker ...
Book about how to use eye tracking studies with links to articles presenting findings in real life.
www.usetesting.com/eyetracking

F-Shaped Pattern For Reading Web Content (Jakob Nielsen's Alertbox)
In our new eye tracking study, we recorded how 232 users looked at thousands of Web pages. We found that users' main reading behavior was fairly consistent ...
www.useit.com/alertbox/reading_pattern.html · Similar

Image results for eye tracking - [Browse images](#)

Hurricane Tracking Software - Tracking The Eye
HurricaneSoftware.com's Tracking The Eye-Hurricane Tracking Page. Hurricane Tracking Program and Storm Tracking Software For Windows.
www.hurricanesoftware.com/ · Cached · Similar

Eye Tracking Update: Eyetracking, EyeTracker, Pupil Tracking, Gaze ...
Eye Tracking Update.com provides a summary of eye tracking, eye tracker, pupil tracking, and gaze tracking news to keep you up to date with the latest ideas, ...
eyetrackingupdate.com/ · Cached

Official Google Blog: Eye-tracking studies: more than meets the eye
Feb 6, 2009 ... To help us get some insight into the split-second decision-making process, we use eye-tracking technology to study users ...
[googleblog.blogspot.com/.../eye-tracking-studies-more-than-meets.html](http://googleblog.blogspot.com/2009/02/eye-tracking-studies-more-than-meets.html) · Cached · Similar

Tobi Technology: Eye tracking and eye control Usability ...
Tobi Technology is a world leader in eye tracking and eye control. Tobi's eye trackers are widely used within usability testing, market research, ...
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Improved Eye Tracking - Success with Visual Disabilities through ...
Read personal accounts re. problems with eye tracking.
www.usabilitystudies.org/eye_tracking_disorders.html · Cached · Similar

Video results for eye tracking

Eye Tracking Demo
2 min 13 sec · Oct 9, 2007
www.youtube.com

3D Eyetracking UI
56 sec · Feb 11, 2009
www.youtube.com

Searches related to eye tracking

[eye tracking equipment](#) [eye tracking webcam](#) [eye tracking software](#) [eye tracking exercises](#)
[eye tracking studies](#) [eye tracking hardware](#) [eye tracking mouse](#) [eye tracking problems](#)

Google

1 2 3 4 5 6 7 8 9 10 Next

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Web Show options Results 1 - 10 of about 6,690,000 for eye tracking (0.08 seconds)

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www.EyeTracking.com - Leaders in eye-tracking services - Market Research and Usability

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Book about Eyetracking Usability Findings from eye tracker... links to articles presenting findings in more detail.
www.uset.com/eyetracking.htm

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www.hurricanetracking.com/ - Cached - Similar

Eye Tracking Update Eyetracking Eyetracker Pupil Tracking Gaze...
Eyetrackingupdate.com provides a summary of eye tracking, eyetracker, pupil tracking, and gaze tracking news to keep you up to date with the latest ideas. ...
eyetrackingupdate.com/ - Cached

Official Google Blog: Eye-tracking studies: more than meets the eye
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1 2 3 4 5 6 7 8 9 10 Next

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AOI Statistics

http://www.google.com/#hl=en&source=hp&q=eye-tracking&aq=f&aq=sg10&aq=8oaq=&g_u=rfp=511&e=002daF08

Web Images Videos Maps News Shopping Gmail more

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Web Show options... Results 1 - 10 of about 6,690,000 for eye tracking (0.08 seconds)

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3D Eyetracking UI
56 sec · Feb 11, 2009
www.youtube.com

Searches related to eye tracking

eye tracking equipment eye tracking webcam eye tracking software eye tracking exercises eye tracking studies eye tracking hardware eye tracking mouse eye tracking problems

White Space

Sequence 6
Entry time 3972 ms
Dwell time 108 ms (4%)
Hit ratio 2/4 (50%)
Revisits 0
Revisitors 0/2
Average fixation 108 ms
First fixation 108 ms
Fixation count 1

GOOOOOOOOOgle
1 2 3 4 5 6 7 8 9 10 Next

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AOI 006

Sequence	3
Entry time	1406 ms
Dwell time	179 ms (4%)
Hit ratio	2/4 (50%)
Revisits	1
Revisitors	1/2
Average fixation	81 ms
First fixation	87 ms
Fixation count	1

AOI 001

Sequence	2
Entry time	925 ms
Dwell time	1204 ms (29%)
Hit ratio	3/4 (75%)
Revisits	2
Revisitors	3/3
Average fixation	234 ms
First fixation	242 ms
Fixation count	4

AOI 005

Sequence	1
Entry time	118 ms
Dwell time	2095 ms (38%)
Hit ratio	3/4 (75%)
Revisits	1
Revisitors	3/3
Average fixation	394 ms
First fixation	654 ms
Fixation count	4

AOI 002

Sequence	4
Entry time	2351 ms
Dwell time	367 ms (13%)
Hit ratio	3/4 (75%)
Revisits	1
Revisitors	2/3
Average fixation	149 ms
First fixation	137 ms
Fixation count	2

AOI 003

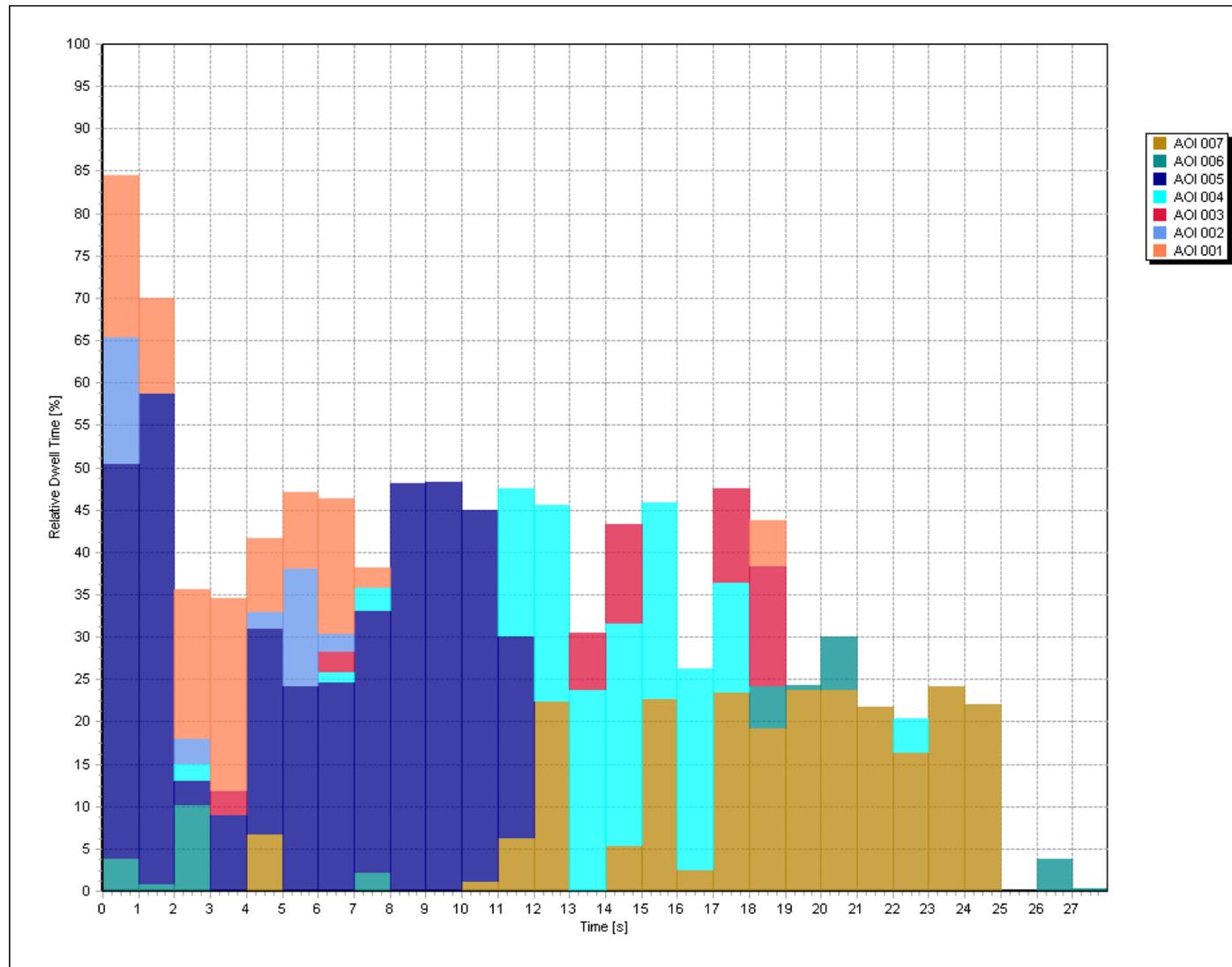
Sequence	8
Entry time	5216 ms
Dwell time	54 ms (1%)
Hit ratio	2/4 (50%)
Revisits	0
Revisitors	0/2
Average fixation	54 ms
First fixation	54 ms
Fixation count	1

AOI 004

Sequence	5
Entry time	2488 ms
Dwell time	58 ms (1%)
Hit ratio	1/4 (25%)
Revisits	1
Revisitors	1/1
Average fixation	29 ms
First fixation	21 ms
Fixation count	1



Binning Chart



Demo



Group Discussion

- How would you use eye tracking as part of our user experience work?
- What would be some of your research questions and concerns?
- How would you communicate your findings in the most effective way?
- How would you use your findings to support decision making?

Share!



Behavioral/Physiological Metrics



Overview

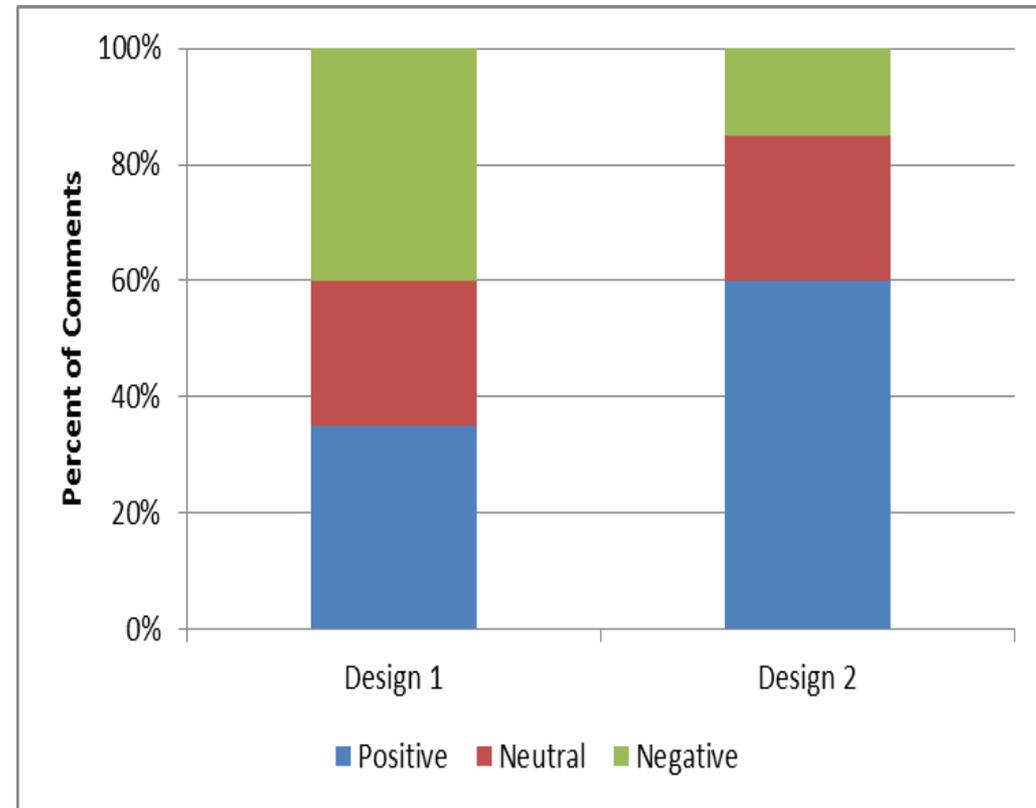
Goal of all of these is typically to make some inferences about the user's state (e.g., emotional state, level of stress, level of engagement, etc.)

- Behavioral observation
- Skin conductance (EDA)
- Facial expressions
- EEG / brain activity
- Heart rate and stress
- Pupil / blinks
- Engagement / attention



Coding of Verbal Expressions

- Code each unprompted verbal expression as “positive”, “negative”, or “neutral”
- Compare the proportion of comments across designs
- Time consuming and is often difficult – how to deal with sarcasm?



Refined Coding of Verbal Expressions

- Strongly positive comments (e.g., “This is terrific!”)
- Other positive comments (e.g., “That was pretty good.”)
- Strongly negative comments (e.g., “This website is terrible!”)
- Other negative comments (e.g., “I don't much like the way that worked.”)
- Suggestions for improvement (e.g., “It would have been better if. . .”)
- Questions (e.g., “How does this work?”)
- Variation from expectation (e.g., “This isn't what I was expecting to get.”)
- Stated confusion or lack of understanding (e.g., “This page doesn't make any sense.”)
- Stated frustration (e.g., “At this point I'd just leave the website!”)



Coding Behavior

- Difficult to code, may have to review videos – time consuming
- Questions of reliability with certain observations
- Difficult to tie behaviors and emotions

Form available at:

<http://www.measuringux.com/UsabilityTestObservationCodingForm.ppt>

Usability Test Observation Coding Form	
Date: _____	Participant #: _____ Task #: _____
Start Time: _____	End Time: _____
Verbal Behaviors	Notes
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly positive comment	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Other positive comment	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly negative comment	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Other negative comment	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Suggestion for improvement	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Question	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Variation from expectation	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Stated confusion	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Stated frustration	_____
Other: _____	_____
Non-verbal Behaviors	Notes
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Frowning/Grimacing/Unhappy	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Smiling/Laughing/Happy	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Surprised/Unexpected	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Furrowed brow/Concentration	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Evidence of Impatience	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Leaning in close to screen	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Variation from expectation	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Fidgeting in chair	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Random mouse movement	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Groaning/Deep sigh	_____
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Rubbing head/eyes/neck	_____
Other: _____	_____
Task Completion Status:	Notes:
Incomplete:	Complete:
<input type="checkbox"/> Participant gave up	<input type="checkbox"/> Fully complete
<input type="checkbox"/> Task "called" by moderator	<input type="checkbox"/> Complete with assistance
<input type="checkbox"/> Thought complete, but not	<input type="checkbox"/> Partial completion



Skin Conductivity (EDA)

- Electrodermal activity (EDA) increases when you sweat — small increases in moisture are associated with increased sympathetic nervous system activity indicating emotional activation or arousal.
- Three types of activation can lead to increases in arousal:
 - increases in cognitive load
 - affective (emotional) state
 - physical activity
- Emotional states associated with EDA increases include fear, anger, and joy.
- Arousal increases are also associated with cognitive demands and may be seen when you are engaged in problem-solving activity.



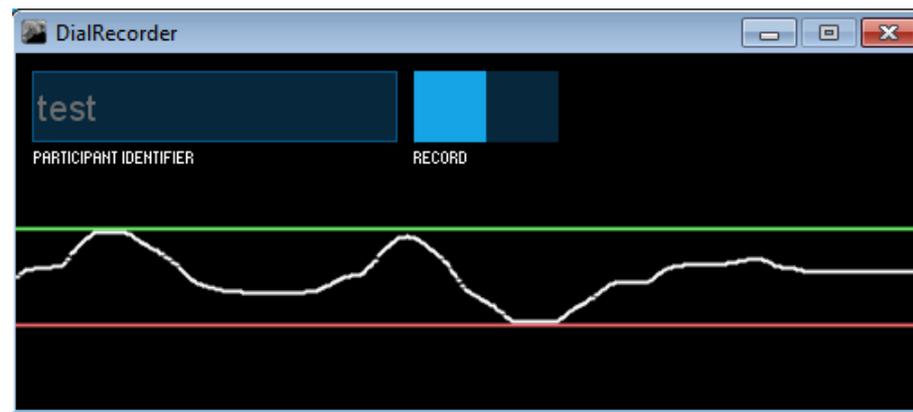
EDA for Arousal, not Valence

- Sweat glands are controlled by the sympathetic system and you sweat when aroused
- Effective for measuring emotion, attention, and cognitive load
 - Increases for interesting stimuli
 - Increases during high cognitive load
- Not effective for measuring valence (+/- arousal)



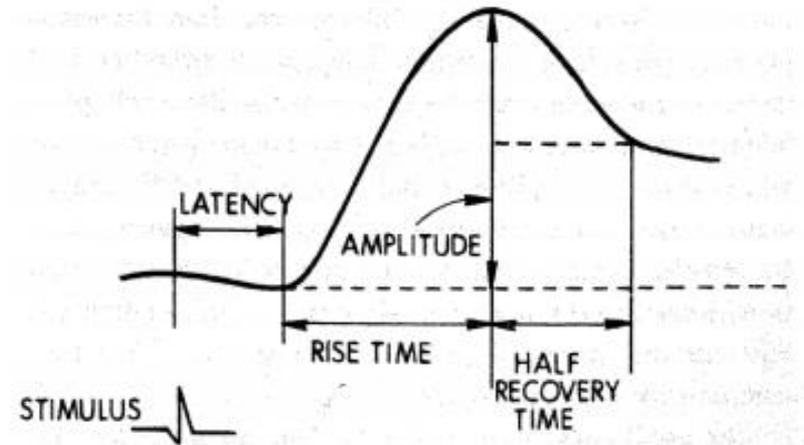
Determining Valence

- Spikes in GSR tell us that *something* happened
 - We need further data to determine valence
- Rating Dials
 - Participant uses a continuous dial to report how s/he is feeling

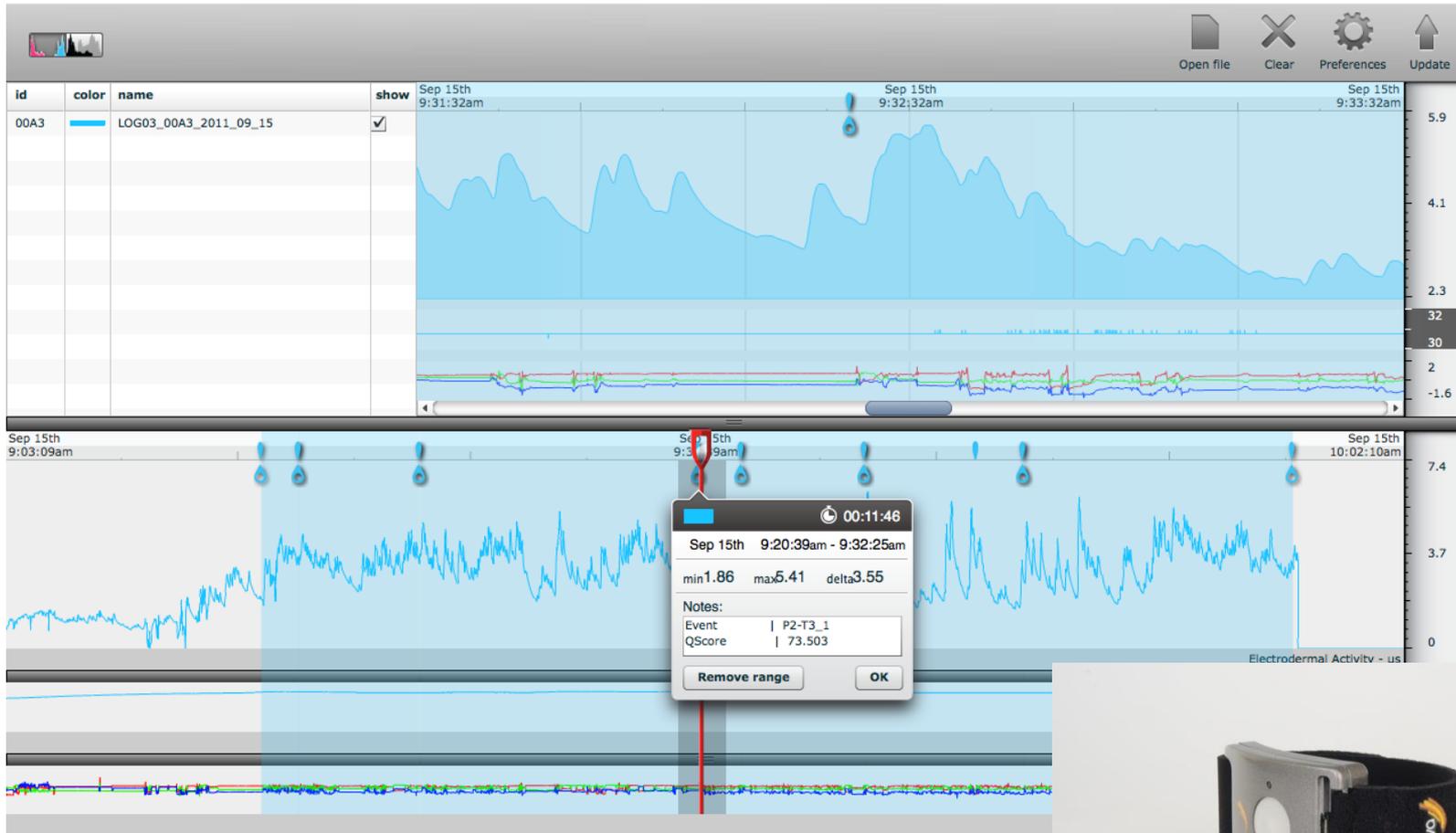


EDA Latency

- 1-3 second latency after presentation of the stimulus
- If pairing with eye tracking, the spike will be NEAR the fixation



Skin Conductance (Affectiva's Q Sensor)



Affectiva's Q-Sensor

Say Hello
to the QTM



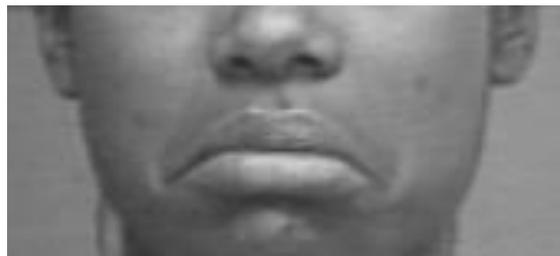
Facial Expressions

- Paul Ekman and Wallace Friesen (1975) developed a taxonomy for characterizing every conceivable facial expression
- Facial Action Coding System (FACS) includes 46 specific actions involving the facial muscles.
- Each emotion exhibits a distinct set of facial expressions that can be reliably identified automatically through computer vision algorithms.
- Software uses the webcam to identify the facial expressions at any moment in time, and then classifies it into one of seven unique emotions: Neutral, Happy, Surprise, Sad, Scared, Disgusted, and Puzzled.



Facial Action Coding System

A taxonomy of 64 different components (“Action Units”) of facial expressions, based primarily on the underlying muscles used. Developed by Paul Ekman and Wallace Friesen in 1976.



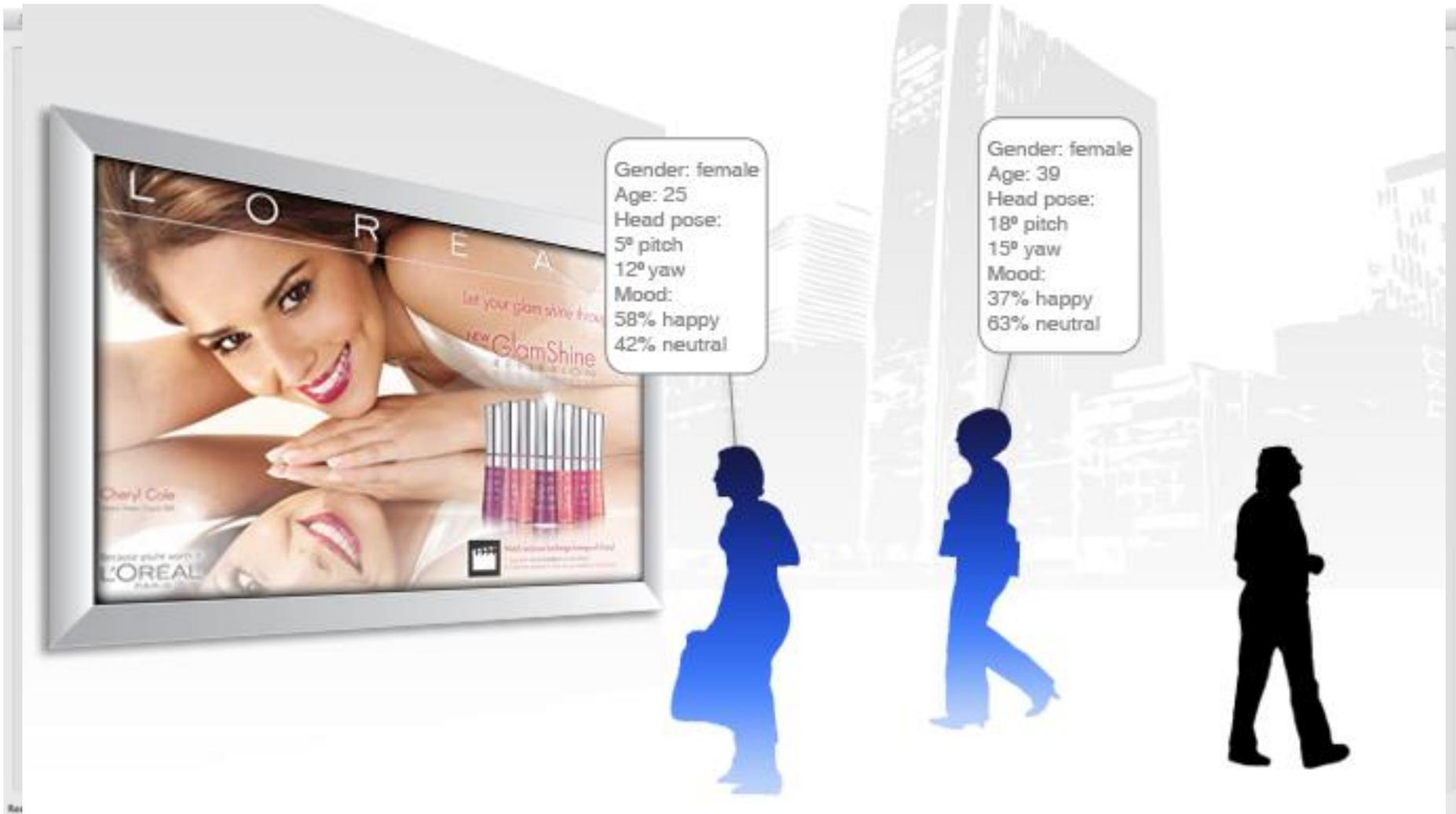
Facial Action Coding System



<https://imotions.com/emotient/>



Facial Expression Analysis



Facial Expression Demo



Brain Activity / EEG

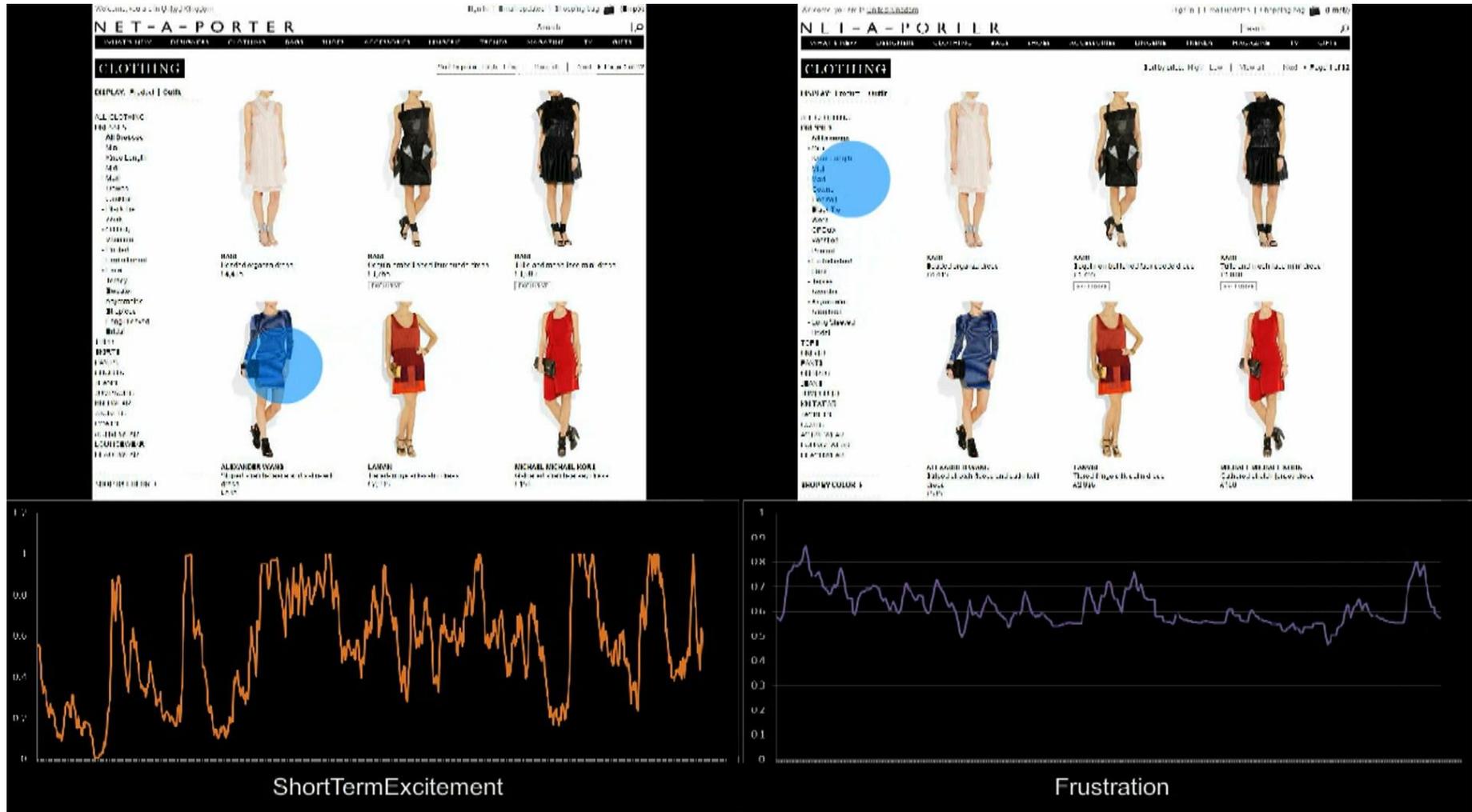
- EEG measures brain waves, specifically the amount of electrical activity on different parts of the participant's scalp.
- Electrical activity is associated with cognitive and emotional states.
- There is a certain pattern of electrical activity when the participant is in a more excited state, relative to a calm state.
- Also, there are specific patterns of electrical activity that have been associated with other emotional states, such as frustration, boredom and engagement.
- This technology has not been fully validated



Brain Measures



EEG Analysis



Heart Rate and Stress

- “fight or flight” response
- Heart initially slows while the threat is assessed
 - Speeds up if there’s a threat
 - Returns to normal rate if none
- Changes in response to:
 - Cognitive load
 - Time pressure
 - Attention
 - Arousal
- Cannot differentiate among these factors – hard to interpret data



Heart Rate and Stress

- Heart rate is measured by BPM (beats per minute) or heart rate variability (HRV)
As stress increases, heart rate variability-- the heart's ability to beat faster or slower in response to emotion or physical demands-- tends to decrease.
- Measures the amount of stress by looking at the time intervals between heart beats – the higher the variability, the less the stress
- Research shows that stress increases when using certain designs, but also impacted by physical factors – stress of the lab?
- Most commonly measured with finger sensors – new research to measure remotely (cameras)



Heart Rate Demo



Analyzing Pulse from Head Motions in Video

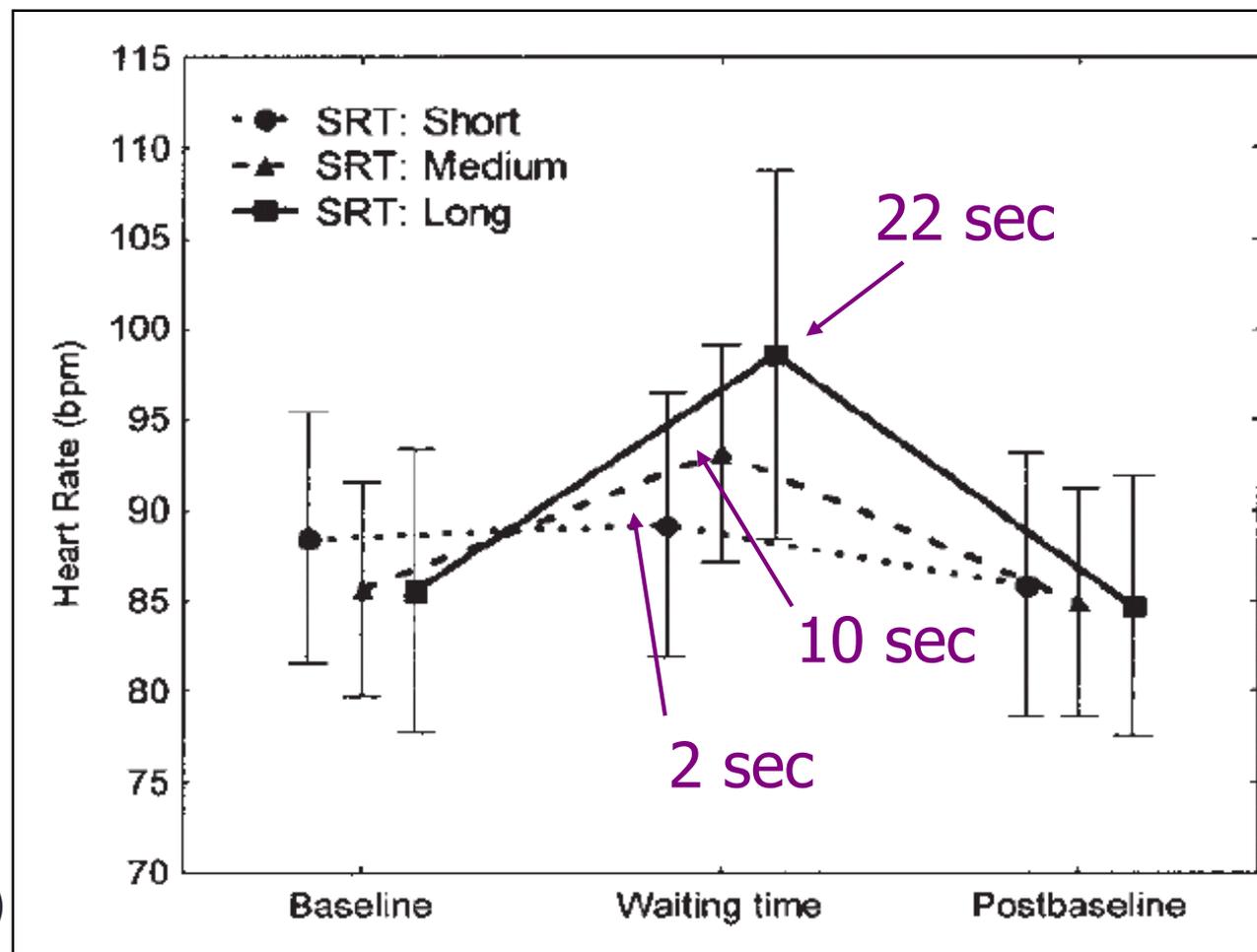
Guha Balakrishnan, Fredo Durand, John Guttag
MIT CSAIL



Heart Rate and Stress

Study done at the University of Vienna:

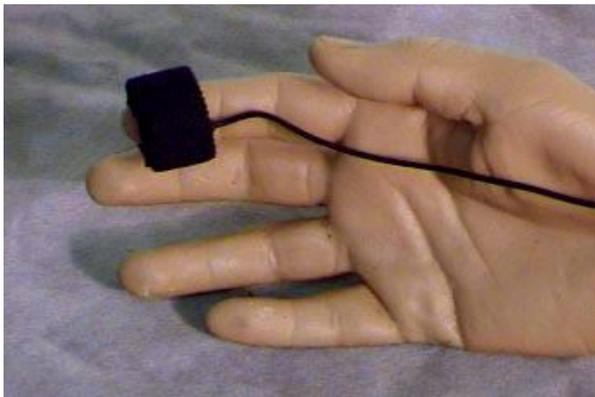
Evidence of physiological stress with webpage load times of 10 secs and higher!



Trimmel, Meixner-Pendleton, Haring (2003)



Collecting Heart Rate



Stress (Pressure Mouse)



Pressure-sensitive Mouse:

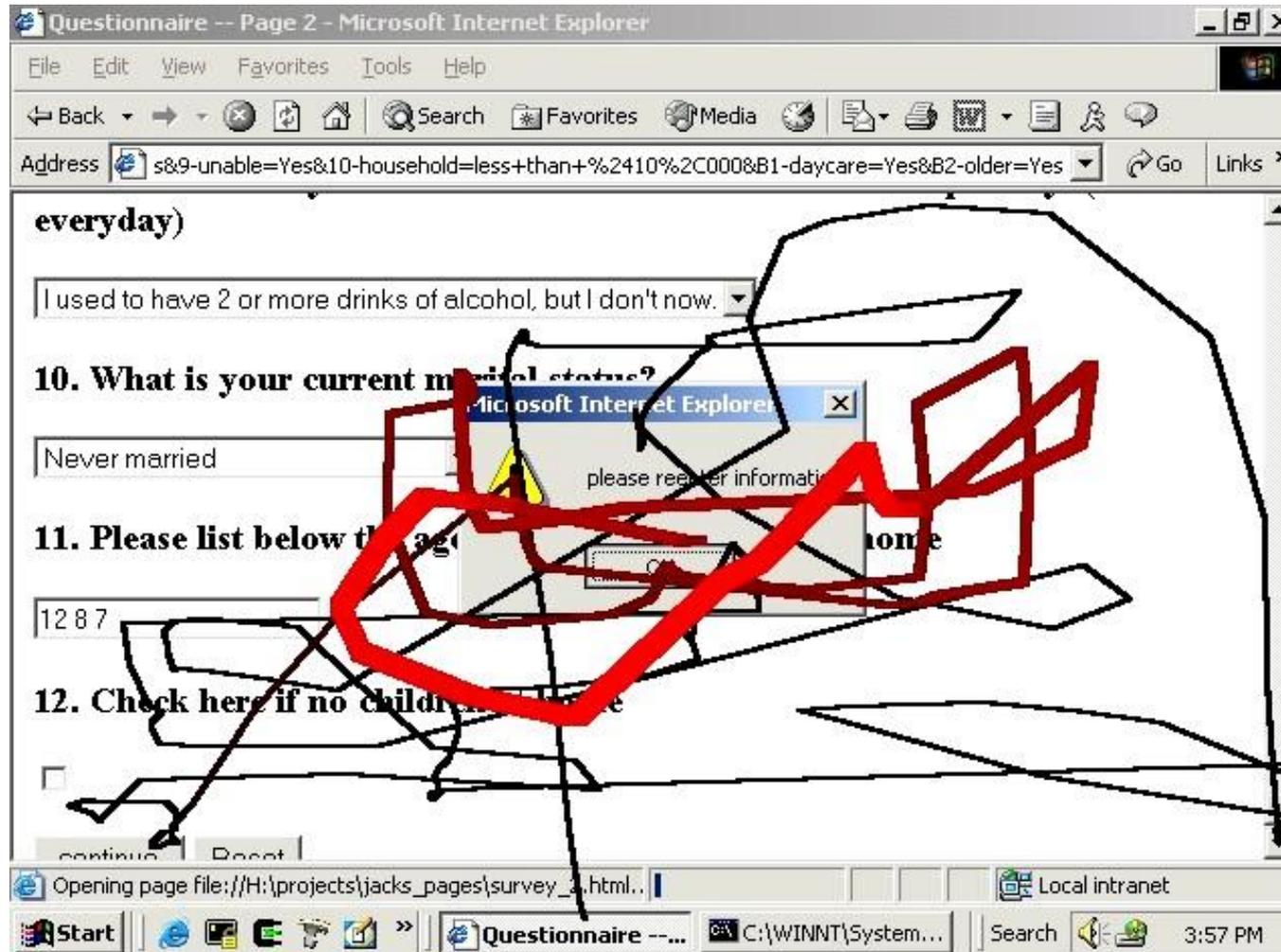


From Qi, Reynolds, and Picard (2001)

Stress (Pressure Mouse)

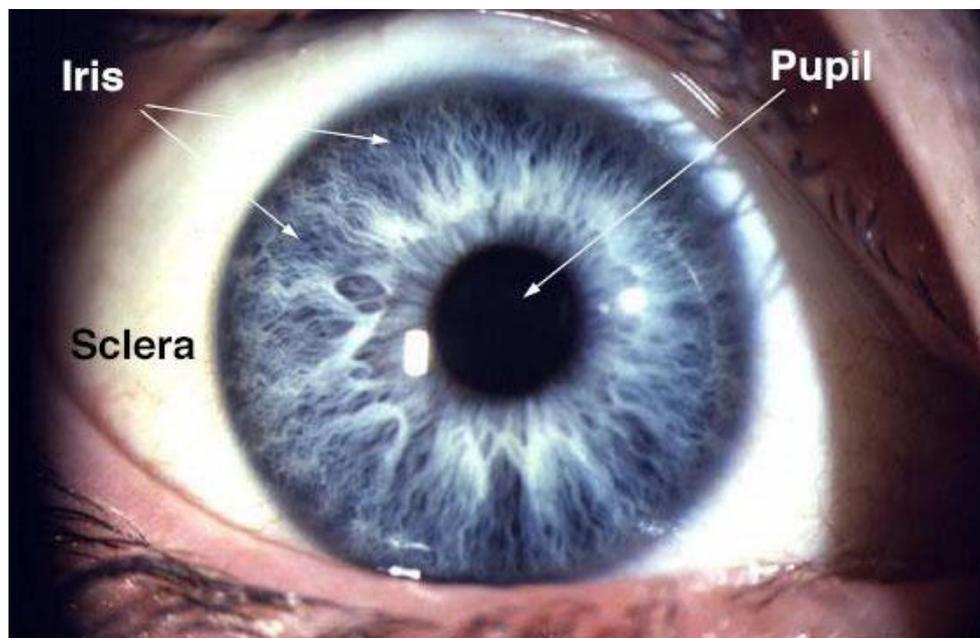


Stress (Pressure Mouse)



Pupillary Response

- Pupil diameter has been shown to correlate well with level of mental effort or cognitive processing, but also overall arousal.

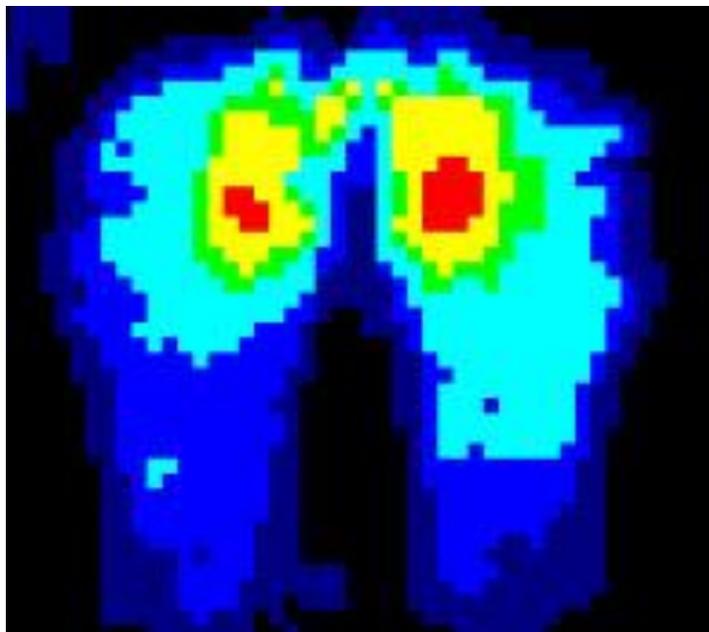


Blink Rate

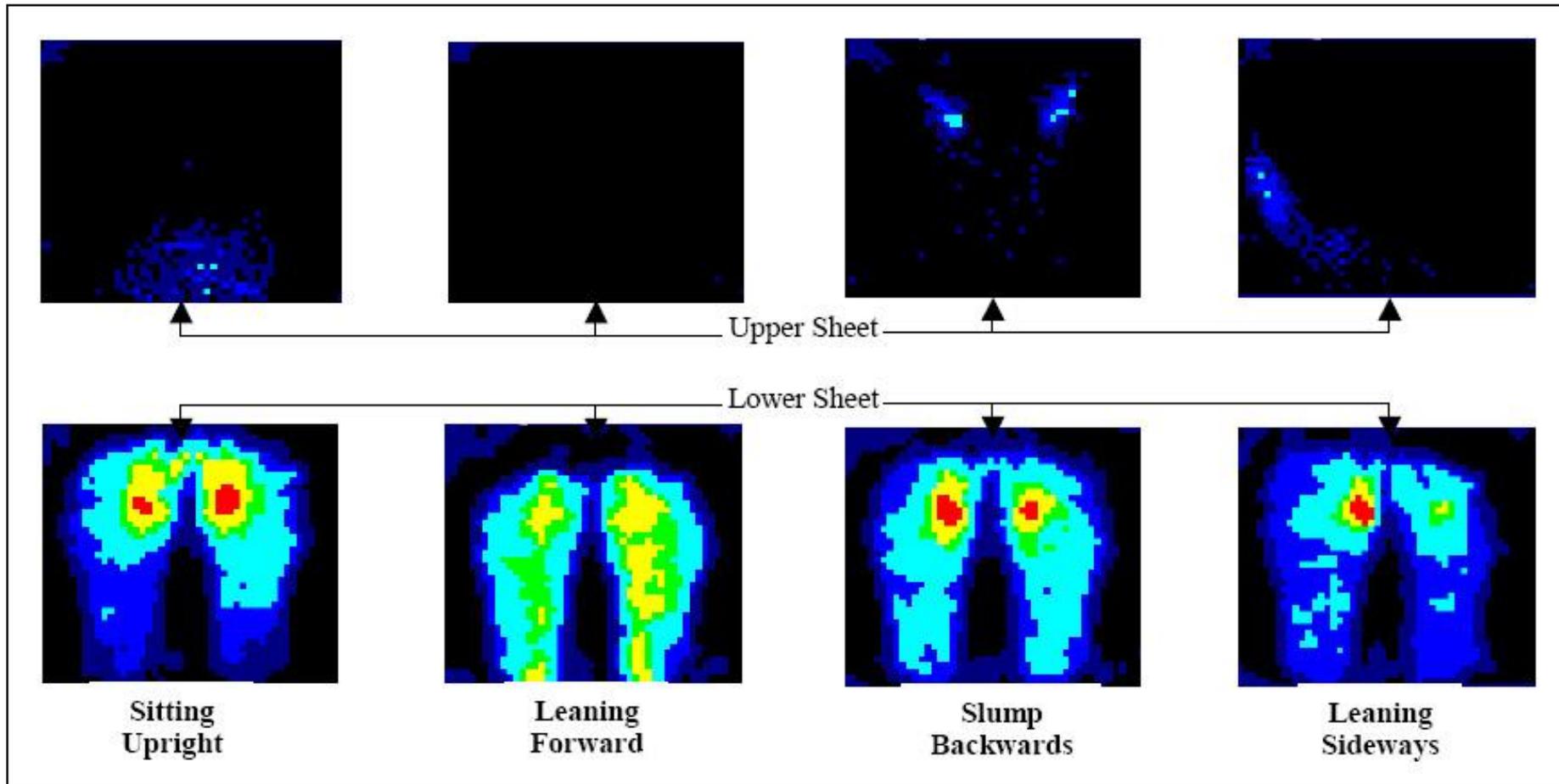
- Blink rate is widely believed to correlate with level of tension or stress.
- Typical blink rates for someone who is relaxed:
 - 15-20 blinks per minute (bpm)
 - Note that just talking raises it to 20-25 bpm
- Blink rates above 70 bpm are pretty clear evidence of stress.



Other Measures



Other Measures



From Kapoor, Mota, and Picard (2001)

Demo (Multi-Modal Integration)



Group Discussion

- Which behavioral/physiological metrics or technologies are most useful?
- What would be some of your concerns?
- How would you combine these technologies with other UX methods?
- How would you use your findings to support decision making?

Share!



Bringing it all together

Advantages of Measuring UX Emotions

- Critical insights, beyond the obvious – drive important design and business decisions
- More complete picture of the entire user experience
- Easier and less expensive than you think



Disadvantages of Measuring UX Emotions

- Noisy data – may be hard to interpret and concerns about reliability
- May be time consuming and expensive
- Range of emotions may be limited and hard to measure

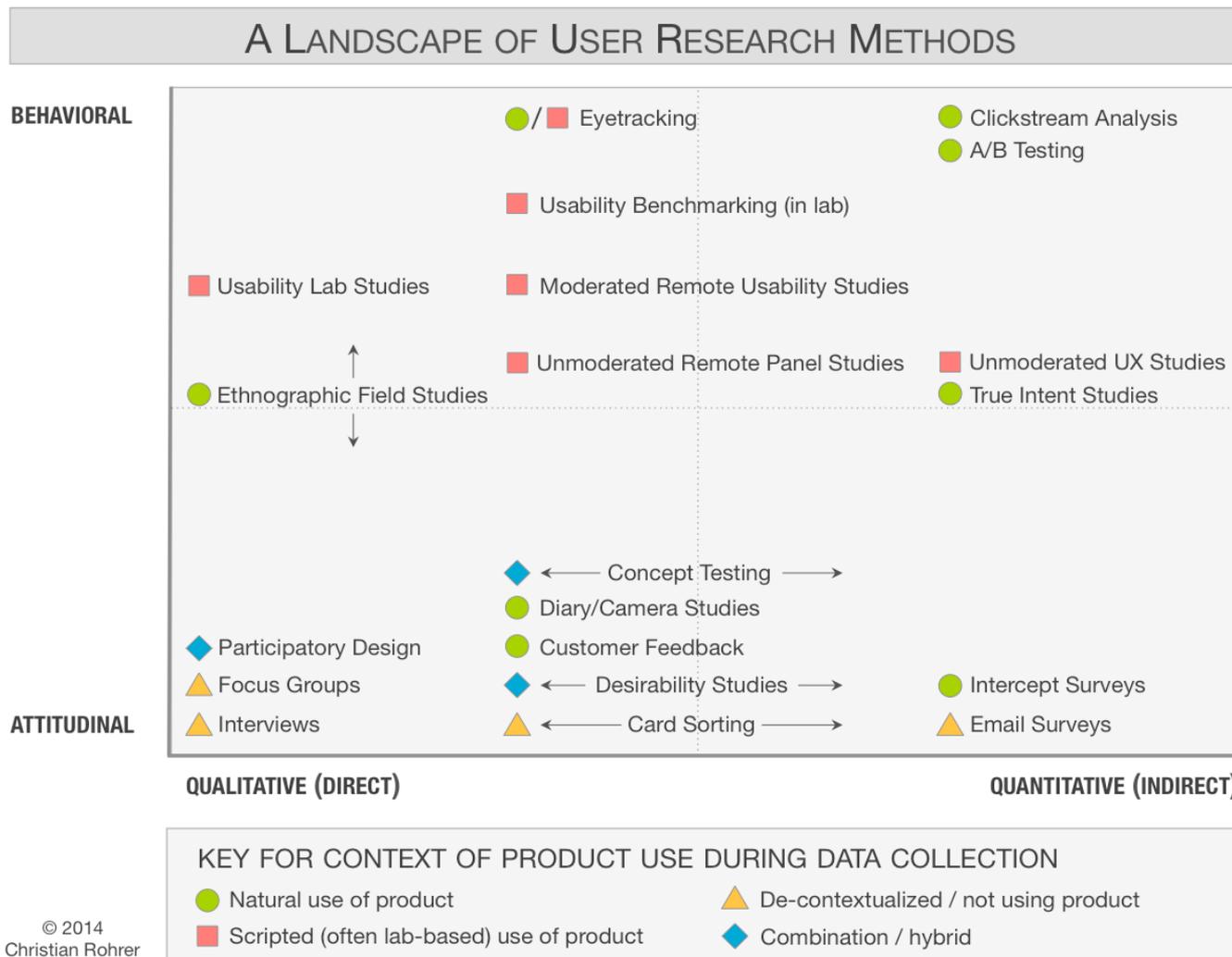


Presenting Emotion Metrics

- Clearly present the method, special attention to validation
- Stick to the big picture, don't give too many details unless asked
- Present a range of metrics, not just “emotion”
- Make the metrics come alive with video clips and quotes
- Weave the metrics into an overall story about the experience



Engagement Metrics & UX Methods



<https://www.nngroup.com/articles/which-ux-research-methods/>



Triangulation

- No single metric tells the whole story – always rely on multiple metrics
- Ideally, use different types of metrics
- Bring in other metrics – analytics, usability, a/b testing,
- Look for consistencies and contradictions – look for explanations, and always question the data
- Find the story!



Google's HEART Framework

- Google's HEART framework:
 - Happiness – satisfaction and loyalty (surveys)
 - Engagement – product usage by time (analytics)
 - Adoption – percent of user who begin using the product or feature (analytics)
 - Retention – percent of users who use the product over time (analytics)
 - Task Success – completion times, error rates (usability tests)

Include goals, signals and metrics for each dimension in the framework

	Goals	Signals	Metrics
Happiness			
Engagement			
Adoption			
Retention			
Task Success			

<http://www.dtelepathy.com/ux-metrics/#quality>



Easy Steps to Move Forward

- Determine which emotions you are interested in based on project goals and reliability
 - How will you collect, analyse, and present the metrics
- Start by collecting self-reported data via surveys
- Experiment with manual coding of emotions during testing
- Pick your project strategically – start with low profile, work your way up, and eventually institutionalize





Thank You!

Bill Albert, PhD
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www.bentley.edu/uxc
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