

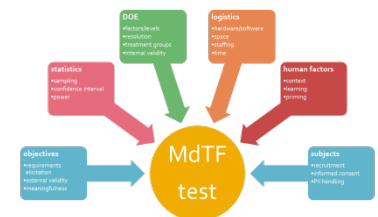
Efficient test design for biometric exit scenarios.

Yevgeniy B. Sirotin, Ph.D.

Outline

- Maryland Test Facility
 - Facilities and Capabilities

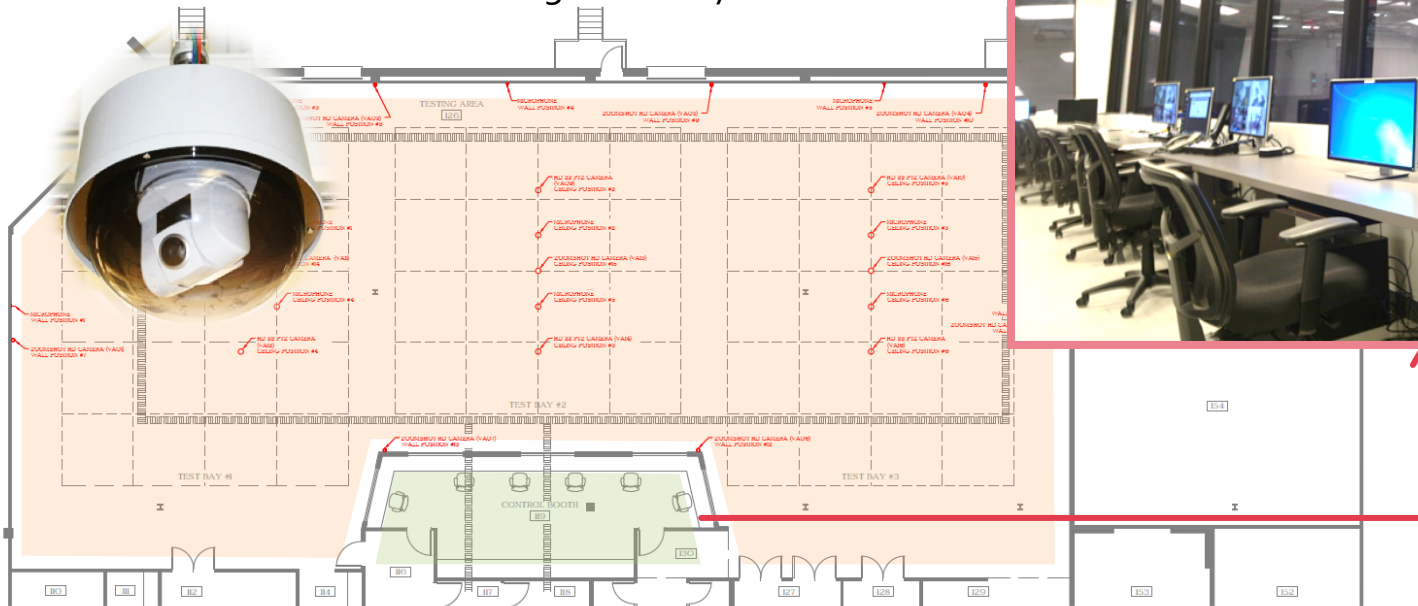
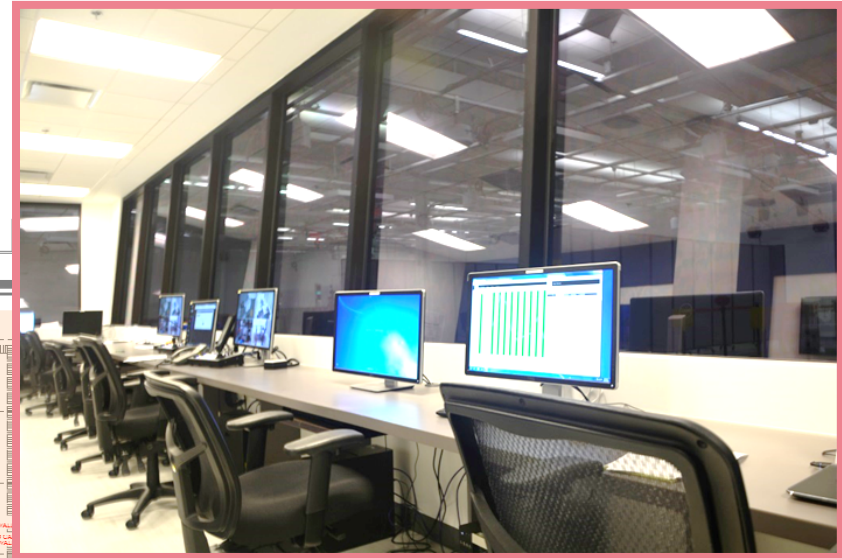
- Test Design Process
 - Balancing multiple requirements and constraints within a single test



The Maryland Test Facility



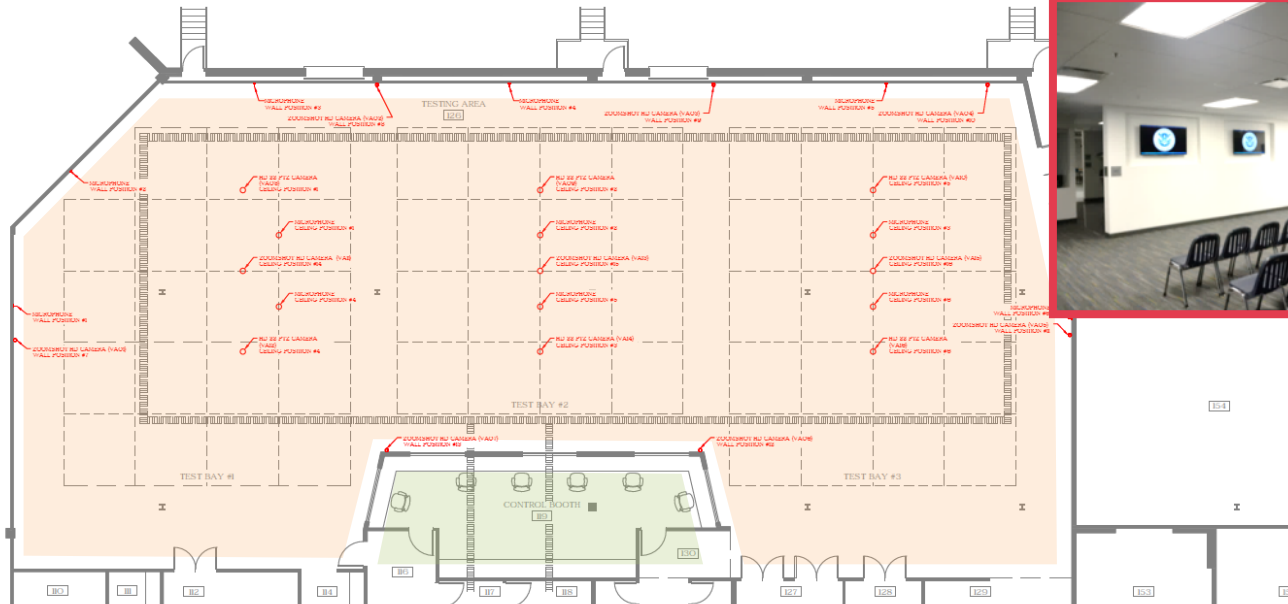
- 20,000+ ft² of office and laboratory space
- Video Recording
 - 16 PTZ and Zoom video cameras
- Eye Tracking
- Environmental sensors
 - ambient light, noise, humidity, ...
- Control center
 - real-time monitoring and analysis



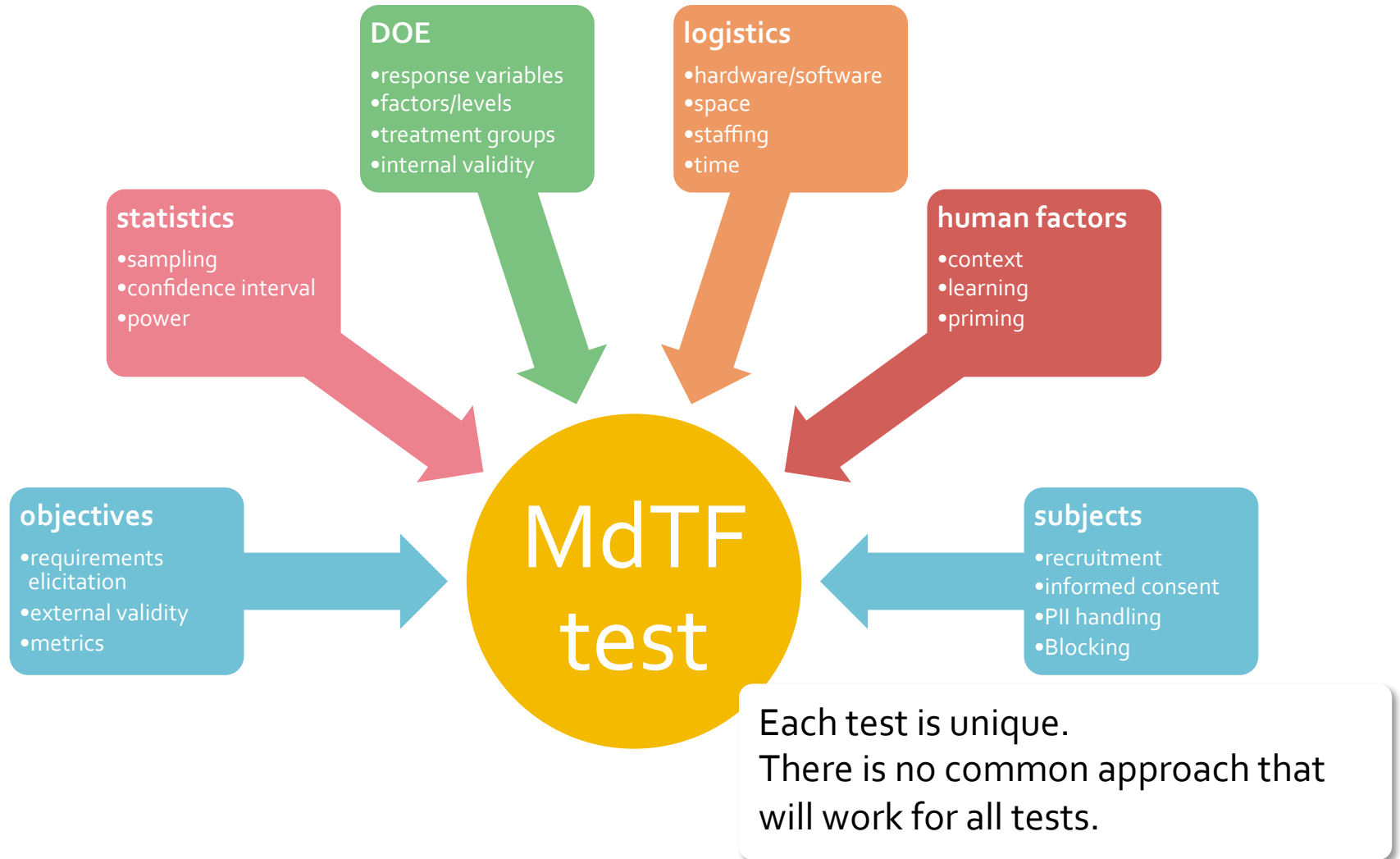
The Maryland Test Facility



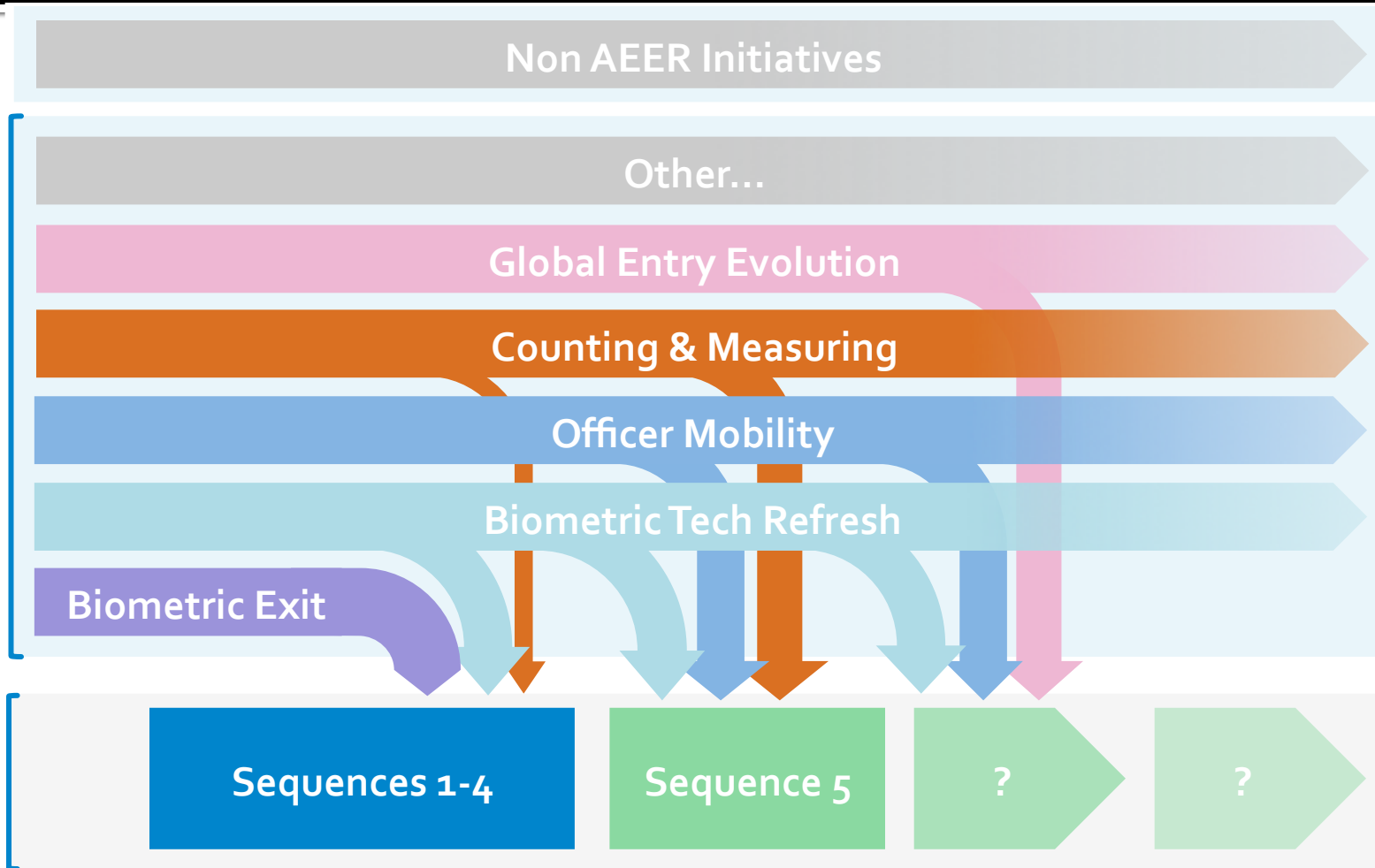
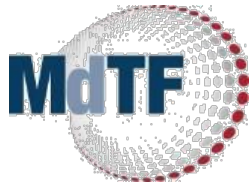
- Private briefing & debriefing rooms
 - Informed consent: closed door, white noise
- Work areas
 - Focus Groups
 - Workshops
 - Training
- Laboratory space



Elements of an MdTF test

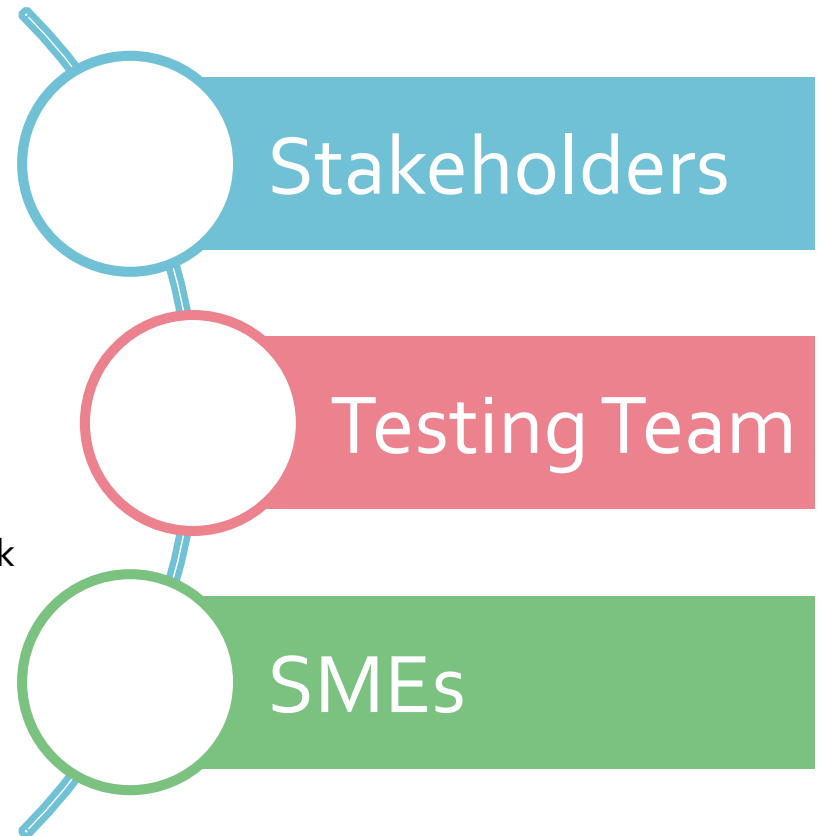


MdTF Sequence Testing



Identifying test objectives

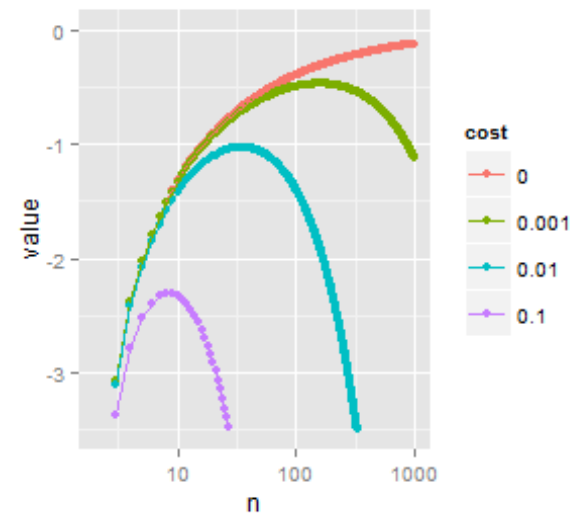
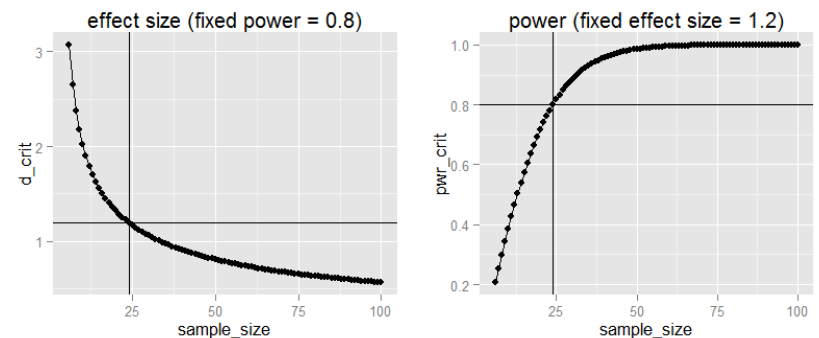
- Why is the test being performed?
 - Single process
 - validation – demonstrate function
 - exploration – identifying important factors
 - benchmarking – compare to specific criteria
 - refinement – identify best factor levels
 - Different processes
 - differentiation – identify differences
 - comparison – compare along specific metrics
- What is the desired outcome?
 - data – obtain specific data
 - knowledge – know why it works / does not work
 - demonstration – can show it can / cannot work
- What will happen as a result of the test?
 - recommendations
 - further analysis
 - down-selection



Statistical considerations

- Identify desired effect size (E) or confidence interval
 - Percentage? Benchmark? Critical difference?
- Power
 - Usually ≥ 0.8 (80% chance of detecting effect, when present)
 - Depends on sample size (n) and effect size
- Sample size
 - **Ideal world:** Sample size determined from power and effect size
 - **Reality:** Sample size drives cost ($C = \$ \& t$), tradeoff depends on test objectives
- Test Value = $-[E(n) + C(n)]$

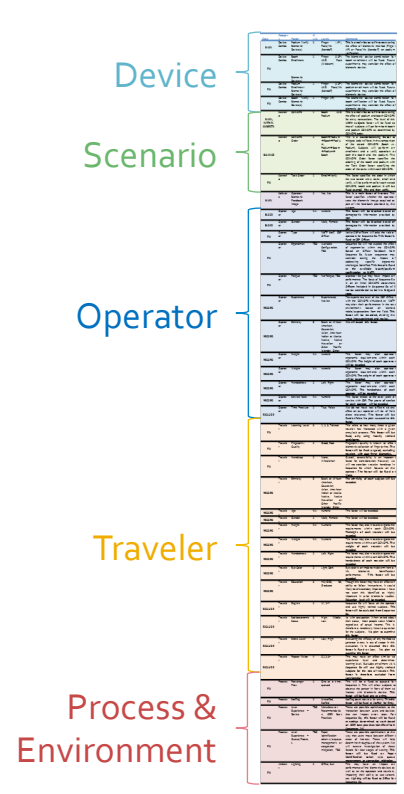
Note: cost function need not be linear and may have discontinuities, but good to be aware of ballpark when scoping the test.



Design of Experiments

- Formalize response variables
 - E.g. Timing, performance, user feedback
- Identify factors and levels.
 - Build factor list (use stakeholders & SMEs)
 - Identify factor categories:
 - Device, Scenario, Operator, Subject, Process, Environment
 - Identify manipulated, fixed, or blocked factors
 - Do once and use many times
- We often include counterbalancing factors.
- Can everything be tested at once?
 - Treatment = tested factor/level combination
 - Use fractional factorial designs to reduce number of treatments needed
 - Use separate sub-experiments to reduce design complexity

Factors/Levels



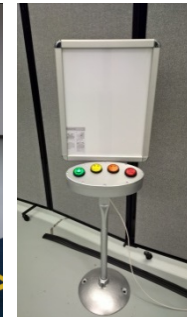
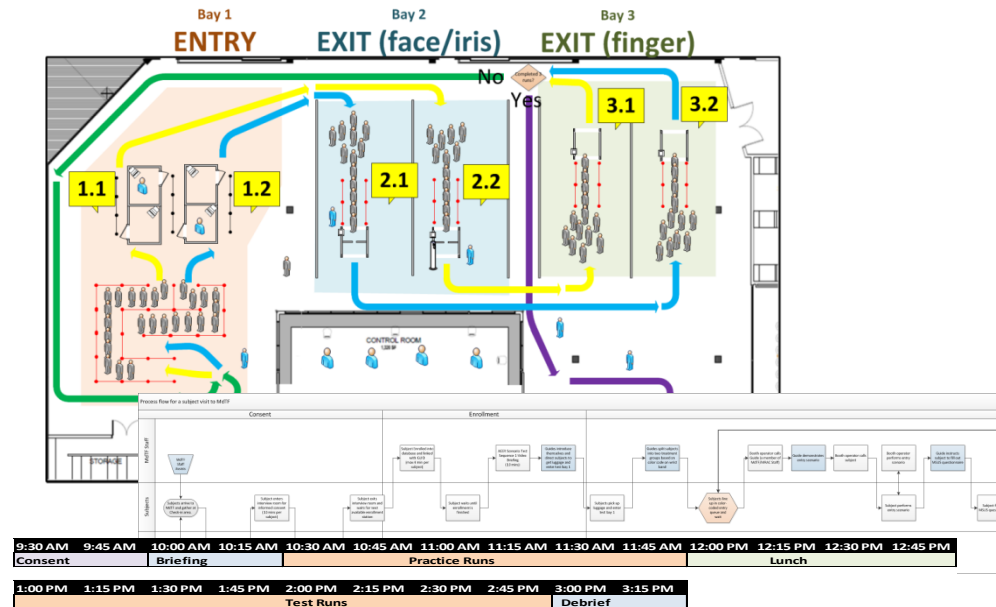
Treatments

#	Entry Face (A)	Entry Iris (B)	Exit (Iris/Face, C)	Exit (Finger, D)	Entry Order (E)	Exit Order (G)
1	Logout C120	Invalid T0100	SRM Glance	Classroom/Guardian	Face First	IRL First
2	Logout E120	Invalid T0100	SRM Glance	Landing V-Series	Face First	IRL First
3	Logout C120	CMITech EMI-30	SRM Glance	Classroom/Guardian	Face First	Finger First
4	Logout E120	CMITech EMI-30	SRM Glance	Landing V-Series	Face First	Finger First
5	Logout C120	Apple Insight D100	SRM Glance	Classroom/Guardian	Face First	IRL First
6	Logout E120	Apple Insight D100	SRM Glance	Landing V-Series	Face First	IRL First
7	Logout E120	Invalid T0100	SRM Glance	Classroom/Guardian	IRL First	Finger First
8	Logout C120	Invalid T0100	SRM Glance	Landing V-Series	IRL First	Finger First
9	Logout E120	CMITech EMI-30	SRM Glance	Classroom/Guardian	IRL First	IRL First
10	Logout C120	CMITech EMI-30	SRM Glance	Landing V-Series	IRL First	IRL First
11	Logout E120	Apple Insight D100	SRM Glance	Classroom/Guardian	IRL First	Finger First
12	Logout C120	Apple Insight D100	SRM Glance	Landing V-Series	IRL First	Finger First
13	Logout C120	Invalid T0100	Apple Insight D100	Classroom/Guardian	Face First	Finger First
14	Logout E120	Invalid T0100	Apple Insight D100	Landing V-Series	Face First	IRL First
15	Logout C120	CMITech EMI-30	Apple Insight D100	Classroom/Guardian	Face First	IRL First
16	Logout E120	CMITech EMI-30	Apple Insight D100	Landing V-Series	Face First	IRL First
17	Logout C120	Apple Insight D100	Apple Insight D100	Classroom/Guardian	Face First	Finger First
18	Logout E120	Apple Insight D100	Apple Insight D100	Landing V-Series	Face First	Finger First
19	Logout E120	Invalid T0100	Apple Insight D100	Classroom/Guardian	IRL First	IRL First
20	Logout C120	Invalid T0100	Apple Insight D100	Landing V-Series	IRL First	IRL First
21	Logout E120	CMITech EMI-30	Apple Insight D100	Classroom/Guardian	IRL First	Finger First
22	Logout C120	CMITech EMI-30	Apple Insight D100	Landing V-Series	IRL First	Finger First
23	Logout E120	Apple Insight D100	Apple Insight D100	Classroom/Guardian	IRL First	IRL First
24	Logout C120	Apple Insight D100	Apple Insight D100	Landing V-Series	IRL First	IRL First

Note: Logistics and human factors will determine if a treatment can be executed?

Planning Logistics

- Space and movement
 - Facility layout
 - Movement plan
 - Process flowchart
- Time budget
 - Estimate time for each activity
 - Informed Consent, Transactions, Surveys, etc.
 - Generate test day schedule
- Time reduction through parallelization
 - Cost: more complex movements
- Staffing
 - Define test staff roles
 - Create and execute staff training sessions
 - Conduct walkthroughs
- Hardware/software
 - Build required test hardware
 - Design required test software
 - Test hardware + software



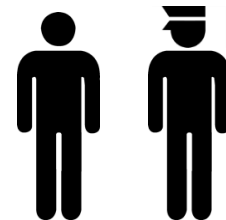
Human Factors Considerations

- Context
 - Video orientation / PPT Briefing
 - Context-appropriate props
 - Booths, podiums, stanchions, baggage, etc...
 - Scripted interactions
- Learning
 - Assess learning using repeated transactions
 - Mitigate learning via practice sessions
 - Simulate state of target population
 - E.g. 56% of travelers have not previously been to US
- Priming
 - Avoid pre exposure to test system
 - E.g. acquire iris images for ground-truth using non-tested collection method
 - Avoid testing multiple similar processes in sequence
 - Counterbalancing schemes
 - Make factor between subjects instead of within subjects
 - Better measure less of what is relevant than more of what is irrelevant

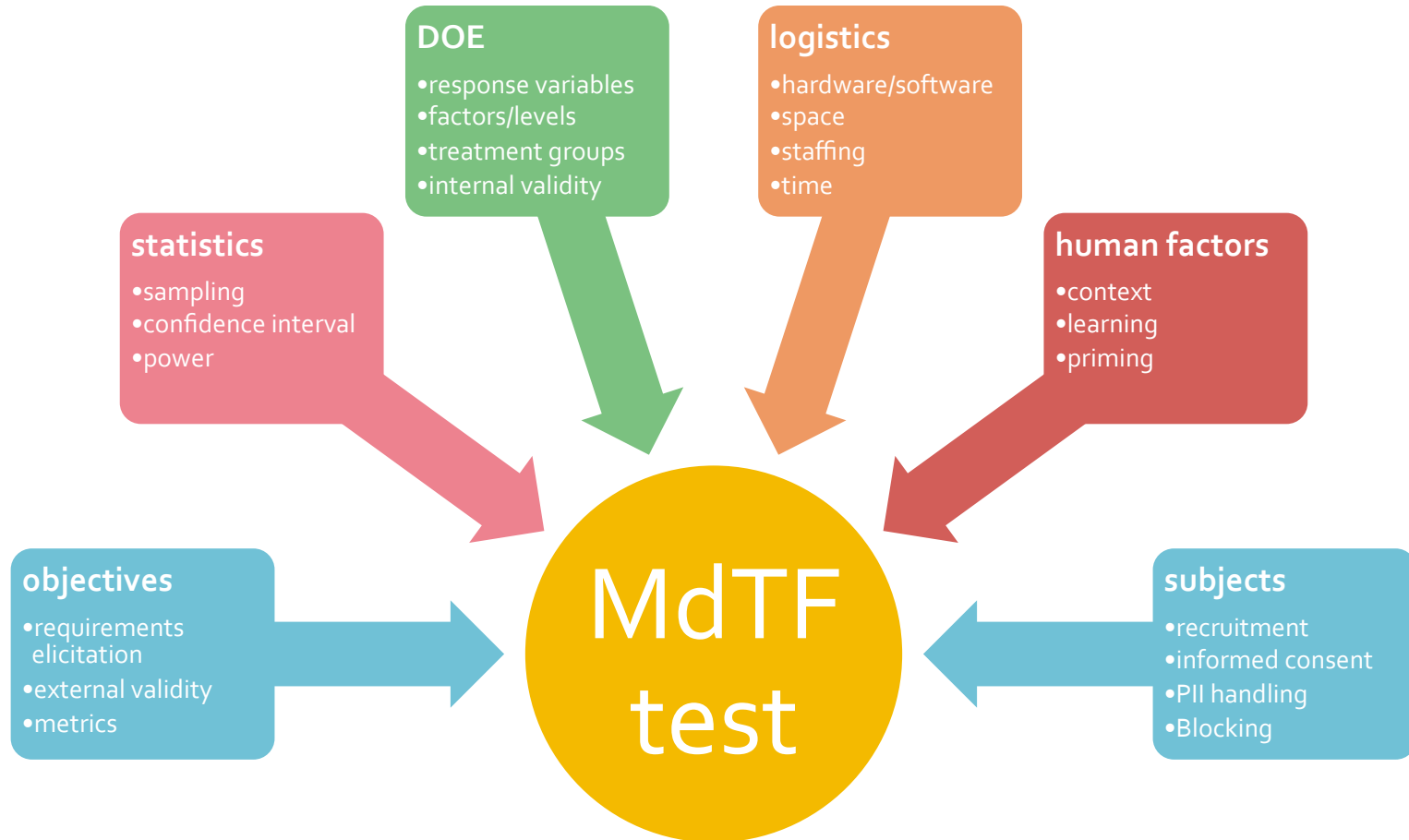


Test Subjects

- Identify test population
 - What are the demographics?
 - What do the subjects know about the tested process?
- Develop blocks
 - Amount of stratification depends on block group size
 - Identify factors for blocking
 - May need to down-select based on importance
 - Age, gender, eye color, experience level, etc...
 - We typically block on no more than 3-4 factors for group size ~30
- Recruiting
 - Different populations require different approaches
 - Local population – for public facing devices
 - Professional population – for operator interface design
 - Population depletion?
 - Over time, becomes hard to find naïve subjects



Conclusions



Thank You!

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