Emotional and Implicit Communication through Touch

Karon MacLean
credits to Colin Swindells, Steve Yohanan, Yasaman Sefidgar, Anna Flagg, Matt Pann, Elizabeth Croft, Jane Garland, Machiel van der Loos, Joanna McGrenere

Workshop on Affective Haptics – 2012 Haptics Symposium

SENSORY PERCEPTION AND INTERACTION RESEARCH GROUP

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the importance of **designing for affect** has been known for a while

"unspectacular natural landscapes" vs. non-natural urban views from hospital room window:

s

faster patient recovery times

fewer nurse requests

fewer medication requests

Ulrich, R. S., "View Through a Window May Influence Recovery from Surgery," Science, 1984.

2

touch and affect

considerable evidence that ***touch*** is an important part of communicating emotion;

and contributes to our affective state.

nursing practice
factors of dementia in senior care
infant-mother separation and surrogacy in primates …

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this leaves lots of questions:

What kind of things do people like to touch?
Can we measure this? What kind of variation is there?

Can we design everyday interactions that feel good? *How do you measure "delight"???*

How do people communicate emotion haptically?
Can we measure this? Is it consistent?
Can we reproduce it?

Can we ***change*** **people's emotions** using just touch?

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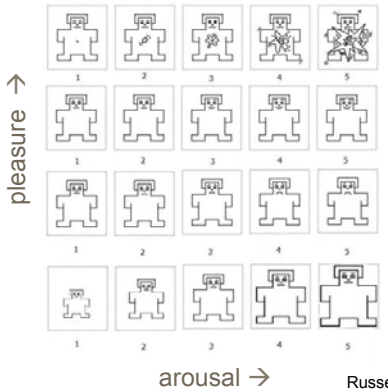
modeling and measuring emotion: **the affect grid**



describes emotional response to haptic behaviours

physiological correlates:

pleasure → EMG
(valence)

arousal → skin cond
(magnitude)

Russell, J. A. and Weiss, A., "Affect grid: A single-item scale of pleasure and arousal," 1989.

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estimating emotion: physiological sensors
triangulated with self reports

estimate users' affect state
(e.g. anxious, angry, happy, sad)

Sensors:
Galvanic Skin Response (GSR)
EMG (forehead "frown" muscles)
Heartrate (HR) and variation (HRV)
Respiration

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What do people like to touch? How can we measure this?

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one example: designing for **feel** in manual controls

- develop methodology for quantifying **subjective emotional response** to haptic behaviors and feels
- characterize real haptic knobs: ***haptic camera***
- start w/ simulations of real knobs → extend
- use this platform to explore & **understand affective responses to the 'feel' of controls**

Swindells, MacLean & Booth, "Designing for Feel: Contrasts between Human and Automated Parametric Capture of Knob Physics. IEEE ToH, 2009.

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example experiments (starting point)

compare (for knob, rendering different environments)

1. free exploration (no context given)
2. goal-oriented exploration
   (given a task, asked to rate feel afterwards)

WHILE measuring

- performance
- physiological measures of valence and arousal
- self reports of valence

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we found…

- biometric responses to haptic stimuli are more subtle than to shocking visual images (low S/N)
- but valence is well correlated to self reports
- self reports have better "dynamic range"
  - users self-calibrate for stimulus range

→ together, validates reliance on self reports for this kind of response

But… what we really want is **realtime estimates**. This isn't good enough!

Swindells, MacLean et al, "A Case-Study of Affect Measurement Tools for Physical User Interface Design", Graphics Interface, 2006.

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other results from this work

do people always prefer physical environments that result in highest task performance?

no!

Fitts task analysis: Swindells, MacLean et al, "Exploring Affective Design for Physical Controls", CHI 2007.

can we mechanically identify the physical environment aspects that are responsible for affective response?

yes, in many cases

Haptic Camera: Swindells & MacLean, "Capturing the Dynamics of Mechanical Knobs", WHC 2007.

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How do people communicate emotion haptically?

How do they "read" it from others?

Can we measure this?
Is it consistent?

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consider the "pet factor"

many studies associate contact with animals (along with plans, landscapes and wilderness) with health benefits.

- myocardial infarction 1-year survival rates 6x greater for dog owners, inexplicable by any other differences (Friedman & Thomas)
- pets seem to protect against anxiety-related illness
- effects particularly strong for aged, ill and young people

why? active lifestyle, companionship, being needed… physical touch?

nursing: physical touch is integral in nearly all patient contact – both necessary and non-necessary (Routasalo, 1999 - survey)

Friedmann & Thomas, "Pet ownership, social support, and one-year survival after acute myocardial infarction in the cardiac arrhythmia suppression trial (CAST)," 1995; and other similar results, as surveyed in Frumkin, 2001.

Routasalo, P., "Physical touch in nursing studies: a literature review", 1999.

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affect: person to Creature

build a synthetic Creature

- senses human touch;
- purrs, breathes, waggles ears
- sits on your lap

how do people *interact* with it?

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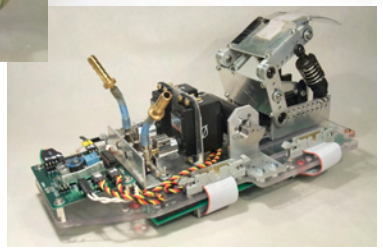
Haptic Creature



(starting to) recognize strokes: 60 force sensors
stiffens/relaxes ears
breathes (ribs)
purrs (vibrator)

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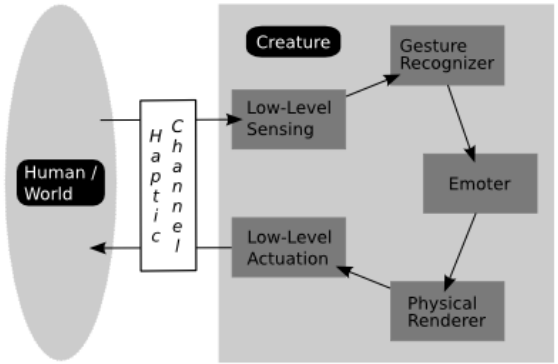
control architecture & emotion model



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creature platform: 3 studies

1. How do people interpret the Creature's emotion display?

   Yohanan & MacLean, "Design and Assessment of the Haptic Creature's Affect Display", HRI 2011 *Best Paper*

2. How do people display particular emotions ***to*** Creature?

   Yohanan & MacLean, "The Role of Affective Touch in Human-Robot Interaction: Human Intent & Expectations in Touching the Haptic Creature", IJSR 2011.

3. Do people's emotions "move" when loop is closed?

   In preparation: Yes!

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self-report and creature-assessment scale used in these studies

Arousal			
	Unpleasant-Activated "distressed"	**Activated** "aroused"	**Pleasant-Activated** "excited"
	Unpleasant "miserable"	**Neutral** "neutral"	**Pleasant** "pleased"
	Unpleasant-Deactivated "depressed"	**Deactivated** "sleepy"	**Pleasant-Deactivated** "relaxed"

Valence

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the Touch Dictionary

Yohanan & Maclean IJSR 2011

Gesture Label	Gesture Definition	Gesture Label	Gesture Definition
Contact Without Movement	Any undefined form of contact with the Haptic Creature that has no movement. For example: laying one's hand a top the Haptic Creature, or resting one's arm alongside it.	Press	Exert a steady force on the Haptic Creature with your flattened fingers or hand.
Cradle	Hold the Haptic Creature gently and protectively.	Pull	Exert force on the Haptic Creature by taking hold of it in order to move it towards yourself.
Finger Idly	Gently and randomly pull at the hairs of the Haptic Creature's fur with your fingers.	Push	Exert force on the Haptic Creature with your hand in order to move it away from yourself.
Grab	Grasp or seize the Haptic Creature suddenly and roughly.	Rock	Move the Haptic Creature gently to and fro or from side to side.
Hit	Deliver a forcible blow to the Haptic Creature with either a closed fist or the side or back of your hand.	Rub	Move your hand repeatedly to and fro on the fur of the Haptic Creature with firm pressure.
Hold	Grasp, carry, or support the Haptic Creature with your arms or hands.	Scratch	Rub the Haptic Creature with your fingernails.
Hug	Squeeze the Haptic Creature tightly in your arms. Hold the Haptic Creature closely or tightly around or against part of your body.	Shake	Move the Haptic Creature up and down or side to side with rapid, forceful, jerky movements.
Kiss	Touch the Haptic Creature with your lips.	Slap	Quickly and sharply strike the Haptic Creature with your open hand.
Lift	Raise the Haptic Creature to a higher position or level.	Squeeze	Firmly press the Haptic Creature between your fingers or both hands.
Massage	Rub or knead the Haptic Creature with your hands.	Stroke	Move your hand with gentle pressure over the Haptic Creature's fur, often repeatedly.
Nuzzle	Gently rub or push against the Haptic Creature with your nose or mouth.	Swing	Move the Haptic Creature back and forth or from side to side while suspended.
Pat	Gently and quickly touch the Haptic Creature with the flat of your hand.	Tap	Strike the Haptic Creature with a quick light blow or blows using one or more fingers.
Pick	Repeatedly pull at the Haptic Creature with one or more of your fingers.	Tickle	Touch the Haptic Creature with light finger movements.
Pinch	Tightly and sharply grip the Haptic Creature's fur between your fingers and thumb.	Toss	Throw the Haptic Creature lightly, easily, or casually.
Poke	Jab or prod the Haptic Creature with your finger.	Tremble	Shake against the Haptic Creature with a slight rapid motion.

Entries listed in alphabetical order of *Gesture Label*; top to bottom, left to right.

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example results

When told to interact as if feeling "distressed", mean likelihood of using "hold" gesture was 3.13.
Similar results for 9 emotion words.

Distressed		Aroused		Excited	
Hold	3.13	Rub	3.70	Lift	4.00
		Hug	3.60	Hug	3.87
		Massage	3.53	Tickle	3.80
		Stroke	3.50	Rub	3.80
		Pat	3.50	Swing	3.73
		Scratch	3.33	Squeeze	3.60
		Tickle	3.20	Scratch	3.50
		Lift	3.13	Stroke	3.40
				Pat	3.37
				Nuzzle	3.37
				Hold	3.37
				Toss	3.30
				Massage	3.27

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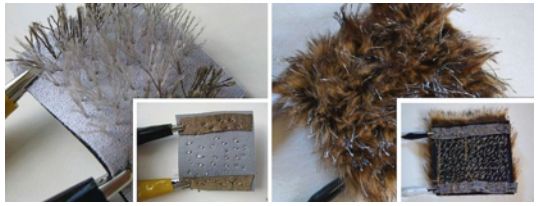
next steps: infer emotions from touch gestures?

start with richer touch sensing



Flagg, Tam, MacLean & Flagg, "Conductive Fur Sensing for a Gesture-Aware Furry Robot", HS'12: **oral + demo**

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Can we CHANGE people's emotions using just TOUCH?

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TAMER: Touch-Guided Mediation of Anxiety via Engagement with a Robot Pet

w/ Garland, Croft & Van der Loos

use Creature paradigm to help children learn to manage dysfunctional anxiety

child's sensed anxiety and/or touch pattern drive's Creature's behavior → biofeedback

Creature learns child's biosignals or gestures:

- mirrors anxiety state?
- lures to better one?
- is the touching alone, calming?
- can coping behavior learned this way transfer to other situations?

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Recent TAMER results

Adults sitting with robot while it breathes:
compared to robot not breathing or absent

- report feeling "happier" (n=35, p<.0001)
- less anxious (State-Trait Inventory drops, n=35, p<0.010)
- *breathing physically slows* (n=33, p<0.018).

Sefidgar, MacLean, et al., "*Interaction Design for a Calming Haptic Social Robot and its Subjective and Physiological Validation*", in preparation, 2012

Many challenges to working with children; strong observational support for efficacy, difficult to quantify.

→ triangulating some parameters from adult model

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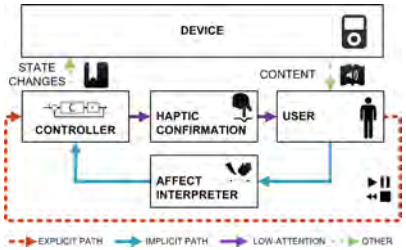
GSR-Based Bookmarking

Uses galvanic skin response to detect orienting responses caused by an interruption to the user



Pan et al, CHI 2011

orienting response (via GSR): an immediate reaction to the perception of a novel element or stimulus.

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Galvanic Skin Response-Derived Bookmarking of an Audio Stream

Matthew K.X.J. Pan, Jih-Shiang Chang, Gokhan H. Ajung Himmetoglu, Moon Thomas W. Hazelton, Elizabeth A. Croft, Karon E. MacLean

maclean@cs.ubc.ca

The University of British Columbia

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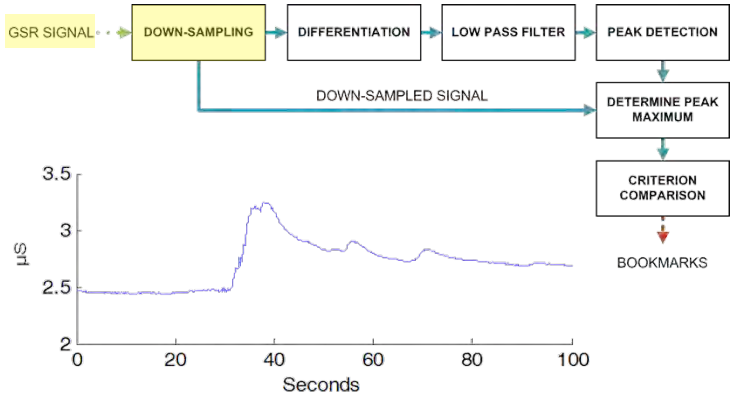
OR Detection:
sampled signal



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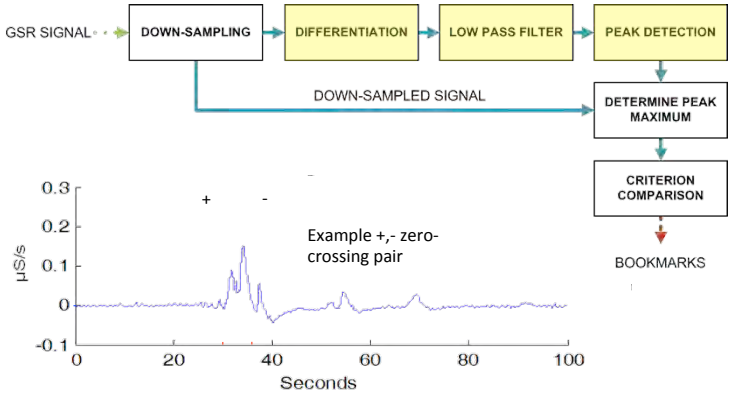
OR Detection:
detect zero crossings on differentiated signal



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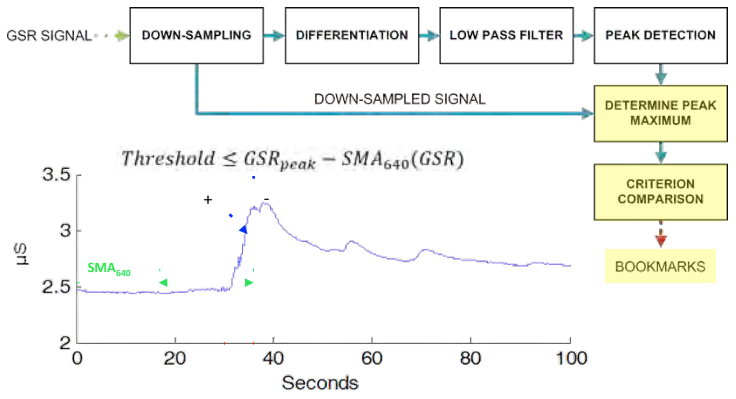
OR Detection:
compare magnitude; place bookmark at set advance



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Experimental Setup

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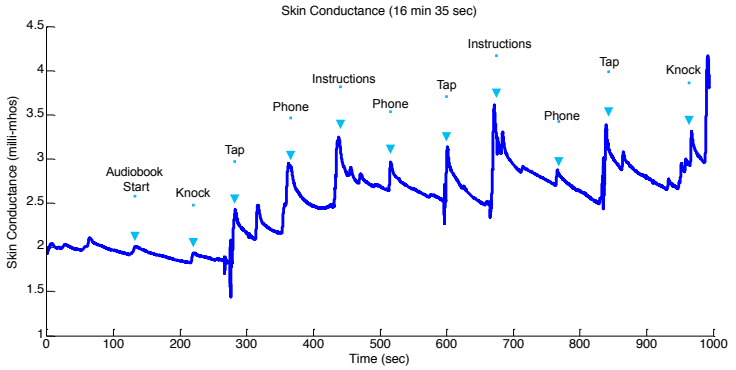
A GSR trace w/ interruptions:



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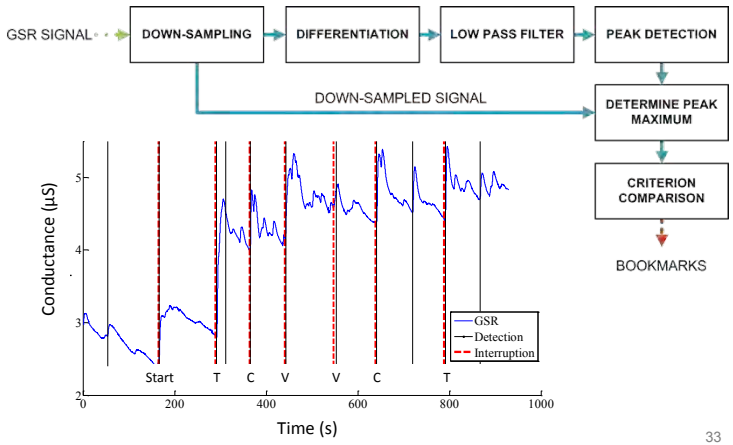
OR Detection: full data stream w/ marks set



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current work: *find* the bookmarks!

now running: a study about navigating to the point of interruption in audio stream

- does haptic notification at time of interruption help?
- do haptic vs visual "landmarks" while navigating through stream help more?

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current

- Dr. Brian Gleeson
- Dr. Kerem Altun
- Steve Yohanan
- Idin Karuei
- Matt Pan (Mech)
- Yasaman Sefidgar
- Anna Flagg
- Diane Tam
- Oliver Schneider
- John Harris
- Hasti Seifi
- Louise Oram

recent undergrads:

- Mike Wu
- Henry Lo
- Michelle Chuang
- Bryan Stern
- Jonathan Chang

dear departed:

- Dr. Vincent Levesque
- Gokhan Himmetoglu
- Gordon Chang
- Tom Hazelton
- Joseph Hall (Mech)
- Matt Bauman
- Brad Swerdfeger
- Mario Enriquez
- Jerome Pasquero
- David Ternes
- Colin Swindells
- Joseph Luk
- Jocelyn Smith
- Iman Brouwer
- Ben Forsyth
- Andrew Chan
- Tim Beamish

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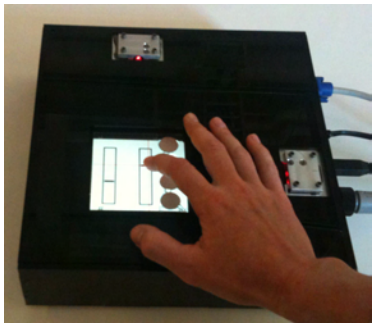
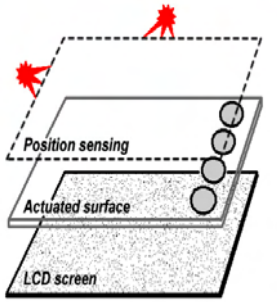
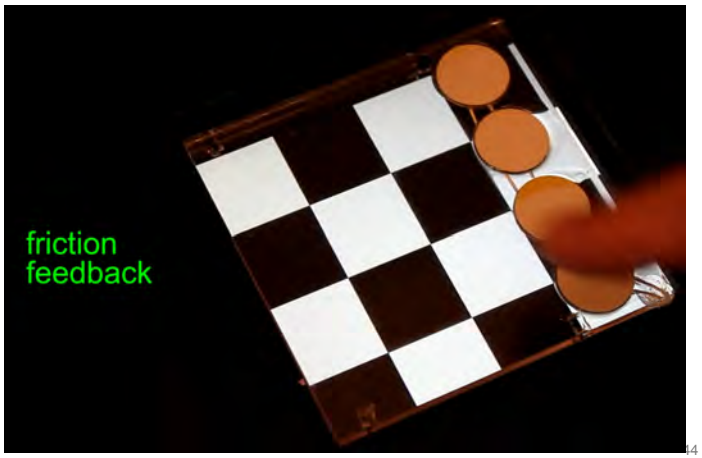
tpad: **variable friction** device
w/ Ed Colgate - Northwestern

Interaction design:
Vincent Levesque, Louise Oram & MacLean, 2010-11





the basic idea…



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two-pronged approach

First: intervention must do no harm.

1) Quantitative:
Introduce targeting distractors due to VF
→ found small performance speedup.

Not worse – but not good enough to justify added cost.
But doesn't **seem** to capture the full value, either.

2) Qualitative: measure "Delight" factor.
Find pain points in current touch interactions;
design interactions in which VF helps.

Levesque, Oram, MacLean et al. Enhancing Physicality in Touch Interaction with Programmable Friction. CHI 2011 (**Best of CHI award**)

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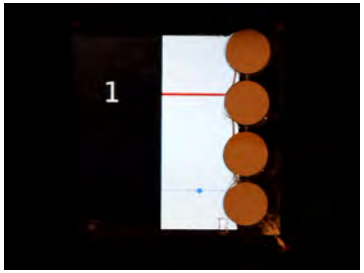
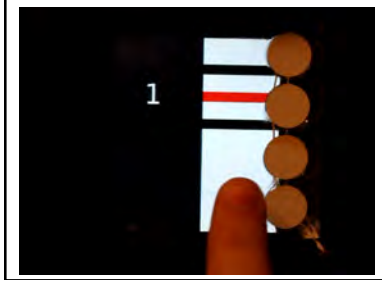
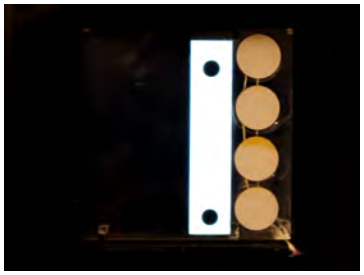
targeting tasks

1) simple target acquisition
2) add random # of distractors
3) Fitts task
all on metronome







qualitative exploration: key interactions