
the tools that haptic designers need
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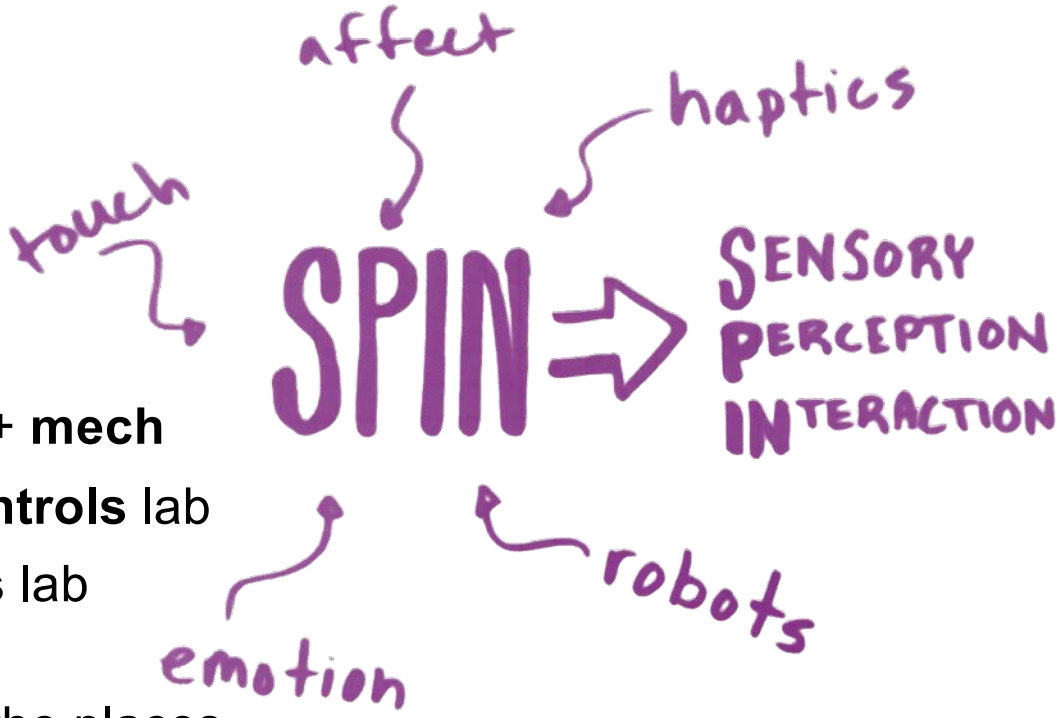
sensory perception and interaction
DESIGNING for PEOPLE
The University of British Columbia

At UBC since 2000
where they call me an HCI person

My history is all over the place:

- 1981: Stanford **biology** (pre-med) + **mech**
- 1986: An MIT **biomechanics & controls** lab
- 1988: A University of Utah **robotics** lab (first real job)
- 1990: An MIT **robotics** lab, one of the places where haptics “started”
- 1996: a Silicon Valley thinktank where I learned about **intensely interdisciplinary** research and **HCI** (Interval Research)



the point: I live in both worlds --
HCI, robotic design & controls;

mechanical AND interaction design

People – mostly researchers – have been designing haptic technology and user applications since around 1990

Last few years: technology is getting there

Problem: major obstacles to using it as a **design medium**

Designing with haptics is **different** than designing with sound or imagery,
or even physical shapes.

a grand challenge

hapticians need tools:
so let's make them

but first we need to understand **what hapticians do**
(or should be doing but don't);

and **what's getting in their way**.

Haptician: anyone who designs haptic **technology** or **experiences**.

hapticians have lots of dimensions

Points where SPIN has provided tools (but lots more to do)

who are you?

- your primary disciplines: e.g., engineering, user experience, application domain expert
- novice or expert – in any of these disciplines (or all – e.g., students)

what are you making?

- haptic technology ←→ haptic content ←→ entire end-user experience

who is it for?

- broad categories of people ←→ specialists ←→ me (end user)

what design stage?

- early concept ←→ user testing & refining ←→ field testing …

who's involved?

- no one ←→ collaborators, boss, client, domain expert, investor … end user

let's start by looking at process

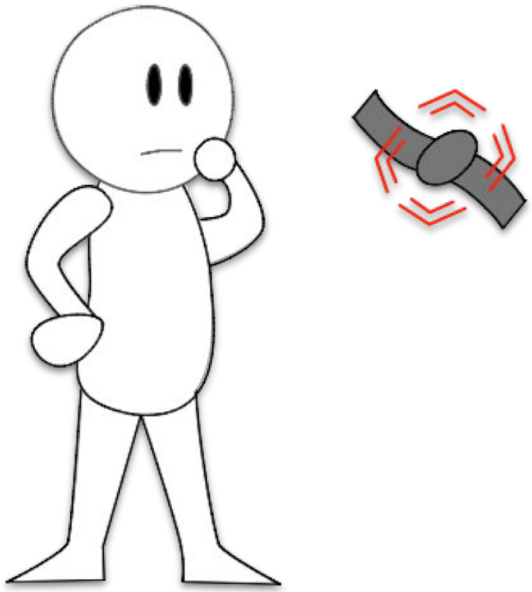
Following is based on studies of *[real, live!!]* industry haptic designers.

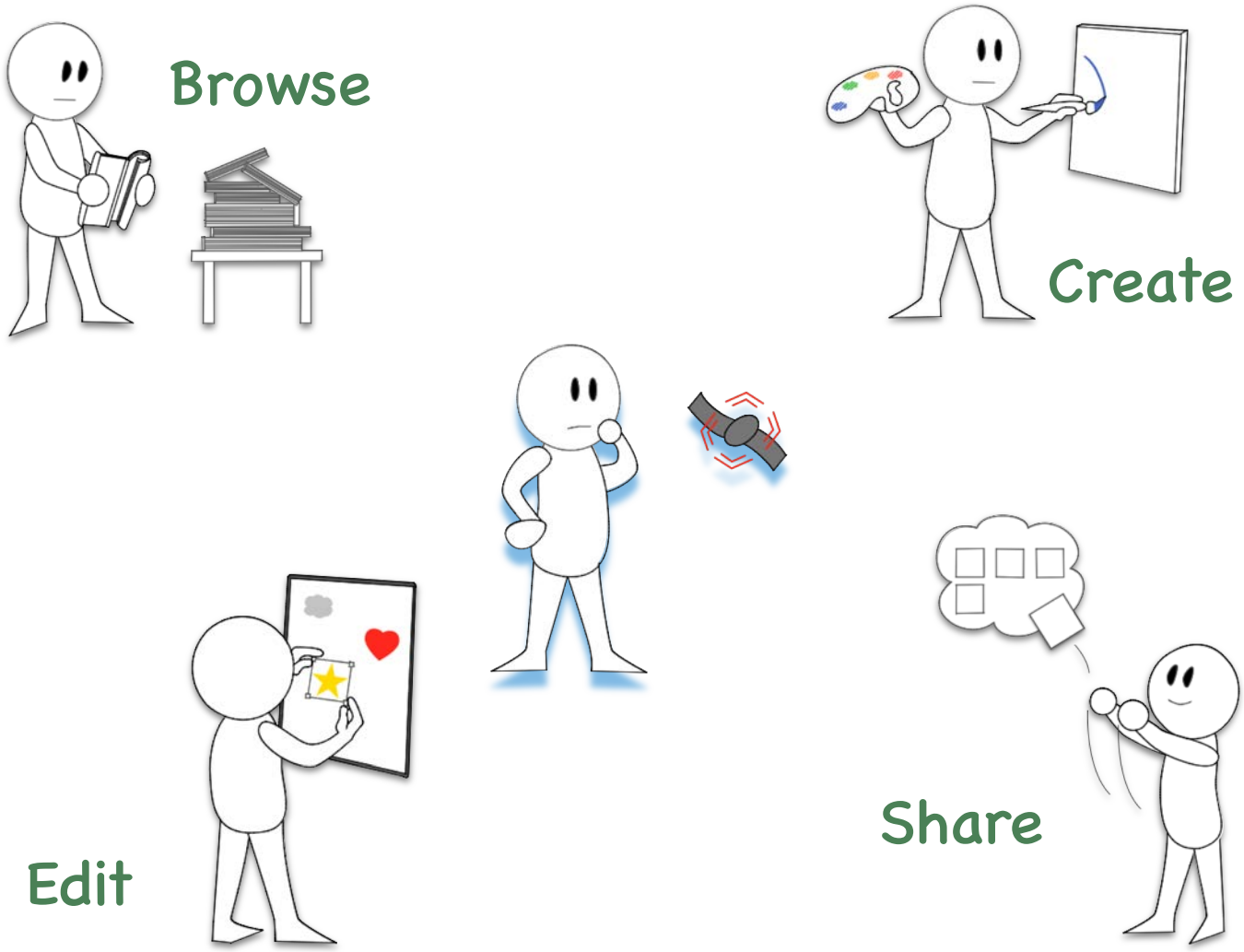
Haptic Experience Design: What Hapticians Do.
Schneider, MacLean, Swindells, Booth. IJHCS **2017**

There are *types* of things that all of us

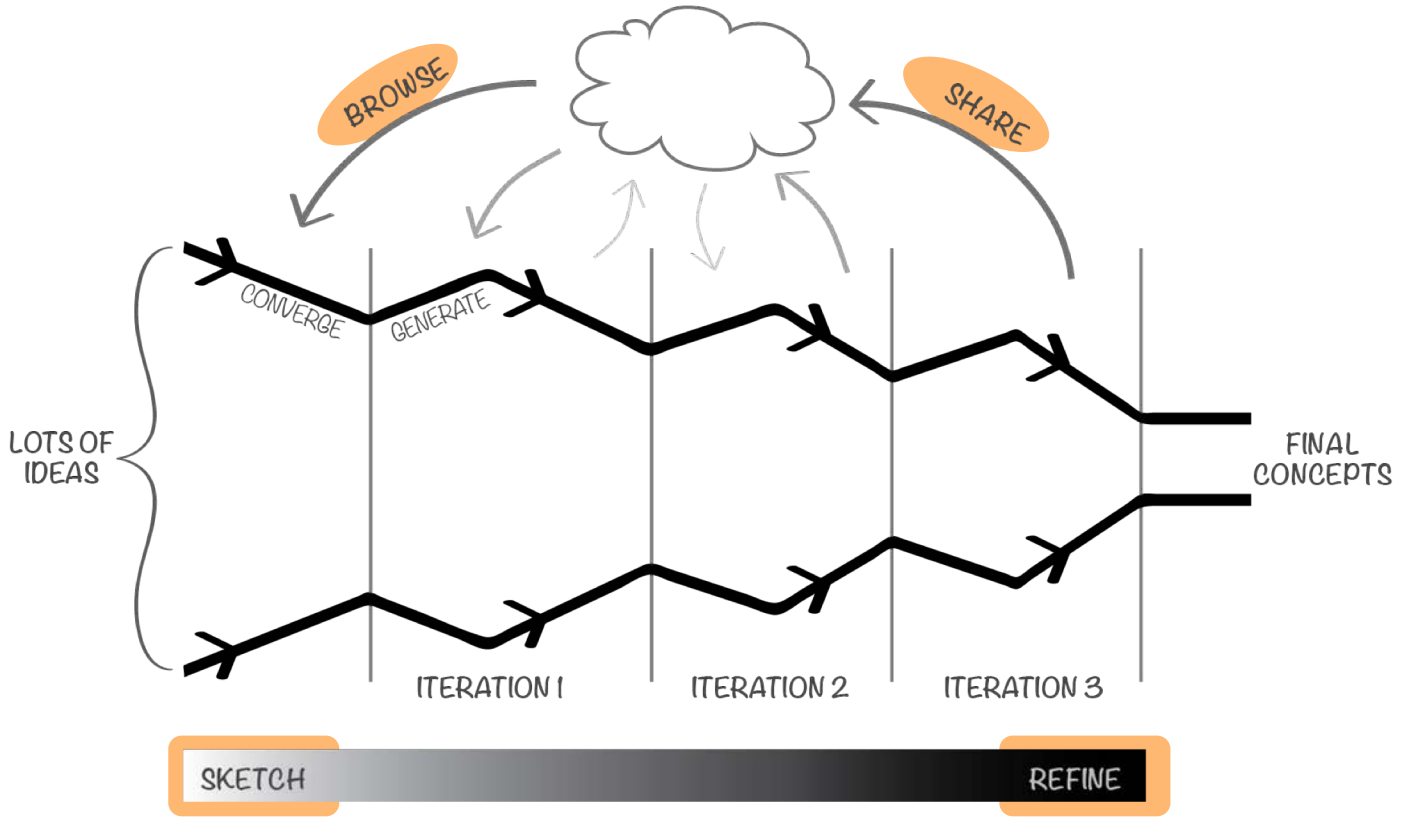
(research, industry)

do at **different stages** of haptic design.




Browse
Create
Edit
Share

Incorporating haptics into the design process



MacLean, Schneider & Seifi 2017. The classic design funnel, where multiple initial ideas are iteratively developed, adapted from **Buxton 2007** to add four important, specific design activities.

consider

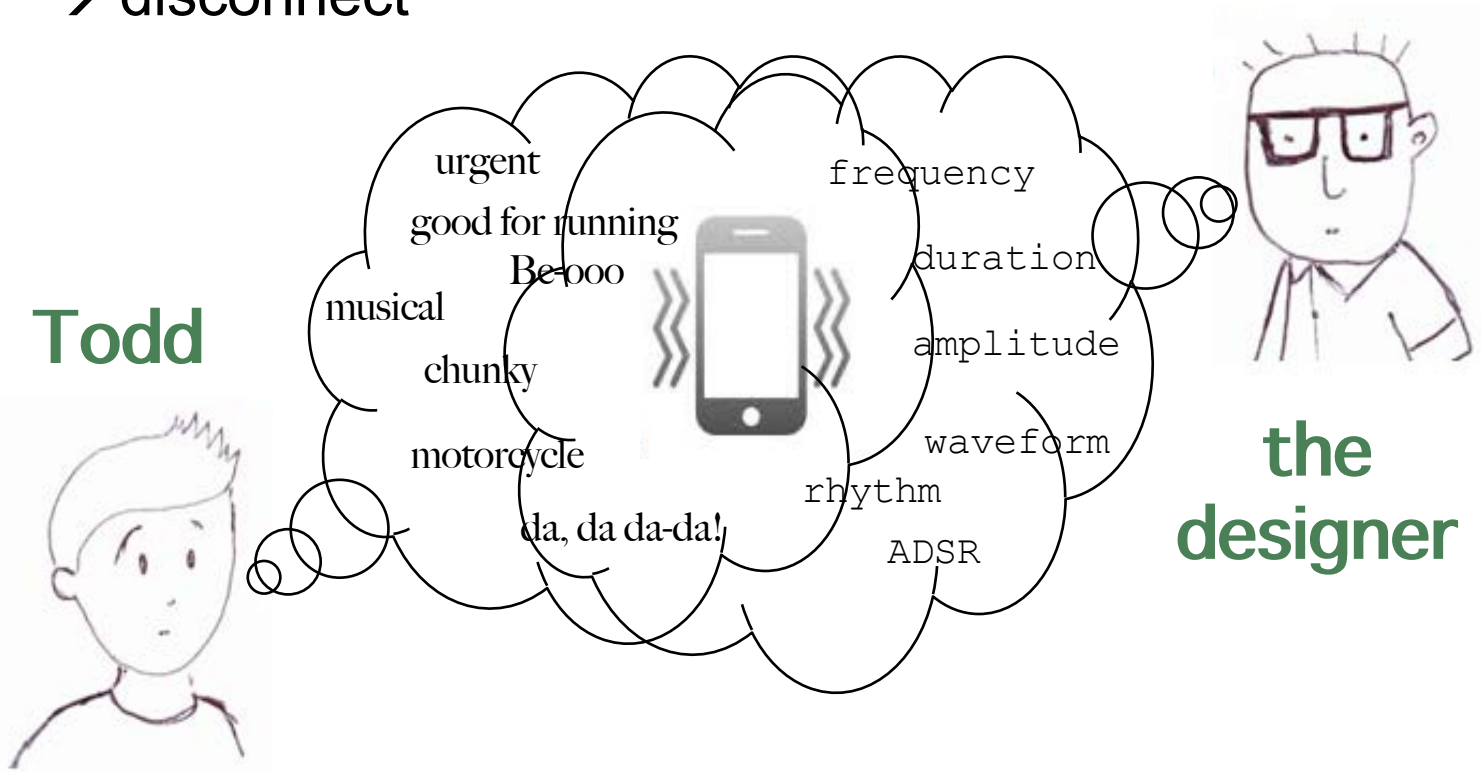
BROWSING

problem:

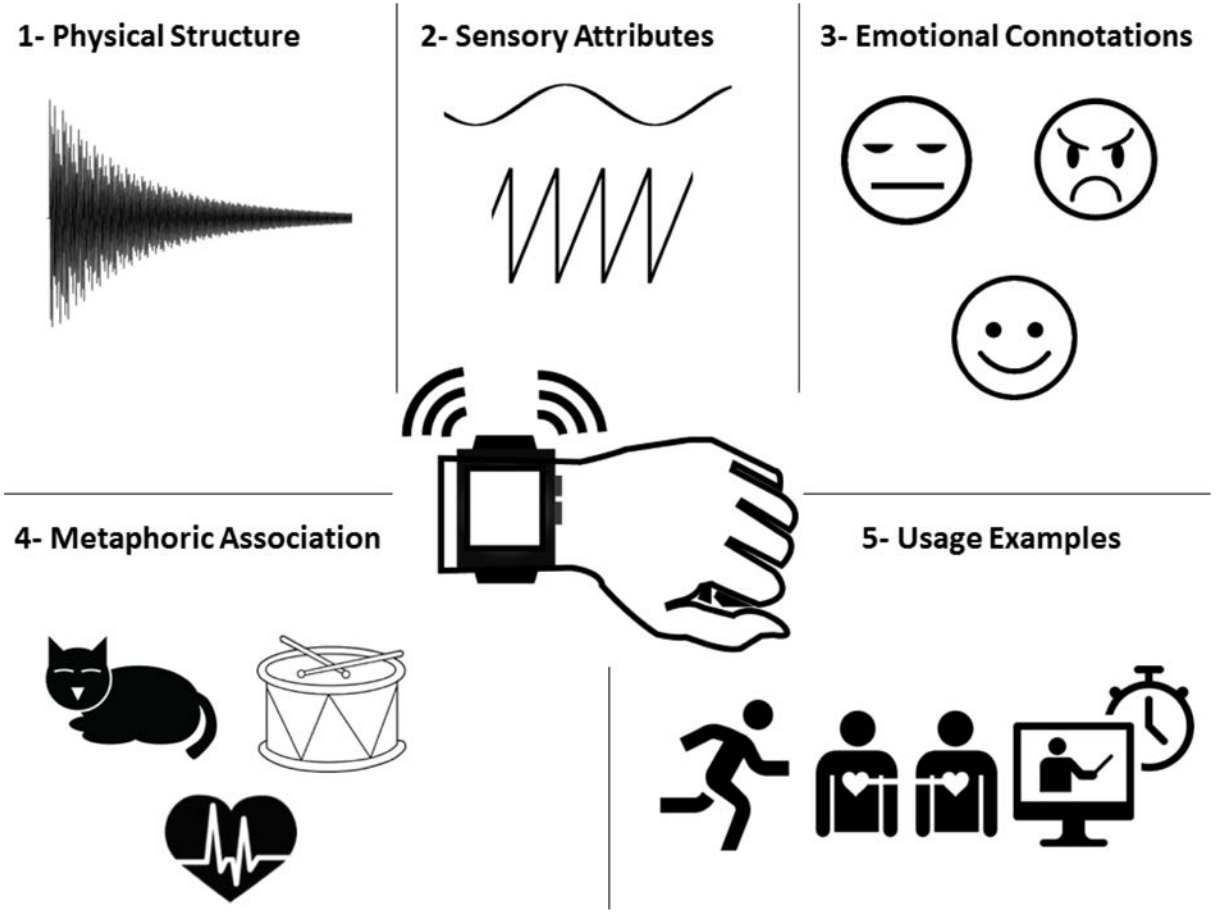
we lack a **tactile design** language

discourse on ‘feel’ is often grounded in machine parameters

→ disconnect



People use a variety of **cognitive frameworks** to **make sense** of haptic signals.

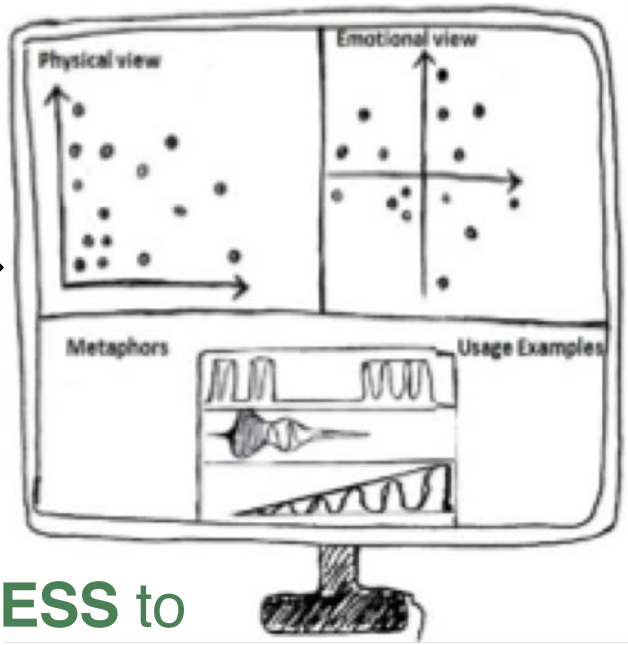


Multisensory Haptic interactions: Understanding the Sense and Designing for it.
MacLean, Schneider & Seifi, 2017.

a haptic browser can use facets to navigate a library in a cognitively accessible way

tags & ratings

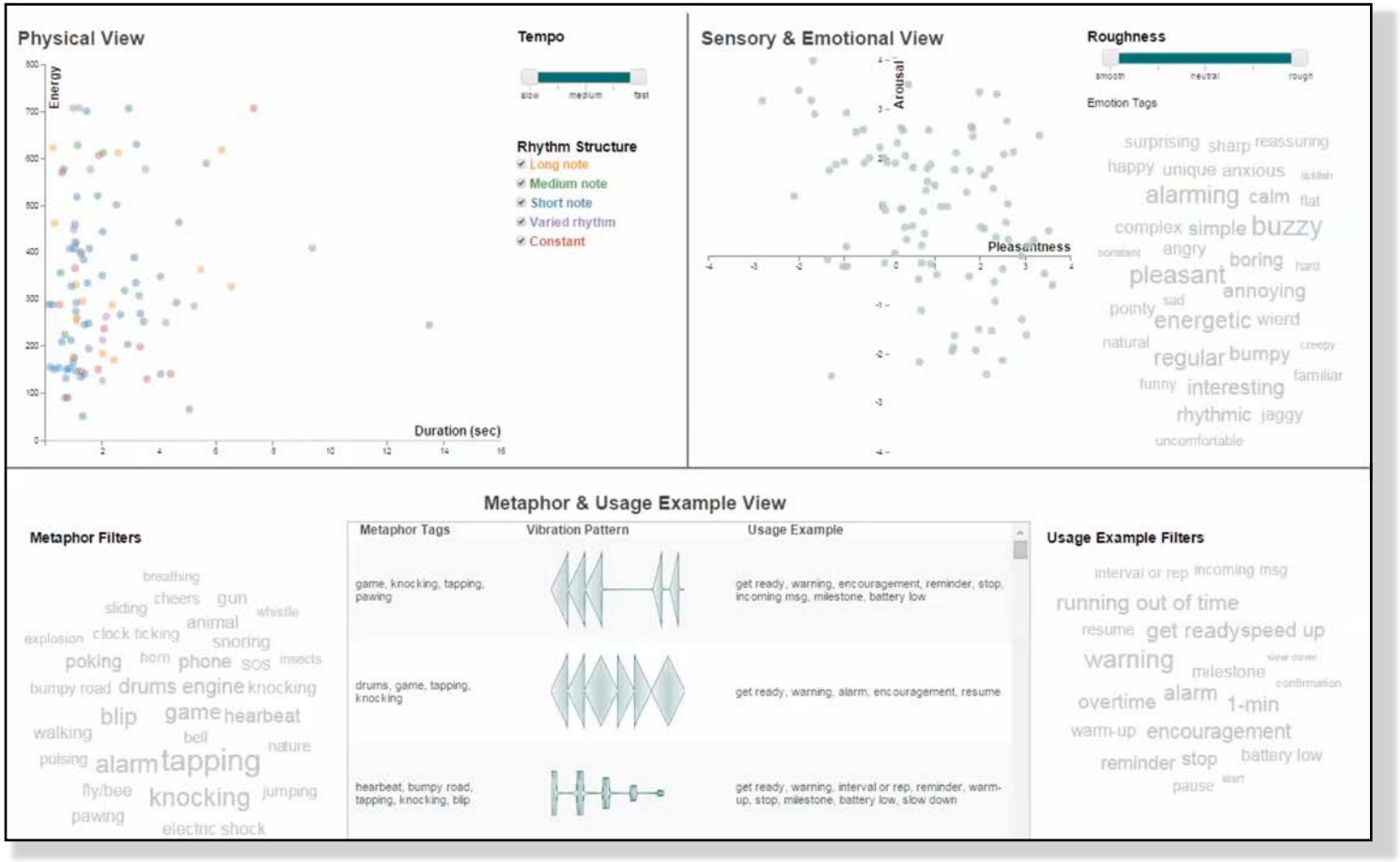
vibration collection



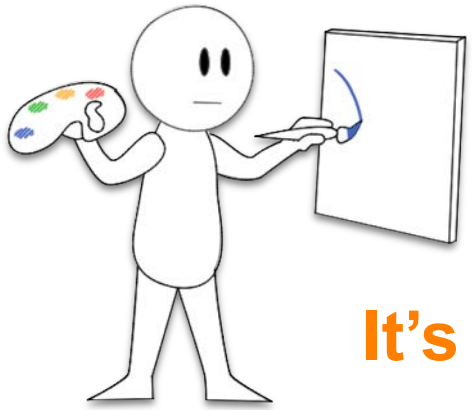
ACCESS to collection via facets

***VibViz*: Organizing, Visualizing and Navigating Vibration Libraries**. Seifi & MacLean, WorldHaptics. **2015**.

VibViz: an online vibrotactile message browser



open source: www.ubc.cs.ca/labs/spin/vibviz/



CREATING

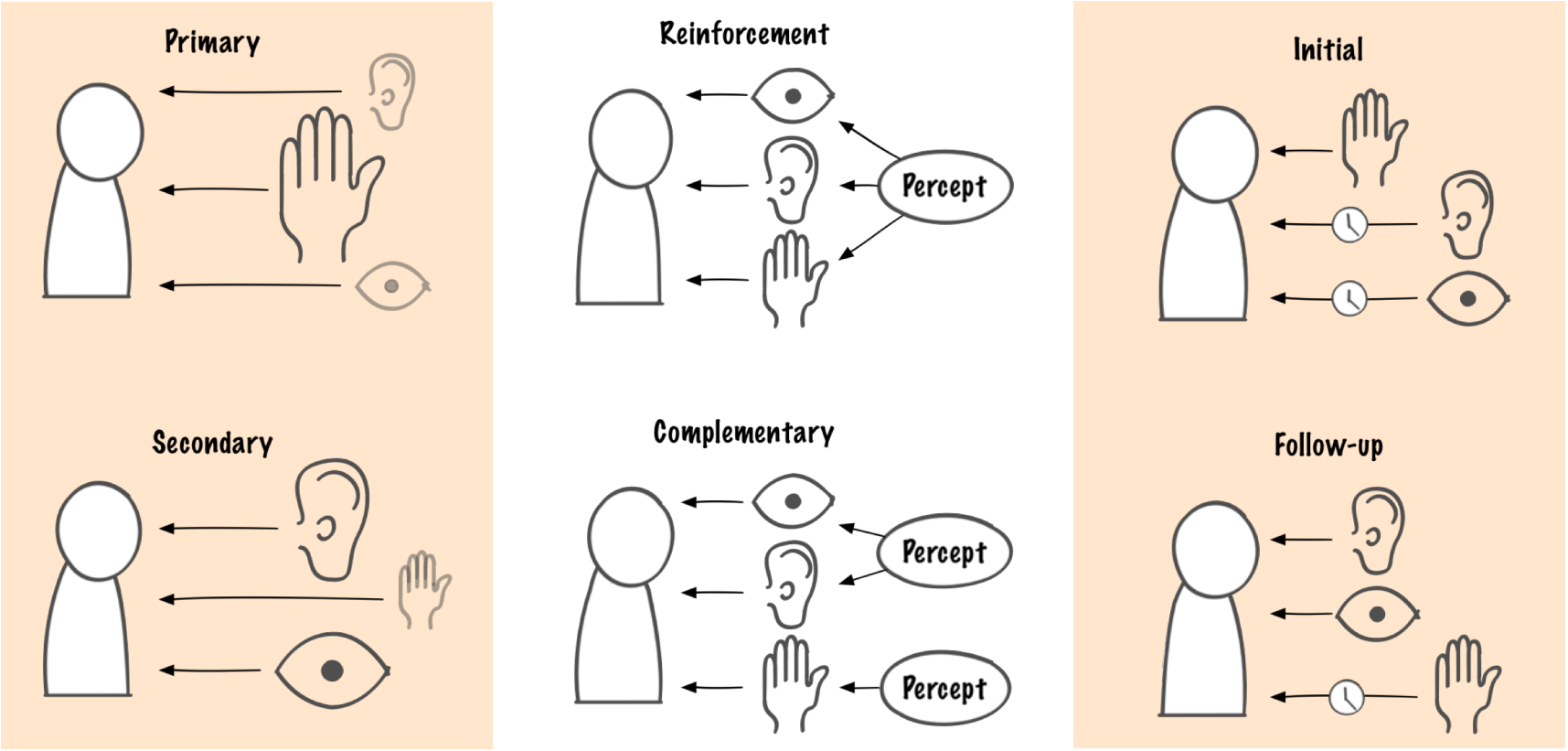
big takeaway for this talk:

It's not enough to just "name an application".
What will haptics DO in that application?

most haptic applications will be multimodal:

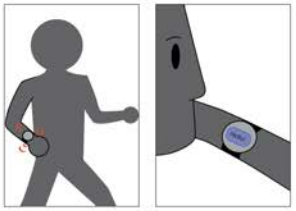
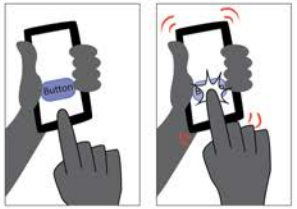
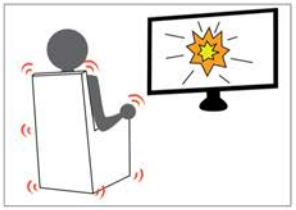
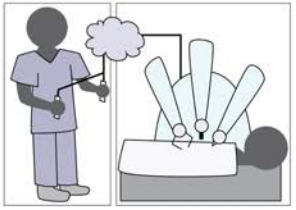
- what's the context?
- how do senses work together?
- what would the experience of using it really be like?

Roles a haptic element can take in a **multimodal** interaction



MacLean, Schneider, Seifi, **Multisensory Haptic interactions: Understanding the Sense and Designing for it,** chapter in *Handbook of Multimodal-Multisensor Interfaces*, 2017

scenarios illustrating **multimodal interaction goals**, and **roles** that a haptic component might take within it

Scenario	Description	Goal	Haptic Role
	**[S1] Wearable notification:** A haptic signal *notifies* the user about a situation; the user can then follow-up with a visual display with additional (complementary) information. At other times navigation alerts *guide* the user through an upcoming turn.	*Notify*, *Guide*	Complementary, Initial
	**[S2] Mobile device confirmation:** When making a selection or typing a key on a mobile device, a tactile click *notifies* the user that the directive was received. Visual button affordance and colour is the primary modality; sound may be another secondary cue.	*Notify*	Reinforcing, Secondary
	**[S3] Augmented media experience:** A special case of entertainment virtual reality, where a haptic seat *provides* movement, force, or tactile sensations that add to the immersion of a movie or game.	*Provide*	Reinforcing, Secondary
	**[S4] Remote surgery:** A special case of workplace VR. A laparoscopic surgeon with restricted visual access to a surgical site is *provided* with a force-feedback channel to feel different aspects of the same thing she sees.	*Provide*	Reinforcing; Primary (*e.g.*, suturing) or Secondary (examining).

From MacLean, Schneider & Seifi, 2017

once a scenario has been developed,

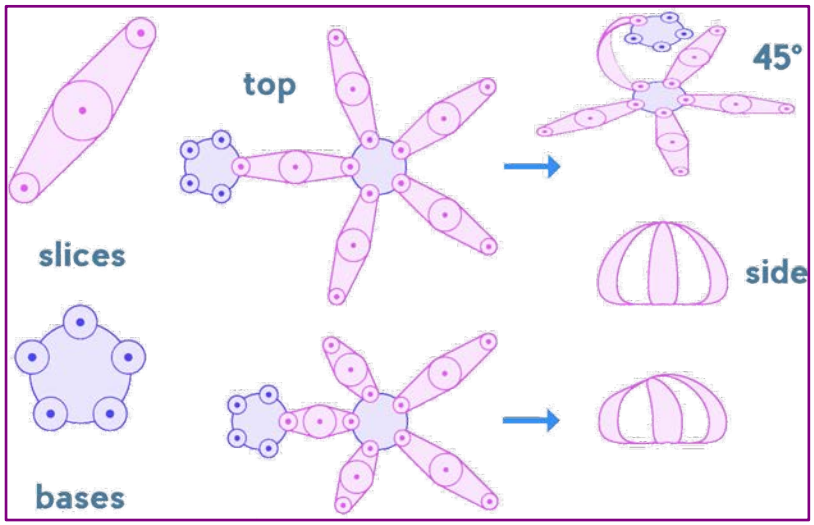
It's critical to have tools that to **haptically sketch it,**

- with **a purpose**: see how well it actually works
- Can your **technology actually deliver** on the concept?
  e.g., surface haptics: does it need to display edges?
- with **minimal effort**
- **lots of sketches (they're cheap)**
- **lots of forms** (from storyboards to crude tech mockups)

Without such tools: huge barrier to

- exploring alternative ideas
- "failing fast".

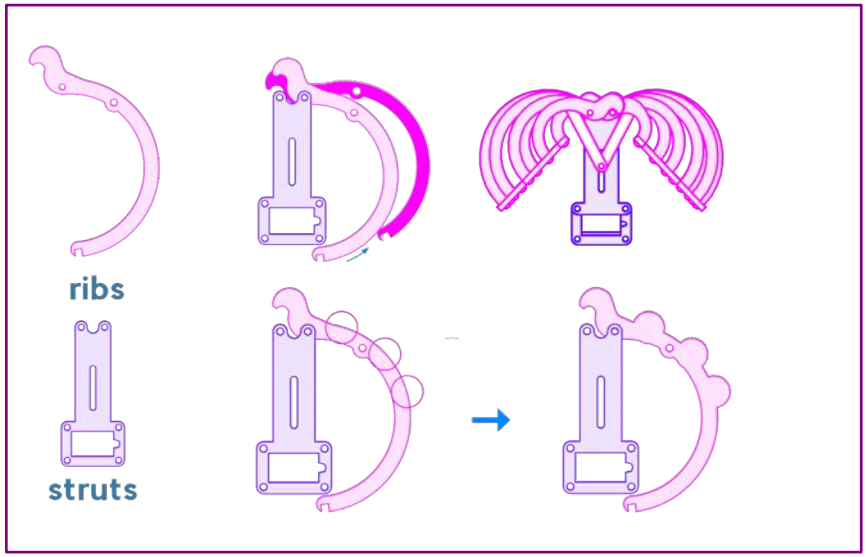
Sketching CuddleBits: Coupled Prototyping of Body and Behaviour for an Affective Robot Pet. Bucci, Cang, et al. **CHI 2017**.



CuddleBit families:
breathing design studies

easily modified **template systems**

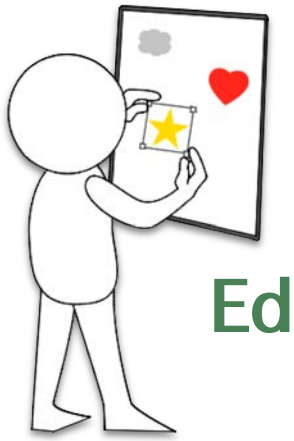
to explore **design variations**




Voodle: Vocal Doodling
for Affective Robot Interaction

editing & sharing

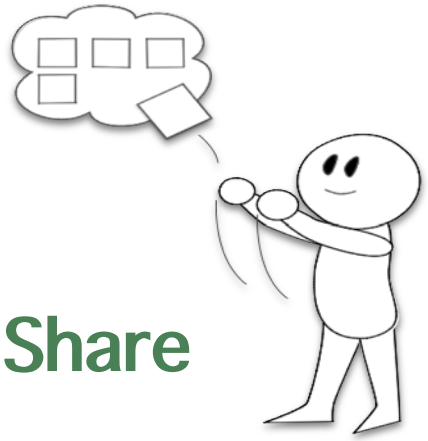
What might a ***detail design*** tool look like?



Edit

Sharing is part of it:

for feedback, evaluation

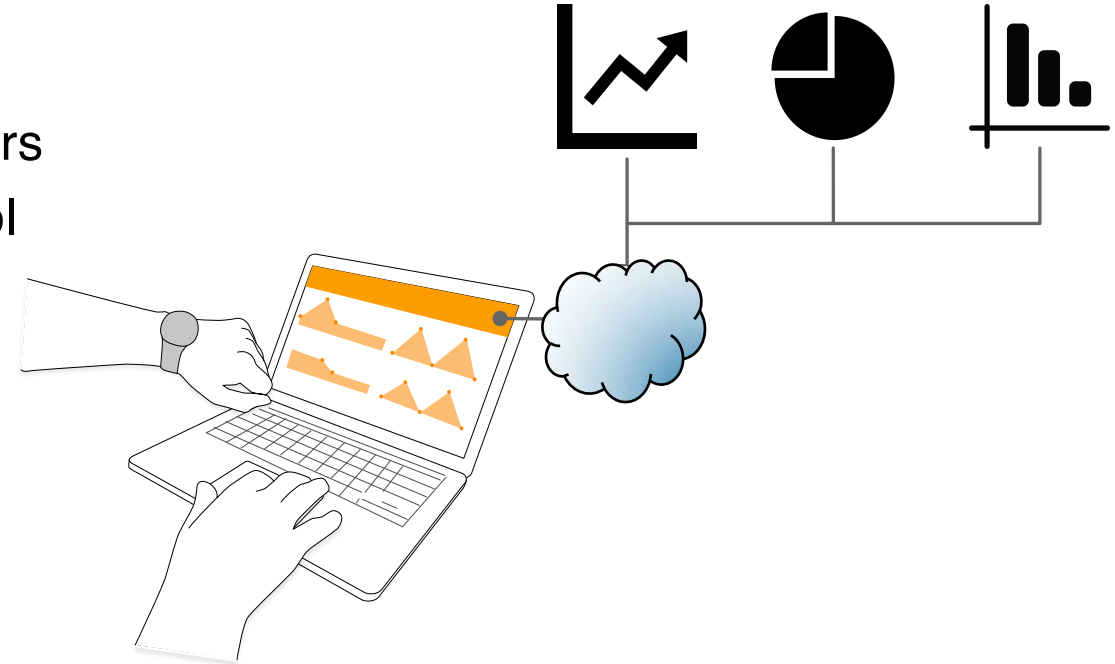


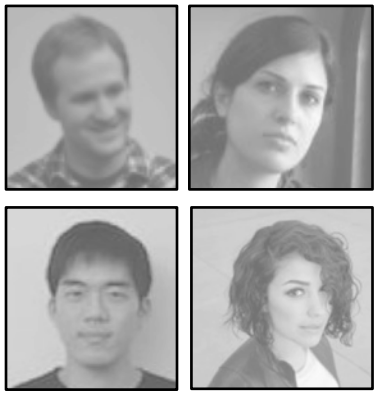
Share

Macaron, a web-based haptic editor

We built **Macaron** to

- observe haptic designers
- powerful **editing** control
- **share** using the cloud (**HapTurk**).

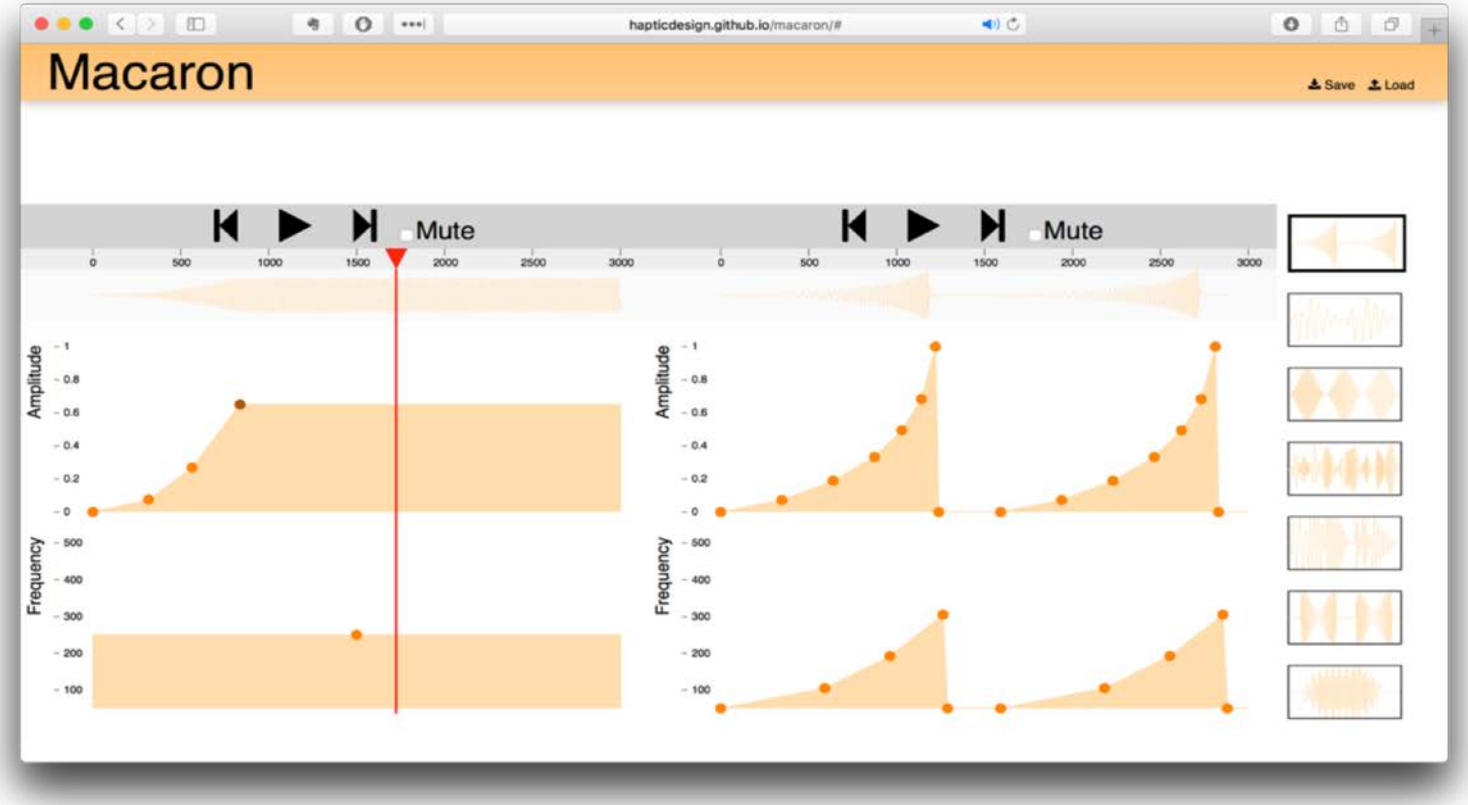




HapTurk: Crowdsourcing Affective Ratings of Vibrotactile Icons. Schneider, Seifi, Kashani, Chun & MacLean. **CHI 2016**

Studying Design Process and Example Use with **Macaron**, a **Web-based Vibrotactile Effect Editor**. Schneider & MacLean. **HAPTICS 2016**

online web tool



http://hapticdesign.github.io/macaron

hapticians have lots of dimensions

Some places my lab is currently working hard

who are you?

- your primary disciplines: e.g., engineering, user experience, application domain expert
- novice or expert – in any of these disciplines (or all – e.g., students)

what are you making?

- haptic technology ←→ haptic content ←→ entire end-user experience

who is it for?

- broad categories of people ←→ specialists ←→ me (end user)

what design stage?

- early concept ←→ user testing & refining ←→ field testing …

who's involved?

- no one ←→ collaborators, boss, client, domain expert, investor … end user

(1) “vibviz” for **haptic device and experience** designers

HAPTIPEDIA

The Haptipedia Project is a collaboration between
UBC and the Max Plank Institute for Intelligent Systems

led by **Dr. Hasti Seifi** (PhD UBC, Postdoc at MPI-IS) and including **Gunhyuk Park!**

HAPTIPEDIA


Force
Actuators
Resolution
...
Device Creators
Cost
...
Robustness
Ease of programming
Experience Designers

ways we hope Haptipedia will contribute:

- **bridge** engineers and user experience designers by providing a common language (taxonomy, facets for accessing it)
- **standards** for reporting and describing technology (so it may be searched and found)
- **accelerate** development – easier to start from what we already know
- **change community practice** in a measurable way (collecting baseline now)

All of these are crucial for a vibrant haptic design ecosystem

(2) studying novice design practice

And you thought the **2017 WorldHaptics Student Innovation Challenge** was just another design contest …

It was actually a big study. We …

- invited student teams to **build a haptic experience using tools and hardware that we provided to them**
- studied them throughout their **process**, with a closing focus group
- shadowed and interviewed the judges, for an independent assessment of **design outcomes**
- did a **major qualitative analysis** on all this, to decode ways in which novice design practice differs (and fails), and where it needs support.

→ manuscript in final preparation → then we'll get going on more tools

(3) systematic review of haptic application design practice in historically HCI vs Haptics communities

My not-so-secret suspicion: that self-identified

- **"Haptics researchers" (haptics conferences, TOH):** focus on engineering and sensation; application design is perfunctory
- **"HCI researchers" (CHI, UIST):** tend to think deeply about application needs and interaction design, but until recently, haptics technology is less advanced. *This is changing fast!*

→ examining how authors in primarily HCI vs Haptics venues tend to focus their design efforts (application papers), the impact of this on their outcomes, and how it's changing (10 year window).

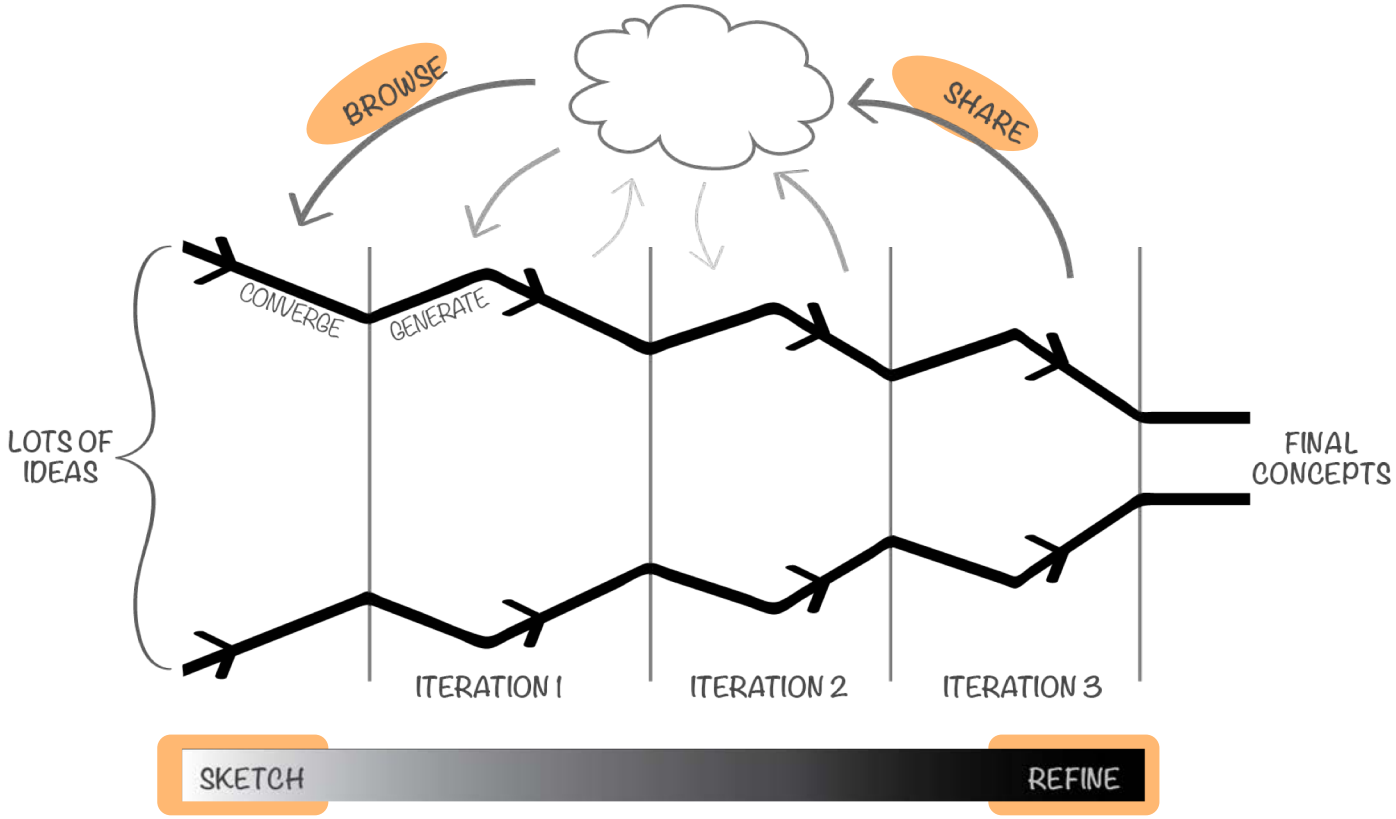
→ seeking insights into how we can get the best of both fields.

(4) haptic robots in care contexts:
co-design with patients and caregivers

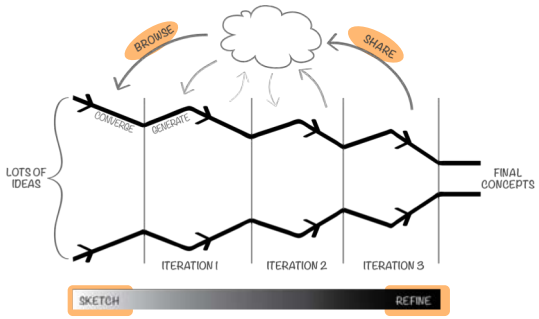
We're establishing several 2-3 year "case study" relationships.
Step 1: Observe. Step 2: jointly explore ways that haptic robots can be helpful as care objects, e.g. mediating and supporting other activities.

- Willow Pavilion Dementia Center @ Vancouver General Hospital (VGH)
  Handles difficult and unique dementia cases for periods of a few weeks to several months, to establish effective care practices for individuals.
- Canuck Place – Provides palliative care to children with terminal diagnoses and their families, both within a pair of physical facilities and throughout the community. Our involvement was invited by the director, based on his experiences with care dog Poppy.
- VGH Neonatal Intensive Care Unit – When we put technology into the NICU to provide intimate maternal functions to premature babies, moms can feel displaced, undermining their relation to their baby. *When they can put something of themselves into the tech, it can change everything.*

summary: design tools and examples are needed to make haptic content design more **accessible**, **rapid**, and **successful**



But … tools that work in isolation in someone's lab aren't enough.
We need an **open design ecosystem.**



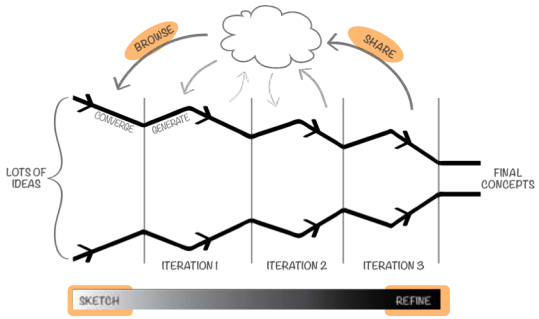
Tools must:

- be designed with **specific design intent and design stage** in mind
- have an appropriate level of **interoperability** (e.g., let you edit a sketch)
- support **collaboration**
- recognize that many hapticians are **novices** (it's a DIY world)
- be **extendable** and **portable** (hardware versatility)
- be supported by a wealth of **examples** and source **datasets**
- **work in the real world**

coming soon:

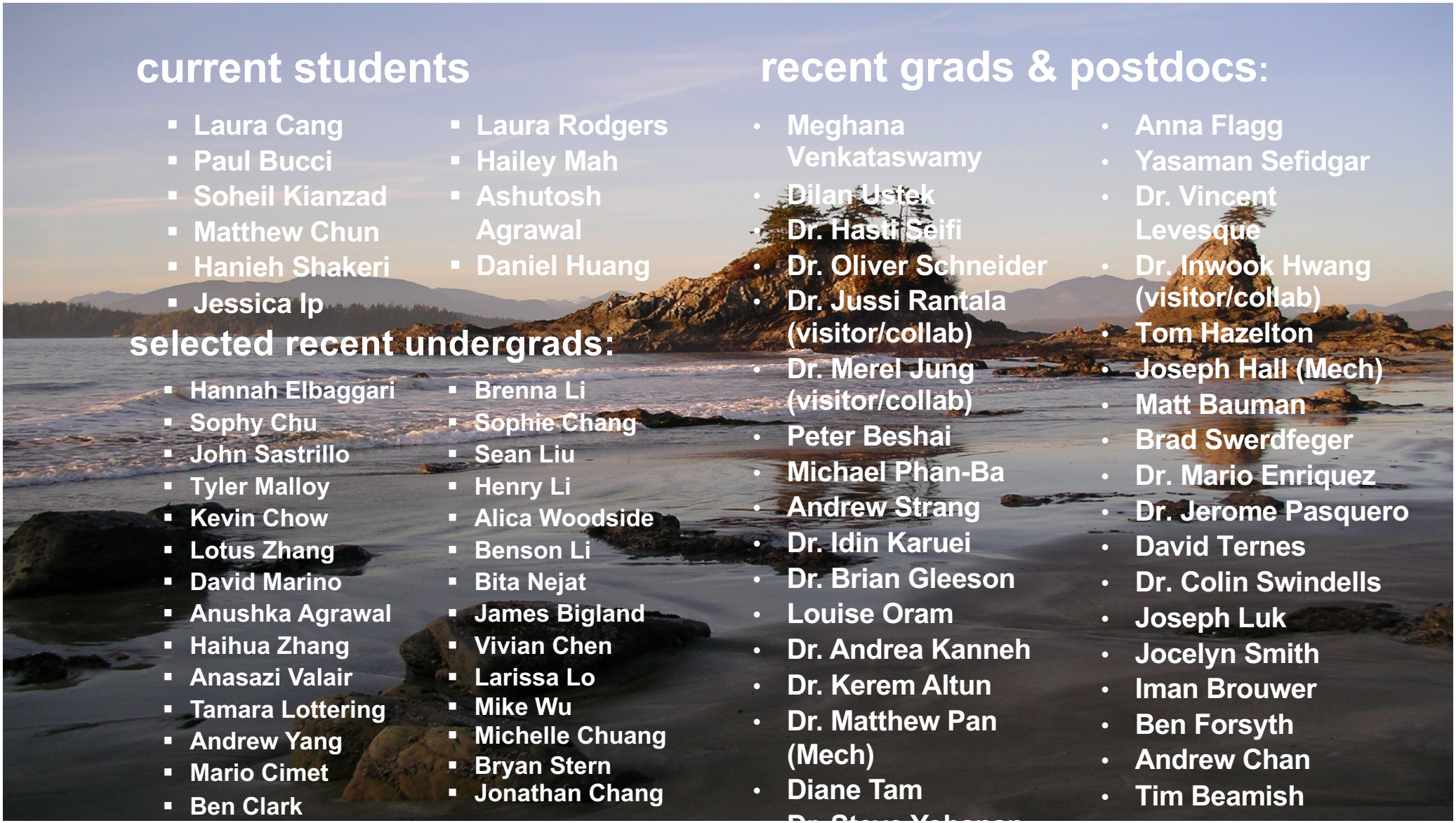
open haptic repository

haphub.io



- Share open tools, datasets, examples (all of us!)
- Curated in a structure that supports effective design practice
- Encourage development of standards

→ Get designers to think about ***how*** haptics will contribute value to their concept.



current students

- Laura Cang
- Paul Bucci
- Soheil Kianzad
- Matthew Chun
- Hanieh Shakeri
- Jessica Ip
- Laura Rodgers
- Hailey Mah
- Ashutosh Agrawal
- Daniel Huang

selected recent undergrads:

- Hannah Elbaggari
- Sophy Chu
- John Sastrillo
- Tyler Malloy
- Kevin Chow
- Lotus Zhang
- David Marino
- Anushka Agrawal
- Haihua Zhang
- Anasazi Valair
- Tamara Lottering
- Andrew Yang
- Mario Cimet
- Ben Clark
- Brenna Li
- Sophie Chang
- Sean Liu
- Henry Li
- Alica Woodside
- Benson Li
- Bita Nejat
- James Bigland
- Vivian Chen
- Larissa Lo
- Mike Wu
- Michelle Chuang
- Bryan Stern
- Jonathan Chang

recent grads & postdocs:

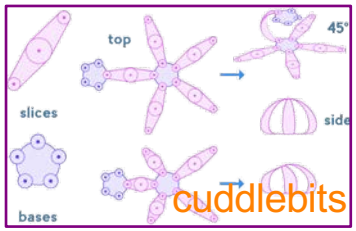
- Meghana Venkataswamy
- Dilan Ustek
- Dr. Hasti Seifi
- Dr. Oliver Schneider
- Dr. Jussi Rantala (visitor/collab)
- Dr. Merel Jung (visitor/collab)
- Peter Beshai
- Michael Phan-Ba
- Andrew Strang
- Dr. Idin Karuei
- Dr. Brian Gleeson
- Louise Oram
- Dr. Andrea Kanneh
- Dr. Kerem Altun
- Dr. Matthew Pan (Mech)
- Diane Tam
- Anna Flagg
- Yasaman Sefidgar
- Dr. Vincent Levesque
- Dr. Inwook Hwang (visitor/collab)
- Tom Hazelton
- Joseph Hall (Mech)
- Matt Bauman
- Brad Swerdfeger
- Dr. Mario Enriquez
- Dr. Jerome Pasquero
- David Ternes
- Dr. Colin Swindells
- Joseph Luk
- Jocelyn Smith
- Iman Brouwer
- Ben Forsyth
- Andrew Chan
- Tim Beamish

summary: design tools and examples are needed to make haptic content design more **accessible**, **rapid**, and **successful**

Browse ⟷ Create ⟷ Share ⟷ Edit

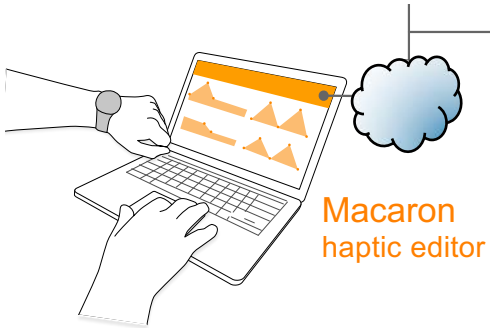
HAPTIPEDIA

VibViz
gallery browser



cuddlebits

HapTurk
crowdsource haptic perception studies

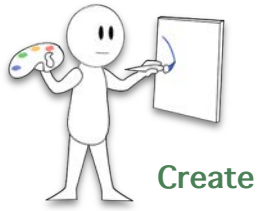


Macaron
haptic editor

PLUS EXAMPLES:
- vibrotactile sensations
- touch datasets for ML recognition training
- haptic device libraries
- …

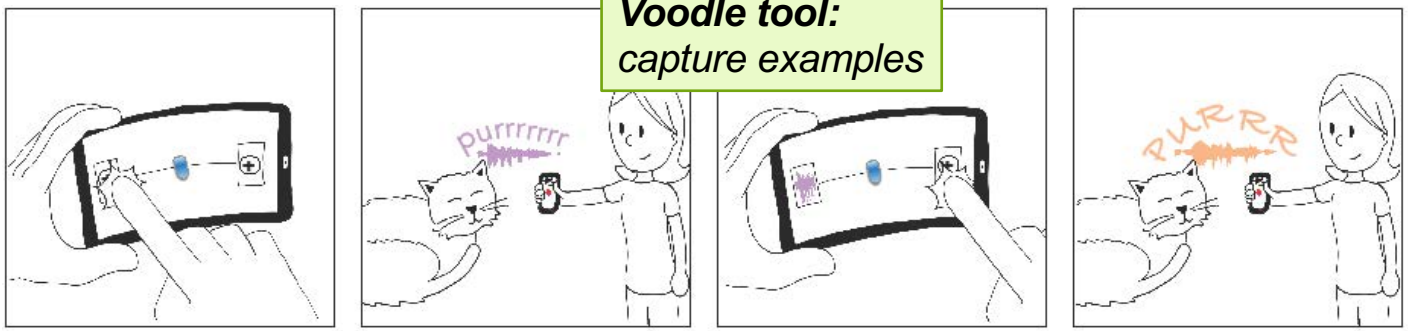
MacMix
Rhythmic Interpolation tool

even when the **body** is adequate,
sourcing **movement** is hard.



one approach:

create your own design axes.



Voodle tool:
capture examples

MacMix tool:
mix, refine, playback examples