Keppi: A Tangible User Interface for Self-Reporting Pain

Alexander Adams, Elizabeth Murnane, Phil Adams, Michael Elfenbein, Pamara Chang, Shruti Sannon, Geri Gay, Tanzeem Choudhury
Chronic pain
Chronic pain

20%

30%

50-80%
Chronic pain

20%

30%

50-80%
Chronic pain

20%

30%

50-80%
Subjective self-report
Ecological Momentary Assessment (EMA)
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Supporting the Self-Management of Chronic Pain Conditions with Tailored Momentary Self-Assessments. CHI’17.
Challenges & Constraints

• Impractical or socially inappropriate to use a phone

• Time consuming to make a self-report

• Accessibility barriers
  • Cognitive impairments
  • Low digital skills
  • Functional limitations (vision, motor skills)
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Initial inspirations
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“Keppi”
DESIGN PROCESS

1. Empathize
2. Ideate
3. Prototype
4. Test
5. Define
6. Ideate
DESIGN PROCESS

Empathize

Define

Test

Prototype

Ideate
DESIGN PROCESS

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Test

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Ideate
DESIGN PROCESS

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Hardware Design
Hardware Design

Custom force-sensitive resistor (FSR)

Keppi V1
V1

VDD (3V)

*stress on lead

60kOHMS

7kOHMS

V2

VDD (3V)

14kOHMS

17kOHMS
Lab Study

• N=28
  - 10 females, 18 males
  - 19-38 years old
  - 10 experiencing chronic pain

• Key assumptions to verify:
  (i) Can users make sense of and use Keppi to map intended pain level to squeeze intensity
  (ii) Can this input technique achieve sufficient resolution to capture no/low/med/high levels of report
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Tasks

• Low/Medium/High task: Report a medium intensity value and release, a high value and release, a low value and release.

• Continuous tracking task: Watching an animation of a red circle tracing a series of sinusoidal curves and a step function, use Keppi to continuously report the more intense and less intense values traced
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QUANTITATIVE FINDINGS
Quantitative Findings

• Low/Medium/High task

• Continuous tracking task

none/low/medium/high reporting levels significantly different in both feedback conditions (one-way ANOVAs)

visual feedback and no visual feedback conditions not significantly different (two-way ANOVA)
Quantitative Findings

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- Continuous tracking task
Quantitative Findings

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QUALITATIVE FINDINGS
Positive Reactions

- Perceived like stress ball, microphone, physiological monitor
- Stick form factor affords a squeeze grip
- Squishiness enjoyable
- Intuitive that harder squeeze $\Rightarrow$ higher pain
- Outlet to release, externalize negative pain perceptions
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“It is pretty intuitive. I naturally relate pain to more squeezing.” (P5)
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Reservations

• Subjectivity of pressure — would prefer number or duration of squeezes

• Unintentional logging

• Reporting confirmation and feedback

• Portability
Reservations

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“If I have a headache, I don’t want to do anything to force more pressure.” (P7)
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DESIGN PROCESS

Empathize

Define

Ideate

Prototype

Test
Keppi V3

Non-Conductive Foam  Piezo-resistive film

Electrode

V3 FSR

V3 electrodes

Keppi as a keychain

Keppi as a necklace
Keppi V3

V3 FSR

V3 electrodes

Keppi as a keychain

Keppi as a necklace
Interviews

• 30-60 minute semi-structured interviews
• N=7
  - 5 females, 2 males
  - 58-72 years old
  - All experiencing chronic pain
Wearable and Handy

• None found Keppi V3 bulky or heavy

• Most preferred flat, coin-shaped form factor

• Body-worn Keppi more convenient and accessible

• Envisioned wearing as necklace or on wrist, belt, keychain
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“I tend to be more private about my pain. I don’t want to talk to people about it. Don’t want them to know I’m in pain. I don’t want them coming up and saying to me, ‘What is that little thing that you’re squeezing?’” (P29)

“If it had different covers, multicolored, that you could slip on, slip off, be interchangeable, then it becomes fashion instead of just a medical device.” (P34)
Discretion and Disclosure

“I tend to be more *private about my pain*. I don’t want to talk to people about it. Don’t want them to know I’m in pain. I don’t want them coming up and saying to me, ‘*What is that little thing that you’re squeezing?’” (P29)

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FUTURE DIRECTIONS
Application Areas

• Wearable device for unobtrusive reporting

• Embedding tangible user interfaces in everyday contexts (on car steering wheel, in arms of dentist chair)

• Private, momentary patient self-reports shared with a therapist during group sessions

• During athletic activities
Application Areas

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Summary & Contributions

• Tangible user interfaces to improve pain measurement and management

• Design challenges, user concerns, and practical trade-offs

• Hardware specifications for three versions of our device

• A characterization of personal preferences to design around

• Future opportunities and application areas
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Thank You! Questions?

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