Running an HCI Experiment In Multiple Parallel Universes

**Table 1:** ANOVA table.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technique</td>
<td>1,11</td>
<td>2.1350</td>
<td>0.1719</td>
</tr>
<tr>
<td>Difficulty</td>
<td>1,11</td>
<td>5.1621</td>
<td>0.0442*</td>
</tr>
<tr>
<td>Technique×Difficulty</td>
<td>1,11</td>
<td>22.6791</td>
<td>0.0006***</td>
</tr>
</tbody>
</table>

Universes:

<table>
<thead>
<tr>
<th>Universe</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
A Study of the Effect of Haptic Feedback on Touch Sliders
A Study of the Effect of Haptic Feedback on Touch Sliders
Experimental Protocol

12 participants

Age: 19-35

2 Techniques

Slider

Haptic Slider

2 Difficulties

Easy

Hard

128 repetitions

Completion time
Results

Difficulty

$p = .04^*$
Results

Difficulty

<table>
<thead>
<tr>
<th></th>
<th>Average Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td>1.00</td>
</tr>
<tr>
<td>Hard</td>
<td>1.25</td>
</tr>
</tbody>
</table>

$p = .04^*$

No significant difference overall ($p = .17$)

Technique
Results

Difficulty

- No significant difference overall (p = .17)

- *p = .04*

Technique

- No significant difference overall (p = .17)

- ***p = .0006***

**Technique x Difficulty**

- Slider vs. Haptic Slider
Results

**Difficulty**

No significant difference overall \((p = .17)\)

\[ p = .04 \]

**Technique**

Technique x Difficulty

\[ p = .0006 \]

\[ p = 0.27 \]
Results

Difficulty

No significant difference overall ($p = .17$)

Technique

Technique x Difficulty

$p = .0006$ ***

$p = .006$ **

$p = .04$ *

$p = .006$ **
Results

Difficulty

\[ p = .04 \]

Technique

No significant difference overall \( (p = .17) \)

Technique x Difficulty

\[ p = .0006 \]

8.8% faster

\[ p = .006 \]
Summary

- *Significant* effect of difficulty

- *Very highly significant* effect of haptic feedback for Hard tasks
Summary

- *Significant* effect of difficulty

- *Very highly significant* effect of haptic feedback for Hard tasks
Summary

- *Significant* effect of difficulty

- *Very highly significant* effect of haptic feedback for Hard tasks
Implications

Haptic feedback facilitates touch slider operation.
Questions?
A Study of the Effect of Haptic Feedback on Touch Sliders
A Study of the Effect of Haptic Feedback on Touch Sliders
Experimental Protocol

12 participants  
Age: 20-43

2 Techniques

2 Difficulties

128 repetitions

Slider

Haptic Slider

Easy

Hard

Completion time
Results

Difficulty

20.4% faster

$p = .0007$ ***
Results

Difficulty

- Easy: 20.4% faster
- Hard

Technique

- Slider: 6.4% faster
- Haptic Slider

$p = .0007$ ***

$p = .004$ **
Summary

• *Very highly significant* effect of difficulty  (Easy is 20.4% faster)

• *Highly significant* effect of haptic feedback  (Haptic Slider is 6.4% faster)
Implications

Haptic feedback facilitates touch slider operation for both fine and coarse control.
Questions?
A Study of the Effect of Haptic Feedback on Touch Sliders
A Study of the Effect of Haptic Feedback on Touch Sliders
Experimental Protocol

12 participants

Age: 19-31

2 Techniques

Slider

Haptic Slider

2 Difficulties

Easy

Hard

128 repetitions

Completion time
Results

Difficulty

26.5% faster

$p = .049$ *
Results

Difficulty

- 26.5% faster

Technique

No significant difference overall (p = .055)
Results

Difficulty

Technique

No significant difference overall \((p = .055)\)

Technique x Difficulty

\(p = .049\)*

26.5% faster

No interaction
Qualitative feedback

“I find the haptic detents to help me, as it provides some guidance as to where my finger is located on the slider, when I can’t see underneath.” [P7]
Qualitative feedback

“I find the haptic detents to help me, as it provides some guidance as to where my finger is located on the slider, when I can’t see underneath.” [P7]

“I don’t expect a touch device to provide haptic feedback. When the touch screen started to provide feedback, I initially thought that it was sort of broken.” [P2]
Summary

• *Significantly* effect of difficulty

• *No significant* effect of haptic feedback
Implications

Haptic feedback does not help
Questions?
Running an HCI Experiment In Multiple Parallel Universes

All universes were the same
Running an HCI Experiment In Multiple Parallel Universes

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<td>5.1621</td>
<td>0.0442*</td>
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<td>Technique×Difficulty</td>
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<td>22.6791</td>
<td>0.0006***</td>
<td>0.0734</td>
<td></td>
<td>0.0106*</td>
<td>0.0375*</td>
<td>0.0026**</td>
</tr>
</tbody>
</table>

Universe 1 2 3 4 5 6
Running an HCI Experiment In Multiple Parallel Universes
1. *p*-values vary **a lot** across replications

2. Researchers over-rely on *p*-values to report and interpret results

*p*-values have many other issues

(Links and references on our Web site)
NHST

Null Hypothesis
Significance Testing
“Anderson, Burnham and Thompson (2000) recently found more than 300 articles in different disciplines about the indiscriminate use of NHST [...]

After review of the debate about NHST, I argue that the criticisms have sufficient merit to support the minimization or elimination of NHST.”

Rex B Kline (2004)
HCI Perspective

**End users:** US (HCI researchers)

**UI:** stats methods & tools

**Task:** produce scientific knowledge
Drawing by Carelman, from Don Norman (1988)
“The problem is NHST misuse”
“The problem is NHST misuse”
"We should use more power"
Alternatives
Estimation
(Confidence Intervals)
Estimation
Good reasons for not Switching?
“The two are equivalent”
“We need both”
“I don’t know,
I’m not a stats expert”
Knowledge

NHST

Estimation
For links
and references:

www.aviz.fr/parallel