Circle Reading — Text Reading performance on "Small Circular Displays"

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Abstract

Our project on readability for small circular displays dug into different text layouts. In the project, we applied empirical research methods to collect data, and figured out the best layout. Experiments show that the adaptive layout provided the best readability as well as user rating.
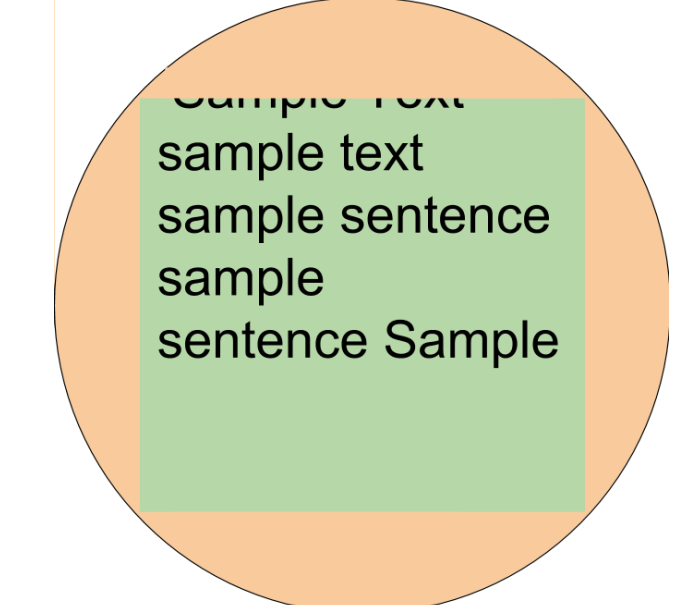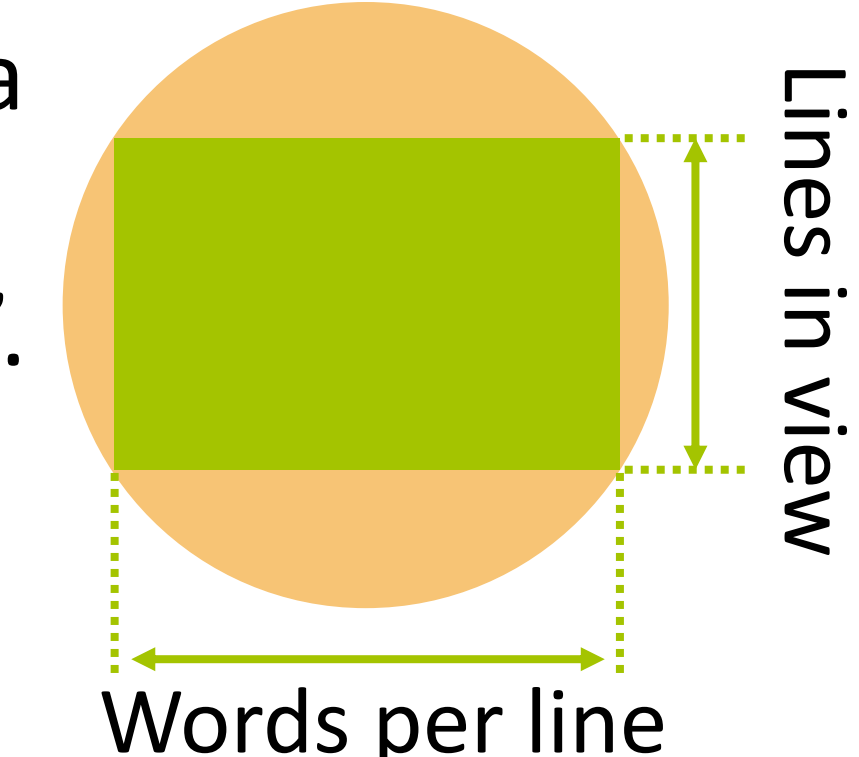
Question & History

Our project will compare the following three scrollable text layouts presented below, and try to address which layout is the best one on watches.
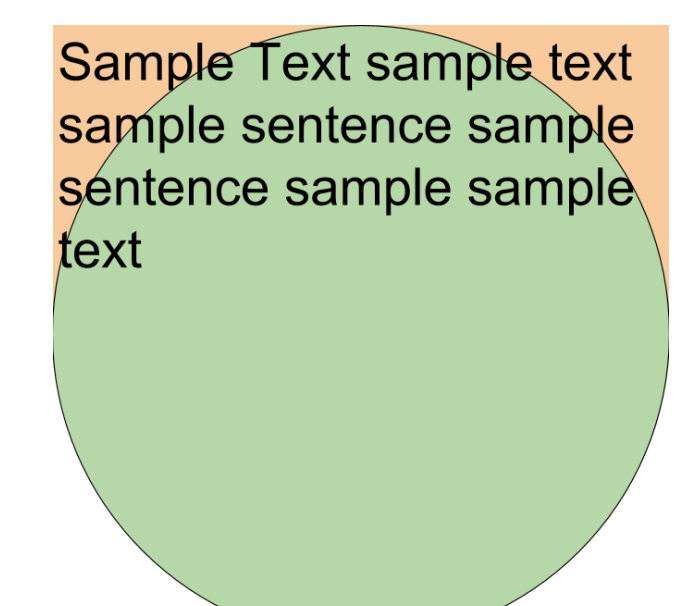
There are existing researches in reading performance such as the study on eye movement and the measurement of reading speed and comprehension. Frameworks like EPF and RSVP gives us a fist look into the area, but they concentrate on presenting graphics instead of text.
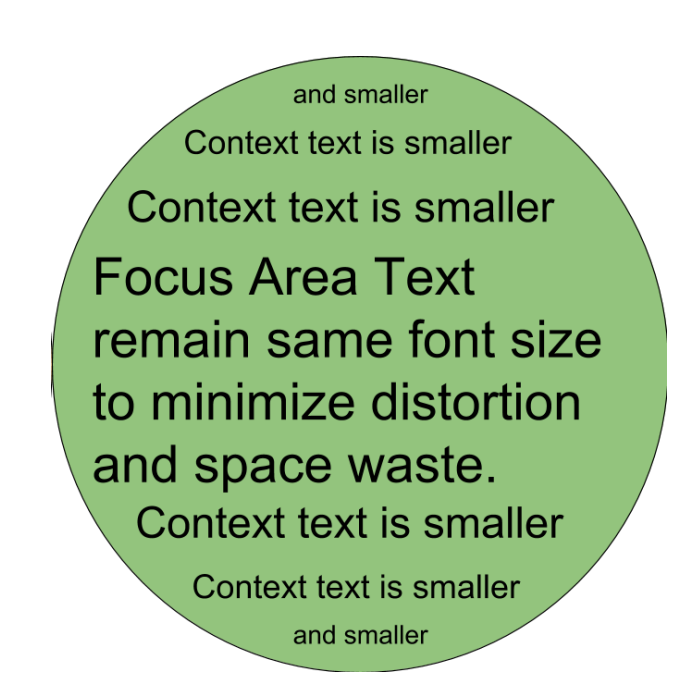
Design & Hypothesis

Traditional layout becomes a trade-off between "Words per line" and "Lines in view". Significantly limits reading performance.

Lines in view
Words per line

Layout "Crop"
Maximizes the expected sentence's words, but drastically crops the screen.

Sample Text sample text sample sentence sample sentence Sample

Layout "Overflow"
Maximizes the line width, but provides extremely "overflowed" sentences.

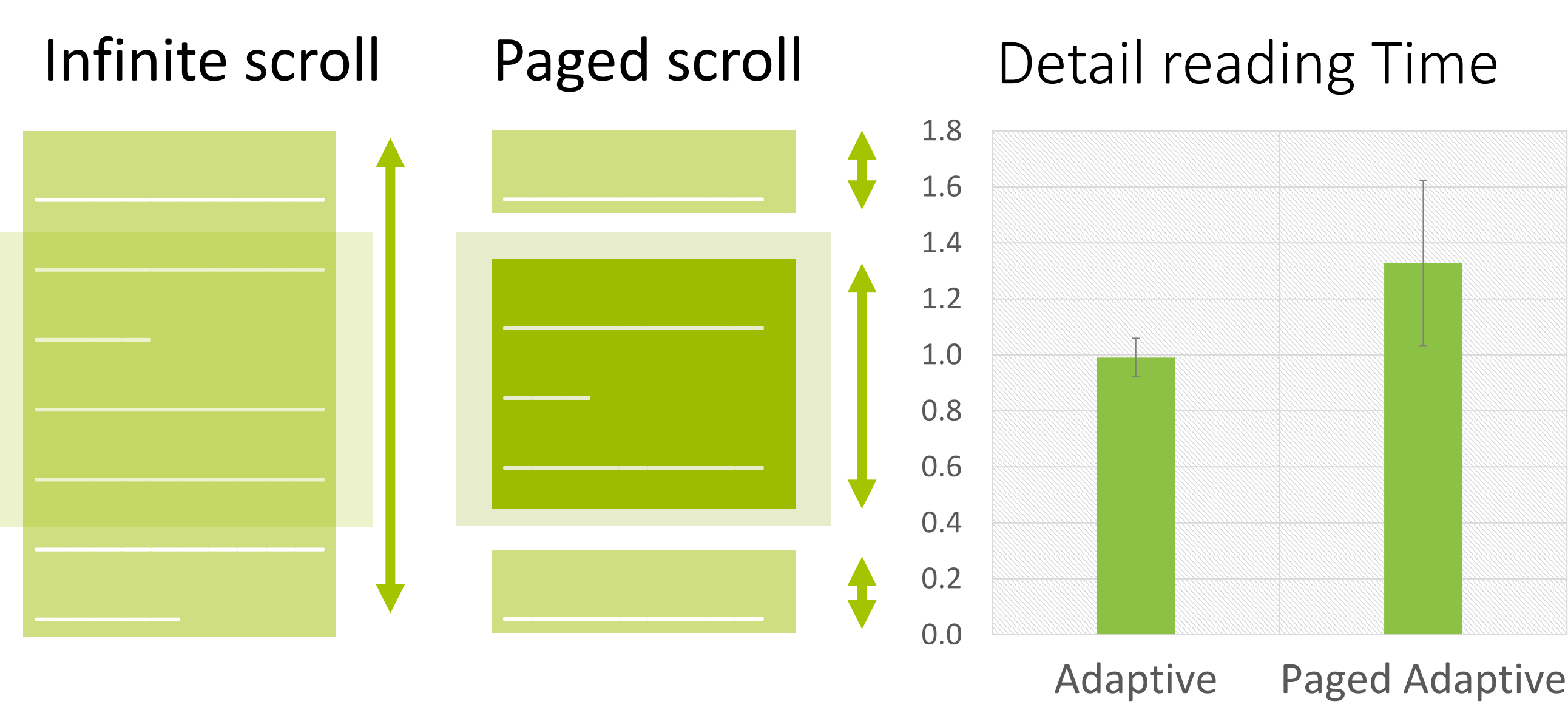Sample Text sample text sample sentence sample sentence sample sample text

Layout "Adaptive"
Bingo! Maximizes both the words per line and lines in view! We predict this layout is the one that maximizes readability.
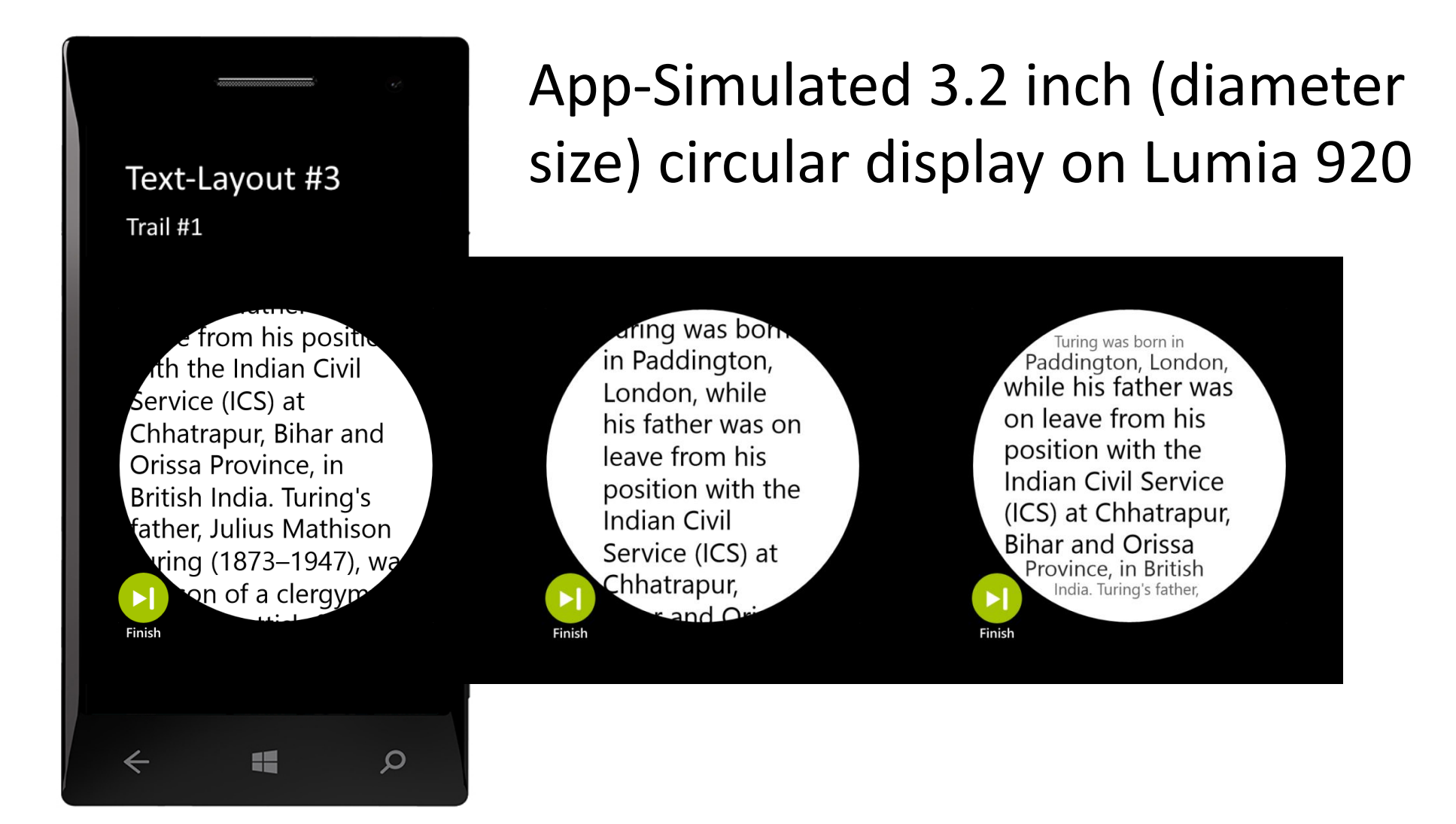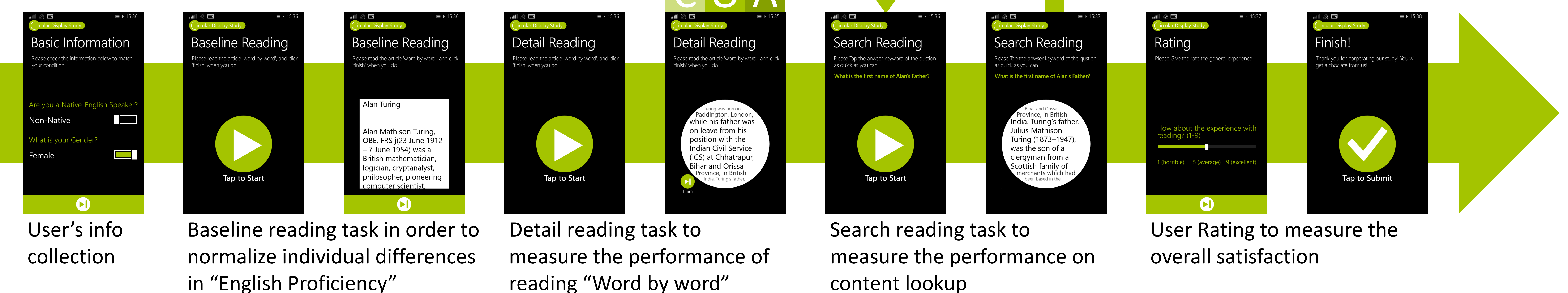
and smaller
Context text is smaller
Context text is smaller
Focus Area Text remain same font size to minimize distortion and space waste.
Context text is smaller
Context text is smaller
and smaller

Study Design & Participants

X 39

Between Groups
Cropped X 10
Overflow X 10
Adaptive X 9
Adaptive(Paged) X10

Inside Group
Ability balanced
Native x5
Non-Native x5

Study Procedure

Different layout
C O A
X3

Basic Information
Please check the information below to match your condition
Are you a Native-English Speaker?
Non-Native
What is your Gender?
Female

User's info collection

Baseline Reading
Please read the article 'word by word', and click 'finish' when you do

Baseline reading task in order to normalize individual differences in "English Proficiency"

Baseline Reading
Please read the article 'word by word', and click 'finish' when you do
Alan Turing
Alan Mathison Turing, OBE, FRS J(23 June 1912 – 7 June 1954) was a British mathematician, logician, cryptanalyst, philosopher, pioneering computer scientist

Detail Reading
Please read the article 'word by word', and click 'finish' when you do

Detail reading task to measure the performance of reading "Word by word"

Detail Reading
Please read the article 'word by word', and click 'finish' when you do

Search Reading
Please Tap the answer keyword of the question as quick as you can
What is the first name of Alan's Father?

Search reading task to measure the performance on content lookup

Search Reading
Please Tap the answer keyword of the question as quick as you can
What is the first name of Alan's Father?

Rating
Please Give the rate the general experience
How about the experience with reading? (1-9)
1 (horrible)   5 (average)   9 (excellent)

User Rating to measure the overall satisfaction

Finish!
Thank you for cooperating our study! You will get a chocolate from us!
Tap to Submit

Study Result

Detail Reading Time / Locating Time

Average of DBR   Average of SBRS

Crop   Overflow   Adaptive

"Adaptive" is faster than "Crop"(p=0.056) in detail reading

User Rating

Crop 4.50   Overflow 3.22   Adaptive 6.33

"Adaptive" is the most satisfied layout rated by participants (P=0.004)

Extra study in "Layout dynamic"

Infinite scroll   Paged scroll

Detail reading Time

Adaptive   Paged Adaptive

Apparatus

Text-Layout #3
Trail #1

App-Simulated 3.2 inch (diameter size) circular display on Lumia 920

Conclusion

Reading Speed
- Reasonable use of scaling transformation keeps sentences readable, and improve both "words per line" and "lines in view", which will achieve better user performance.
- Fat-Finger problem is more significant in smaller display. Reasonable margins will not significantly affect user's performance.

User Rating
- Although distortion does not uniformly apply to a sentence (like partial crop), it will significantly reduce user's rating. There is no evidence that shows it will affect reading speed so far.

Limitation & Future work
- Large scale of user study will be needed.
- Factors in "Layout" still need to be explored in future studies. e.g. How "Lines in view" and "words per line" affect user performance is the direction of future study.