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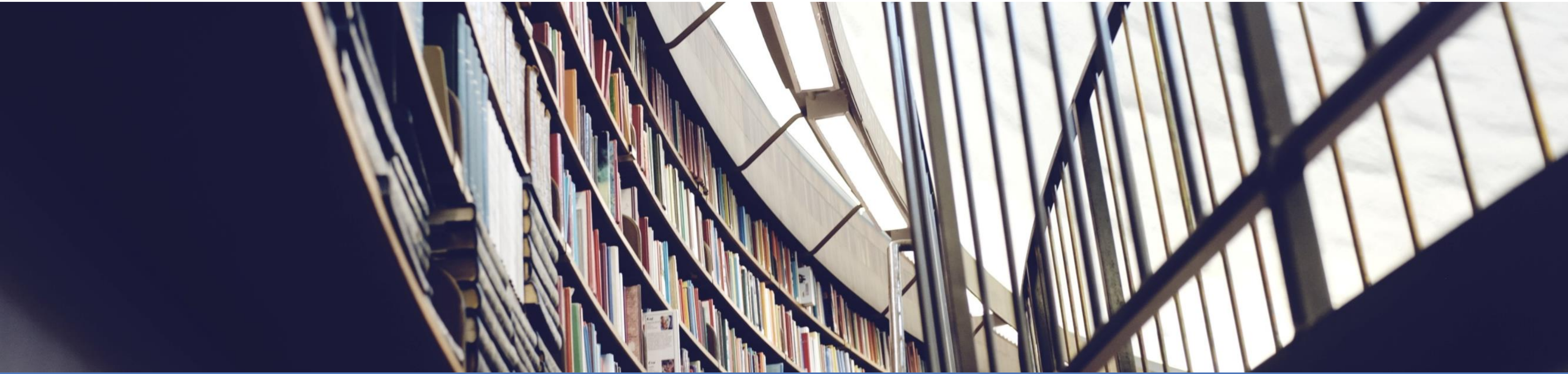


How to Review Literature

Human-Computer Interaction Exercise

Literature Reviews

- **Original research** (such as empirical papers or theses) typically have a **related work section** to:
  - **Ensure scientific standards and methodologies**
  - **Demonstrate your familiarity and expertise** around the topic and its scholarly context
  - **Develop a theoretical framework** and methodology for your research
  - **Position yourself** in relation to other researchers and theorists
  - Show how your research **addresses a gap** or **contributes to a debate**
- **Extensive literature reviews** (secondary research) can be stand-alone contributions
  - They are called **literature reviews**, **scoping reviews**, **survey paper**, **meta-analysis**, **meta-analysis of a meta-analysis**

The Student‘s Approach

- **The process of conducting a literature review** typically follows the same steps:
  1. Search for relevant keywords and databases
  2. Search, evaluate, and filter your results
  3. Find a structure (identify fields, themes, categories,…)
  4. Write your literature review
- Not scientific, but we like this!

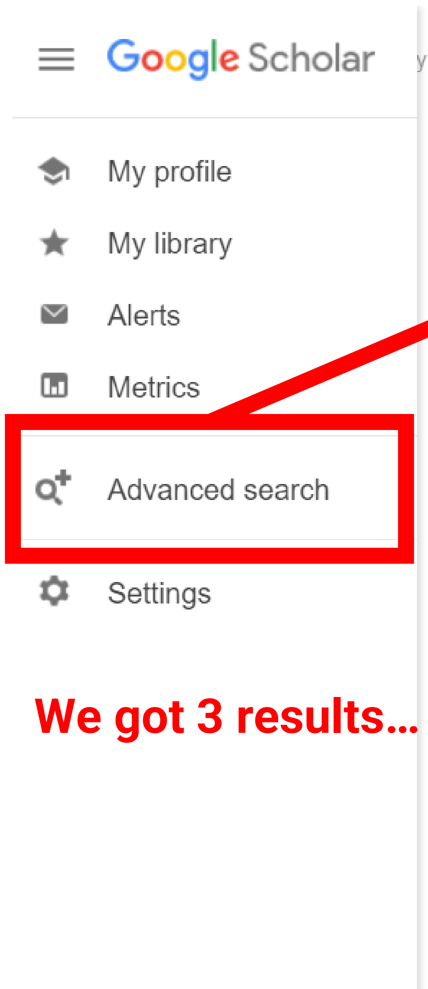
Find your Keywords

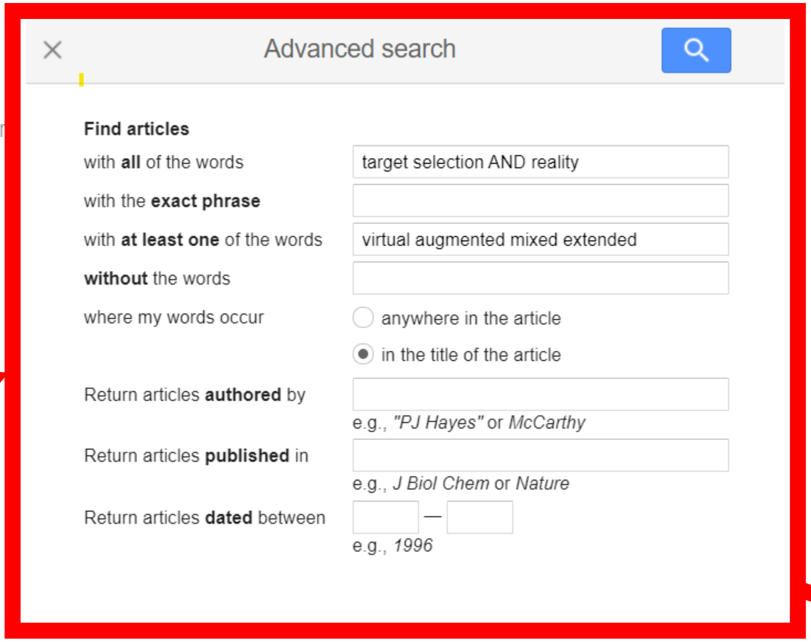
- **Make a list** of **keywords/annotations**
  - Include each of the key concepts or variables you’re interested
  - Find synonyms and related terms
  - Add new keywords later…
- How to find keywords? Identify your **research fields**, **theoretical frameworks**, **device categories**, and **measures (or methods)**
  - **Research field(s):** “human-computer interaction“ (rarely required),…
  - **Theoretical frameworks:** “social acceptability“, „accessibility“, „ergonomics“, …
  - **Device categories:** “virtual reality“, „augmented reality“, „wearables“, „mobile devices“, …
  - **Measures/Tasks:** “target selection“, „Fitts‘ law“, “EMG“,“electromyography“, …
  - **Be more specific, if required:** “heart rate“, „privacy“, „face detection“, …

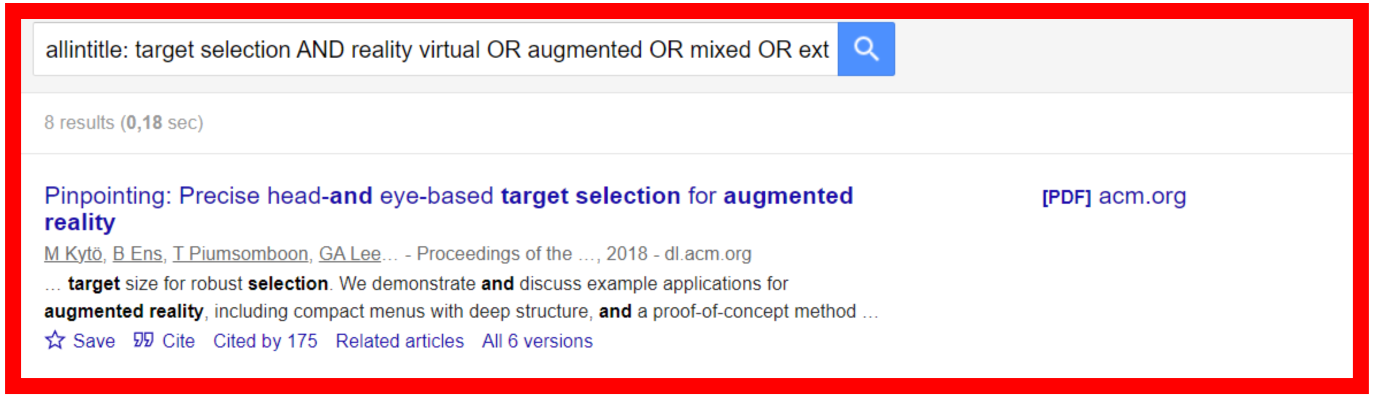
Relevant Sources

- Use your keywords to start searching for literature
- Some useful databases to **search for journals and conferences articles**:
  - Google Scholar https://scholar.google.de/
  - ACM https://dl.acm.org/
  - IEEE https://ieeexplore.ieee.org/
  - The university's library https://idp.hebis.de/
  - JSTOR https://www.jstor.org/
  - EBSCO https://www.ebsco.com/de-de
  - Project Muse (humanities and social sciences) https://muse.jhu.edu
  - PubMed (life sciences and biomedicine) https://pubmed.ncbi.nlm.nih.gov/
- **Record all your sources!**

Know your Query



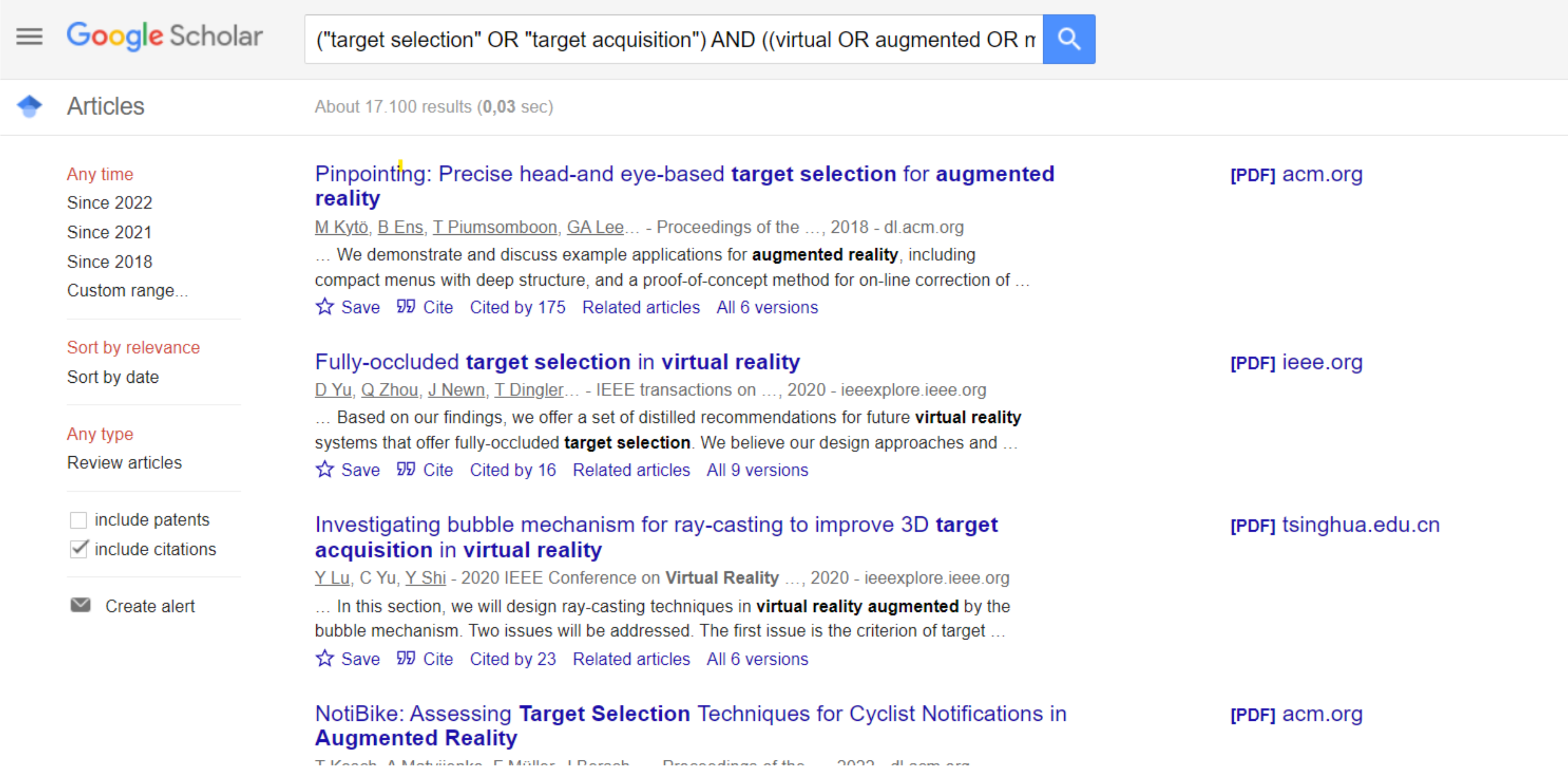




We got 3 results… let‘s improve the query

Improve your Query

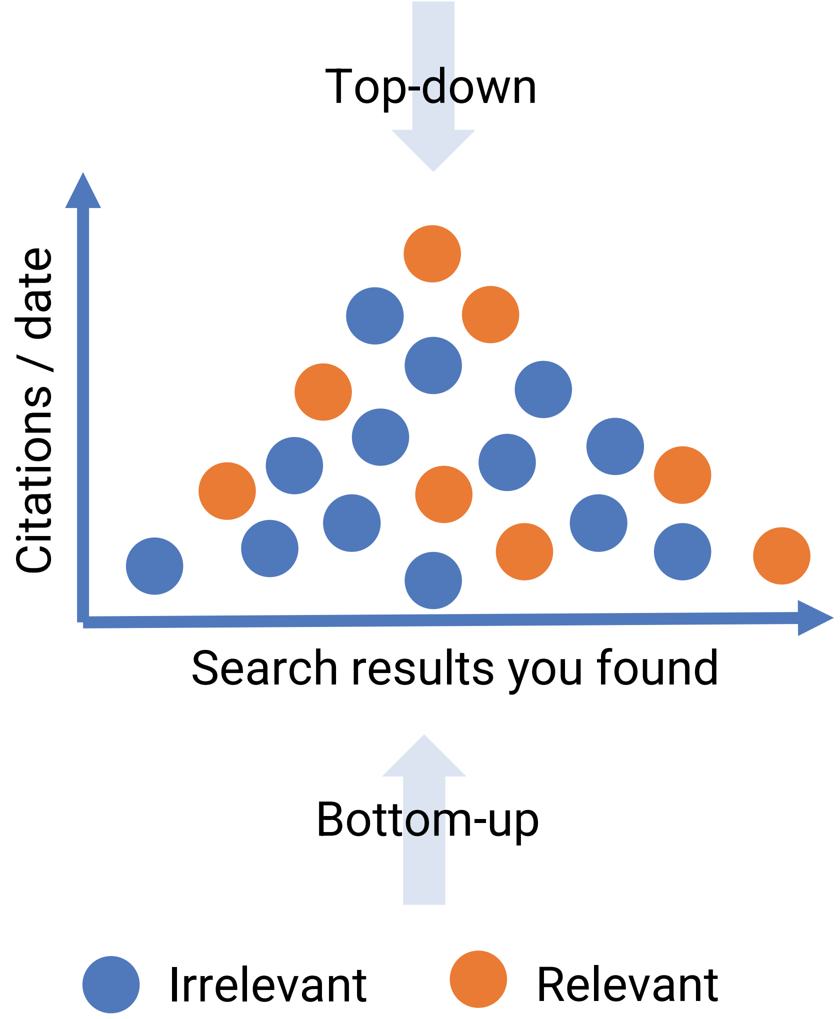
("target selection" OR "target acquisition") AND ((virtual OR augmented OR mixed OR extended) AND (reality))



Awesome! ☺

Filtering

- Use “quotes” or (parentheses) to connect terms
- Use boolean operators AND, OR, NOT
- Read the title and abstract
- Now you have three options
  1. **Check all results** and search for relevant publications (“bottom up”)
     - Thorough but slow: important work is not highlighted
  2. **Check the most cited publications** (“top down by citations”)
     - Fast but shallow: the most important publications are not necessarily those you are searching for (or your missed them)
  3. **Check the newest publications** (“top down by date”)
     - Check their bibliography and their quality



Google Scholar

allintitle: (accessibility OR accessible) AND (virtual OR augmented OR mixed

Another search term…

Articles

10 results (**0,13** sec)

Be careful google dropped some

- Any time
- Since 2022
- Since 2021
- Since 2018
- Custom range...

- Sort by relevance
- Sort by date

- Any type
- Review articles

- include patents
- include citations

Create alert

Articles added in the last year, sorted by date

Abstracts | Everything

Virtual reality in the EAP classroom: Creating immersive, interactive, **and accessible** experiences for international students

K Coleman, B Derry - Language Teachin[g], 2022 -

Awesome! But no PDF …

?

3 days ago - … restrictions, social distancing, **and** remote learning. Fortunately, **virtual reality** (VR) has … language **and** the ability to experience it in an immersive **and** interactive way. Now …

Save | Cite

The role of desktop **virtual reality** as an **accessible and** equitable strategy to improve career opportunities for women in technology

NO Onele - Journal of Computer Assisted Learning - Wiley Online Library

18 days ago - … **Virtual reality** for teaching **and** learning can be a part of postgraduate studies in … where **virtual reality** has been found effective. This study may guide other studies **and** add …

Save | Cite

[PDF] Open **and Accessible** Education with **Virtual Reality**

M Rana - researchgate.net

21 days ago - … **and** implementation experiments into a practical guide to make such a **virtual reality** environment more **accessible**… Quest 2 **virtual reality** environment more **accessible** for …

Save | Cite

[PDF] researchgate.net

A master's thesis (has no publisher)!

Click

[PDF] **Accessible** Subtitles in 6DoF 3D **Virtual Reality**: How Preference of Subtitle Presentation Modes relates to Presence **and** VR Sickness.

L Bouwels - 2022 - researchgate.net

43 days ago - … presented in VR360 **and** 3D **Virtual Reality** research. … further **accessibility**

Let‘s check it…

UNIVERSITY OF TARTU
Institute of Computer Science
Software Engineering Curriculum

Masud Rana

Open and Accessible Education with Virtual Reality

Master's Thesis (30 ECTS)

Supervisor(s): Ulrich Norbisrath, Ph.D.

Tartu 2022

7 References

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51

Probably related to our topic!
(but not thorough and
no credible sources)

Credibility and Importance

- **Make sure the sources** you use **are credible**, and make sure you read any landmark studies and major theories in your field of research
- Find out how citations an article has – a **high cited paper** means the article has been influential in the field, and **should certainly be included**
- Original reserach always has been peer-reviewed and published
  - **Search for publisher**
    - **ACM**
    - **IEEE**
    - **Springer**
    - **Elsevier (we don‘t like that)**
    - … there are more, but we don‘t like them, too

h-index

- https://scholar.google.es/citations?view_op=top_venues&hl=en&vq=eng_humancomputerinteraction
- The h-index (Hirsch index) is defined as the maximum value of h where the given author/journal has published h papers that have each been cited at least h times
- h5-index is the h-index for articles published in the last 5 complete years
- h5-median is the median number of citations for the articles that make up its h5-index

Google Scholar

Top publications

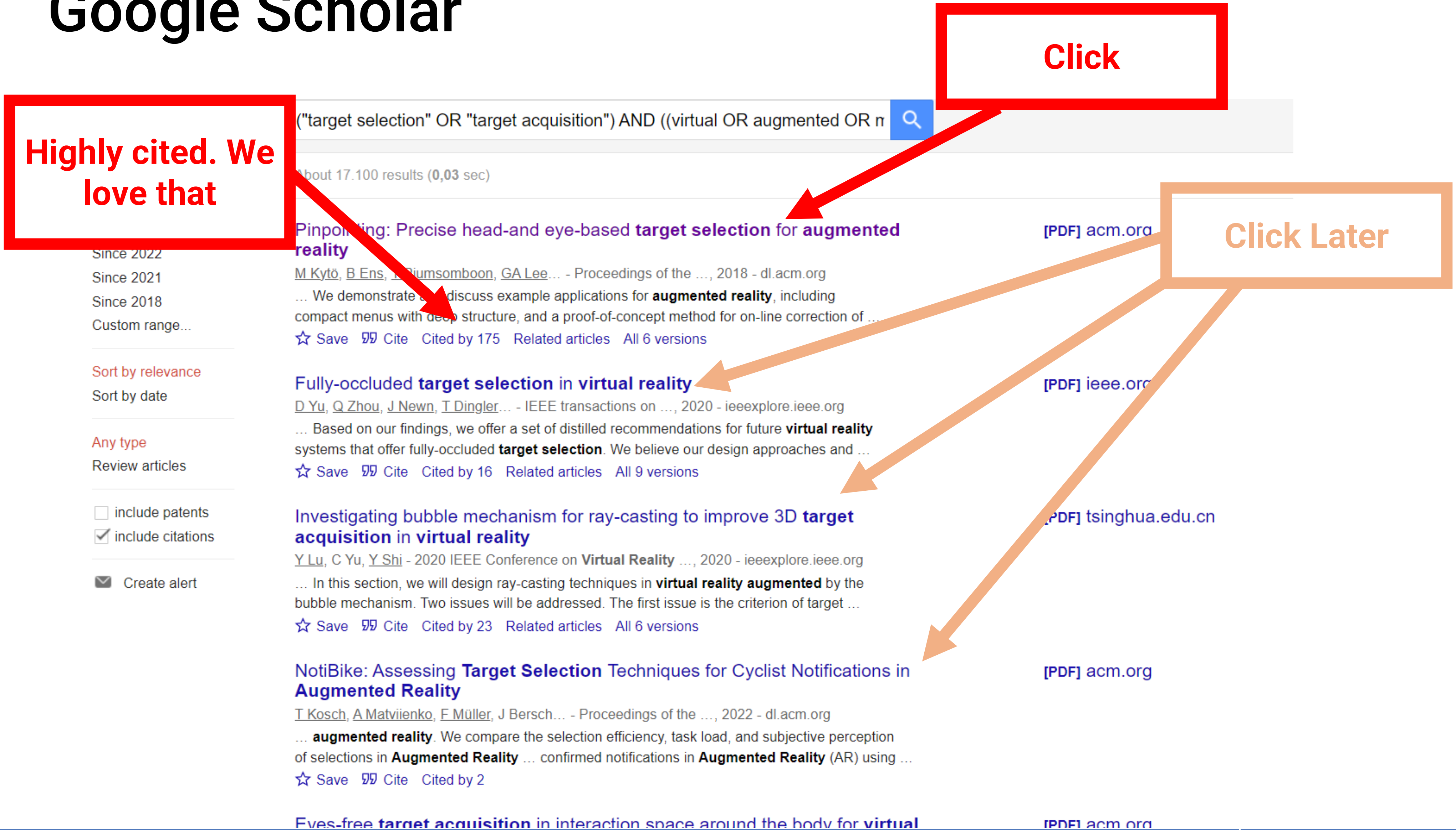
Categories > Engineering & Computer Science > **Human Computer Interaction**

	Publication	h5-index	h5-median
1.	Computer Human Interaction (CHI)	95	122
2.	ACM Conference on Computer-Supported Cooperative Work & Social Computing	61	86
3.	ACM Conference on Pervasive and Ubiquitous Computing (UbiComp)	54	91
4.	ACM/IEEE International Conference on Human Robot Interaction	46	66
5.	IEEE Transactions on Affective Computing	45	85
6.	ACM Symposium on User Interface Software and Technology	44	68
7.	International Journal of Human-Computer Studies	43	70
8.	IEEE Transactions on Human-Machine Systems	40	64
9.	Behaviour & Information Technology	36	48
10.	ACM Transactions on Computer-Human Interaction (TOCHI)	34	53
11.	International Conference on Multimodal Interfaces (ICMI)	33	63
12.	IEEE Transactions on Haptics	31	44
13.	International Journal of Human-Computer Interaction	31	44
		31	41
		31	41
		31	39
		30	45
		30	43
		28	38
20.	International Conference on Tangible, Embedded, and Embodied Interaction	27	41

Dates and citation counts are estimated and are determined automatically by a computer program.

Published here (ACM, IEEE, Springer, Elsevier, or similar venues) indicates scientific standards and reliablity of the work

Google Scholar



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Very important place in HCI

Home > Conferences > CHI > Proceedings > CHI '18 > Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality

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RESEARCH-ARTICLE •

Best paper award

The title

Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality

The authors

Authors: Mikko Kytö, Barrett Ens, Thammathip Piumsomboon, Gun A. Lee, Mark Billinghurst Authors Info & Claims

The conference or journal

CHI '18: Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems • April 2018 • Paper No.: 81 • Pages 1–14 • https://doi.org/10.1145/3173574.3173655

Online: 19 April 2018 Publication History

Highly cited

107 3,617

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Pinpointing: Precise Head- and Eye-Based...

Pages 1–14

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ABSTRACT

Supplemental

ABSTRACT

Head and eye movement can be leveraged to improve the user's interaction repertoire for wearable displays. Head movements are deliberate and accur[...] state-of-the-art pointing technique. Eye gaze can potentially be faster [...]fers from low accuracy due to calibration errors and drift of wearable eye-tracking sensors. This work investigates precise, multimodal selection techniques using head motion and eye gaze. A comparison of speed and pointing accuracy reveals the relative merits of each method, including

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Feedback

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Pages 1–14

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ABSTRACT

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the achievable target size for robust selection. We demonstrate and discuss example applications for augmented reality, including compact menus with deep structure, and a proof-of-concept method for on-line correction of calibration drift.

Video for people who don't want to read the abstract

Supplemental Material

Pointing modes

suppl.mov

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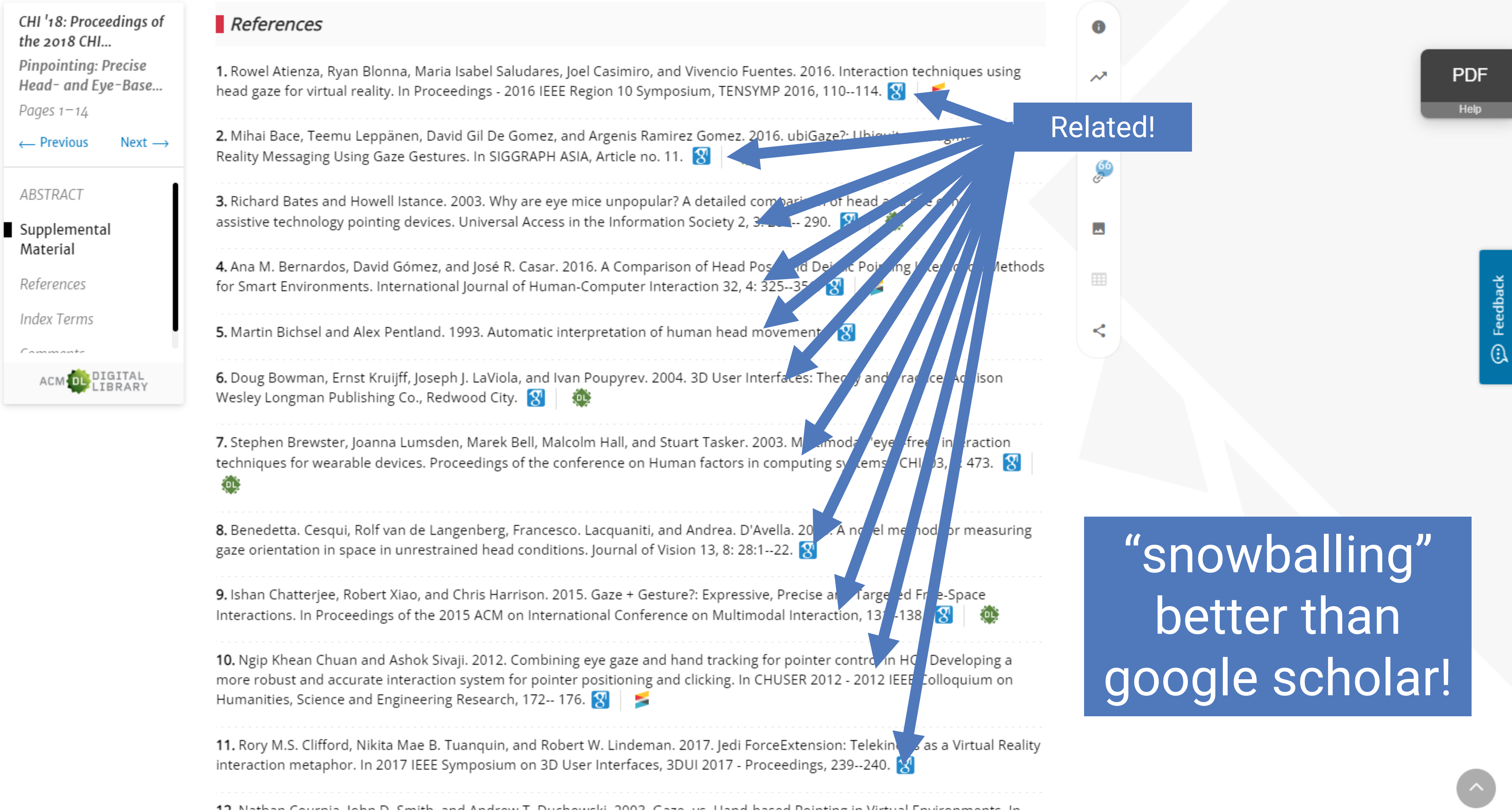
Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality

Human-centered computing

Human computer interaction (HCI)

Interaction devices

Interaction paradigms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Related!

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Fast Screening

look at everything that still seems related

Look if you can add more keywords to your list

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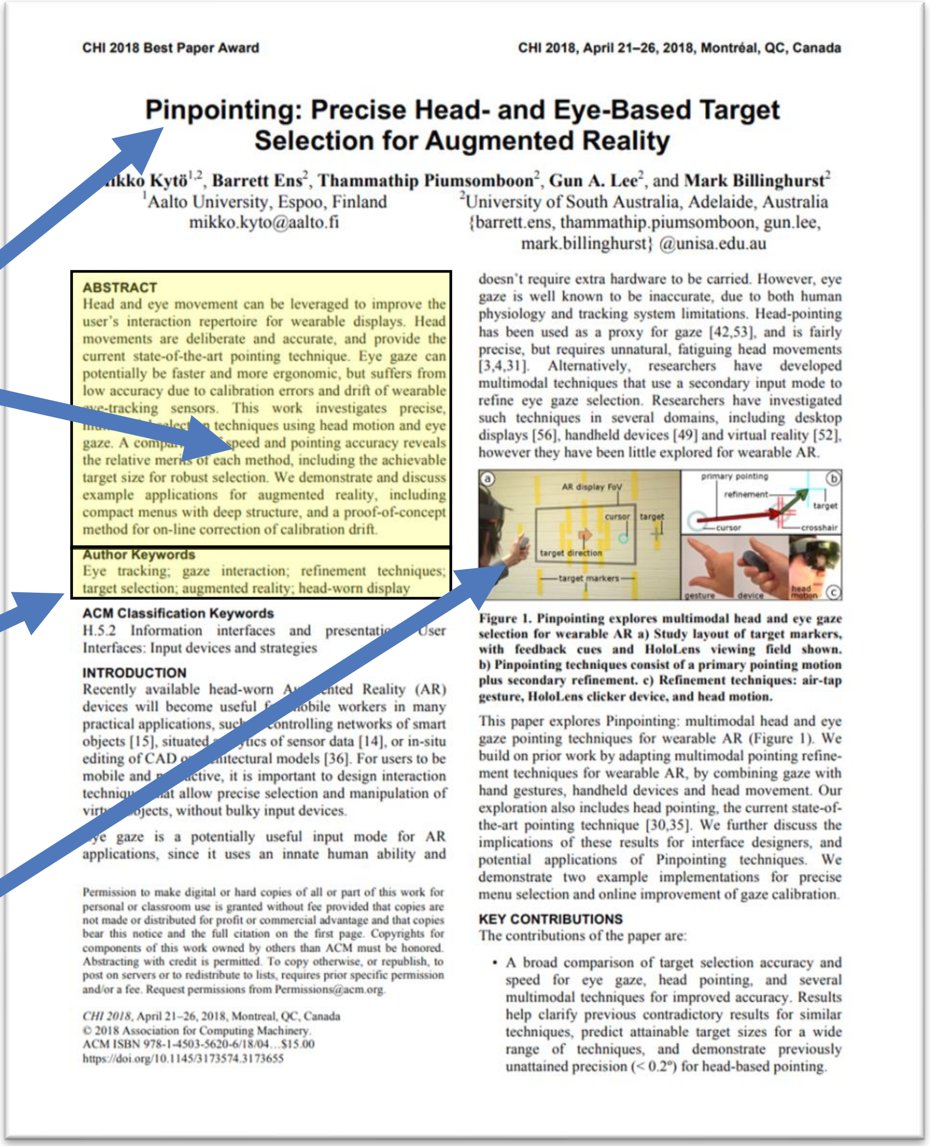

CHI 2018 Best Paper Award CHI 2018, April 21–26, 2018, Montréal, QC, Canada

Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality

ikko Kytö[1,2], Barrett Ens[2], Thammathip Piumsomboon[2], Gun A. Lee[2], and Mark Billinghurst[2]
[1]Aalto University, Espoo, Finland
mikko.kyto@aalto.fi
[2]University of South Australia, Adelaide, Australia
{barrett.ens, thammathip.piumsomboon, gun.lee, mark.billinghurst} @unisa.edu.au

ABSTRACT
Head and eye movement can be leveraged to improve the user's interaction repertoire for wearable displays. Head movements are deliberate and accurate, and provide the current state-of-the-art pointing technique. Eye gaze can potentially be faster and more ergonomic, but suffers from low accuracy due to calibration errors and drift of wearable eye-tracking sensors. This work investigates precise, multimodal selection techniques using head motion and eye gaze. A comparison of speed and pointing accuracy reveals the relative merits of each method, including the achievable target size for robust selection. We demonstrate and discuss example applications for augmented reality, including compact menus with deep structure, and a proof-of-concept method for on-line correction of calibration drift.

Author Keywords
Eye tracking; gaze interaction; refinement techniques; target selection; augmented reality; head-worn display

ACM Classification Keywords
H.5.2 Information interfaces and presentation: User Interfaces: Input devices and strategies

INTRODUCTION
Recently available head-worn Augmented Reality (AR) devices will become useful for mobile workers in many practical applications, such as controlling networks of smart objects [15], situated analytics of sensor data [14], or in-situ editing of CAD or architectural models [36]. For users to be mobile and productive, it is important to design interaction techniques that allow precise selection and manipulation of virtual objects, without bulky input devices.

Eye gaze is a potentially useful input mode for AR applications, since it uses an innate human ability and doesn't require extra hardware to be carried. However, eye gaze is well known to be inaccurate, due to both human physiology and tracking system limitations. Head-pointing has been used as a proxy for gaze [42,53], and is fairly precise, but requires unnatural, fatiguing head movements [3,4,31]. Alternatively, researchers have developed multimodal techniques that use a secondary input mode to refine eye gaze selection. Researchers have investigated such techniques in several domains, including desktop displays [56], handheld devices [49] and virtual reality [52], however they have been little explored for wearable AR.

Figure 1. Pinpointing explores multimodal head and eye gaze selection for wearable AR a) Study layout of target markers, with feedback cues and HoloLens viewing field shown. b) Pinpointing techniques consist of a primary pointing motion plus secondary refinement. c) Refinement techniques: air-tap gesture, HoloLens clicker device, and head motion.

This paper explores Pinpointing: multimodal head and eye gaze pointing techniques for wearable AR (Figure 1). We build on prior work by adapting multimodal pointing refinement techniques for wearable AR, by combining gaze with hand gestures, handheld devices and head movement. Our exploration also includes head pointing, the current state-of-the-art pointing technique [30,35]. We further discuss the implications of these results for interface designers, and potential applications of Pinpointing techniques. We demonstrate two example implementations for precise menu selection and online improvement of gaze calibration.

KEY CONTRIBUTIONS
The contributions of the paper are:

- A broad comparison of target selection accuracy and speed for eye gaze, head pointing, and several multimodal techniques for improved accuracy. Results help clarify previous contradictory results for similar techniques, predict attainable target sizes for a wide range of techniques, and demonstrate previously unattained precision (< 0.2°) for head-based pointing.

CHI 2018, April 21–26, 2018, Montreal, QC, Canada
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https://doi.org/10.1145/3173574.3173655

Mikko Kytö, Barrett Ens, Thammathip Piumsomboon, Gun A. Lee, and Mark Billinghurst. 2018. Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 81, 1–14. https://doi.org/10.1145/3173574.3173655

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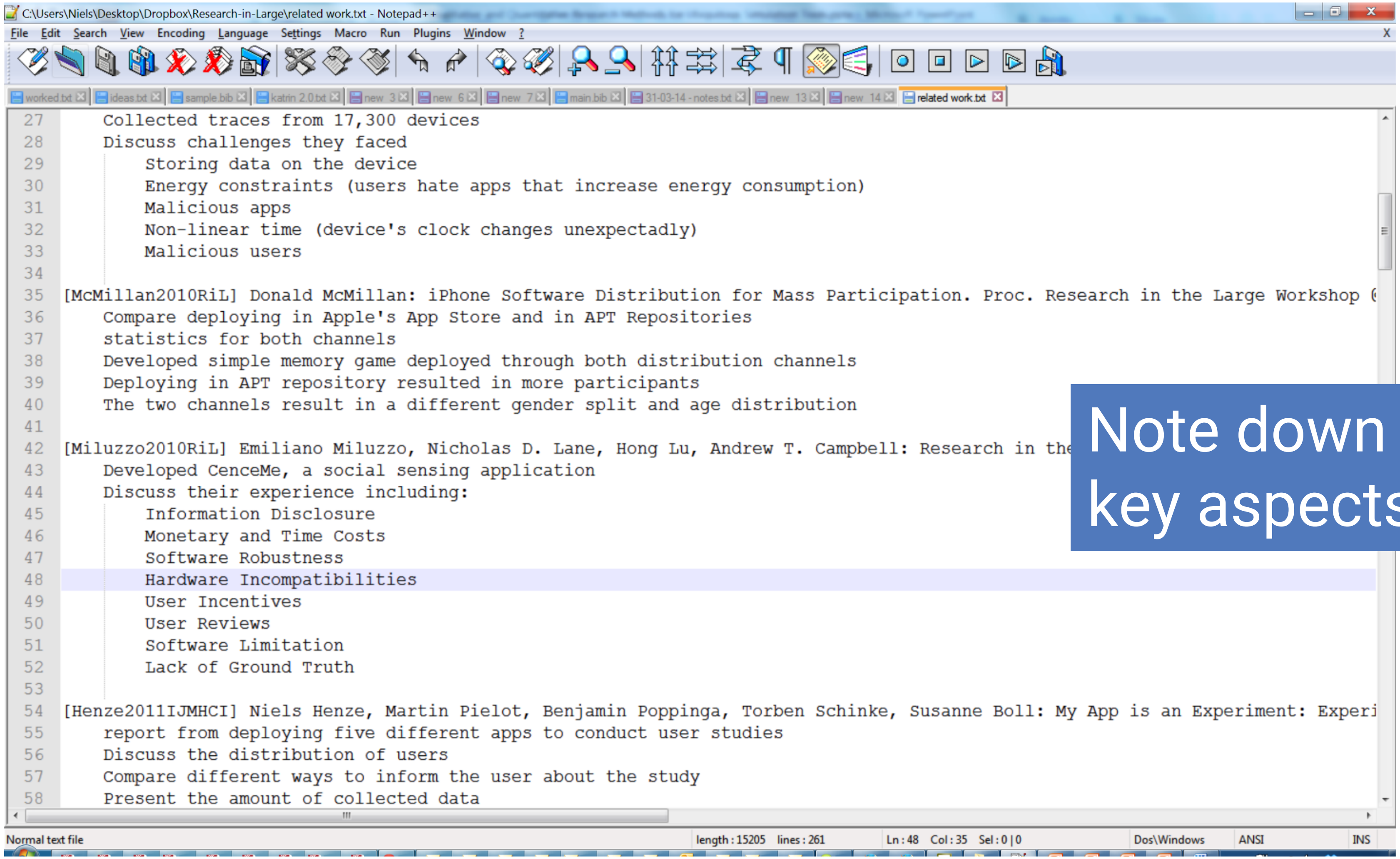


```
    Collected traces from 17,300 devices
    Discuss challenges they faced
        Storing data on the device
        Energy constraints (users hate apps that increase energy consumption)
        Malicious apps
        Non-linear time (device's clock changes unexpectadly)
        Malicious users

[McMillan2010RiL] Donald McMillan: iPhone Software Distribution for Mass Participation. Proc. Research in the Large Workshop (
    Compare deploying in Apple's App Store and in APT Repositories
    statistics for both channels
    Developed simple memory game deployed through both distribution channels
    Deploying in APT repository resulted in more participants
    The two channels result in a different gender split and age distribution

[Miluzzo2010RiL] Emiliano Miluzzo, Nicholas D. Lane, Hong Lu, Andrew T. Campbell: Research in the
    Developed CenceMe, a social sensing application
    Discuss their experience including:
        Information Disclosure
        Monetary and Time Costs
        Software Robustness
        Hardware Incompatibilities
        User Incentives
        User Reviews
        Software Limitation
        Lack of Ground Truth

[Henze2011IJMHCI] Niels Henze, Martin Pielot, Benjamin Poppinga, Torben Schinke, Susanne Boll: My App is an Experiment: Experi
    report from deploying five different apps to conduct user studies
    Discuss the distribution of users
    Compare different ways to inform the user about the study
    Present the amount of collected data
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Note down references and key aspects

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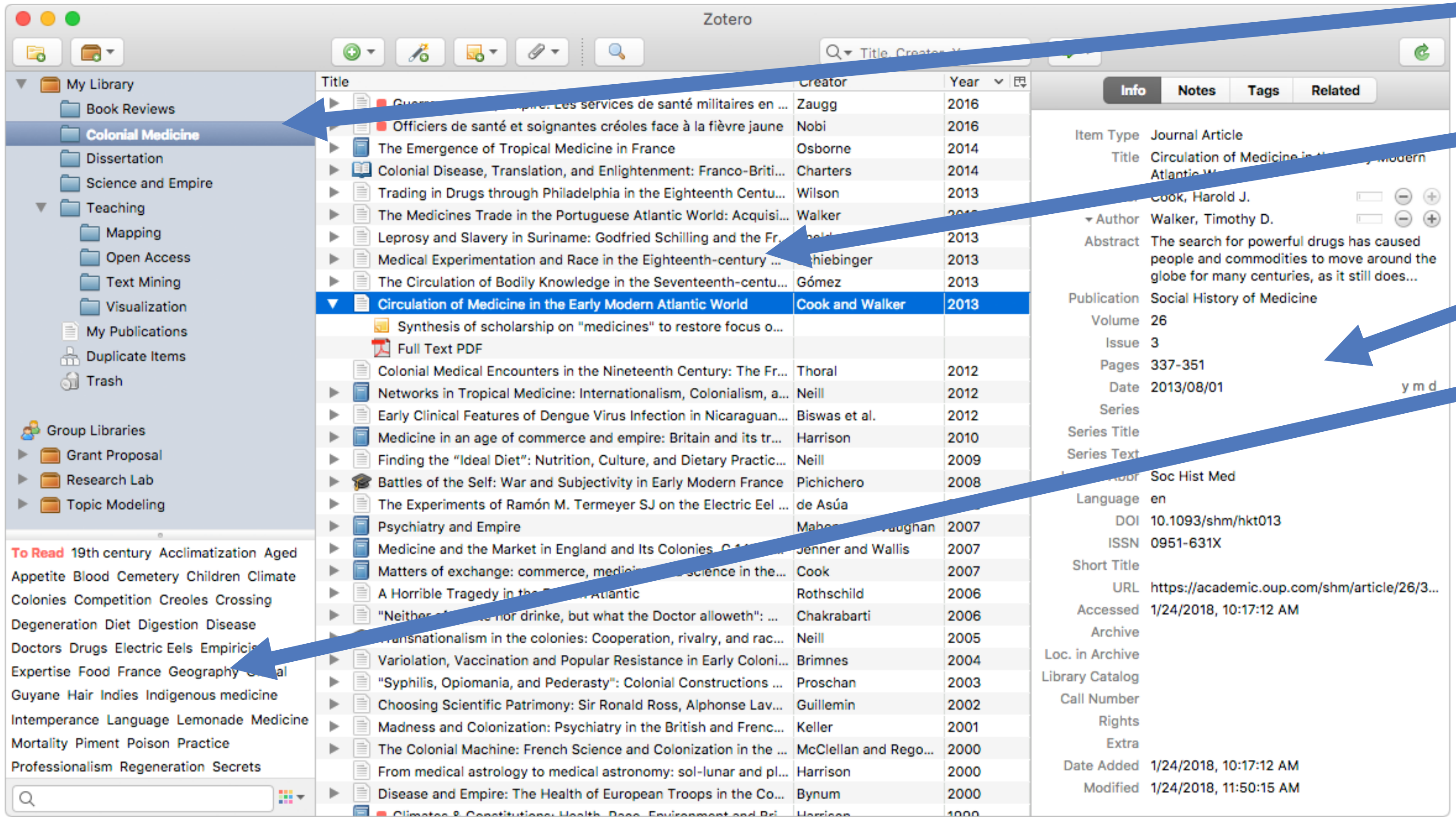

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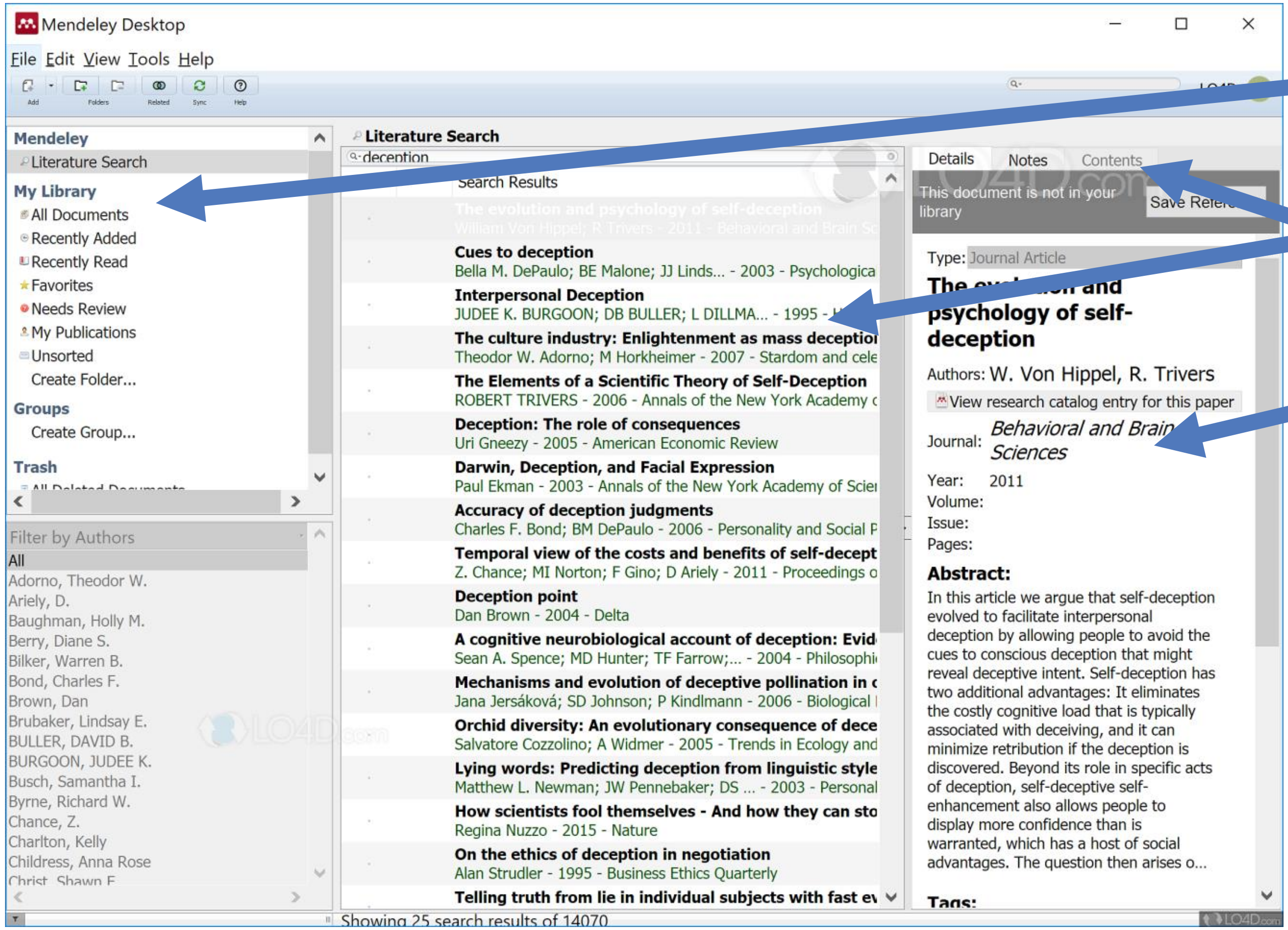
Bibliography Software: Mendeley



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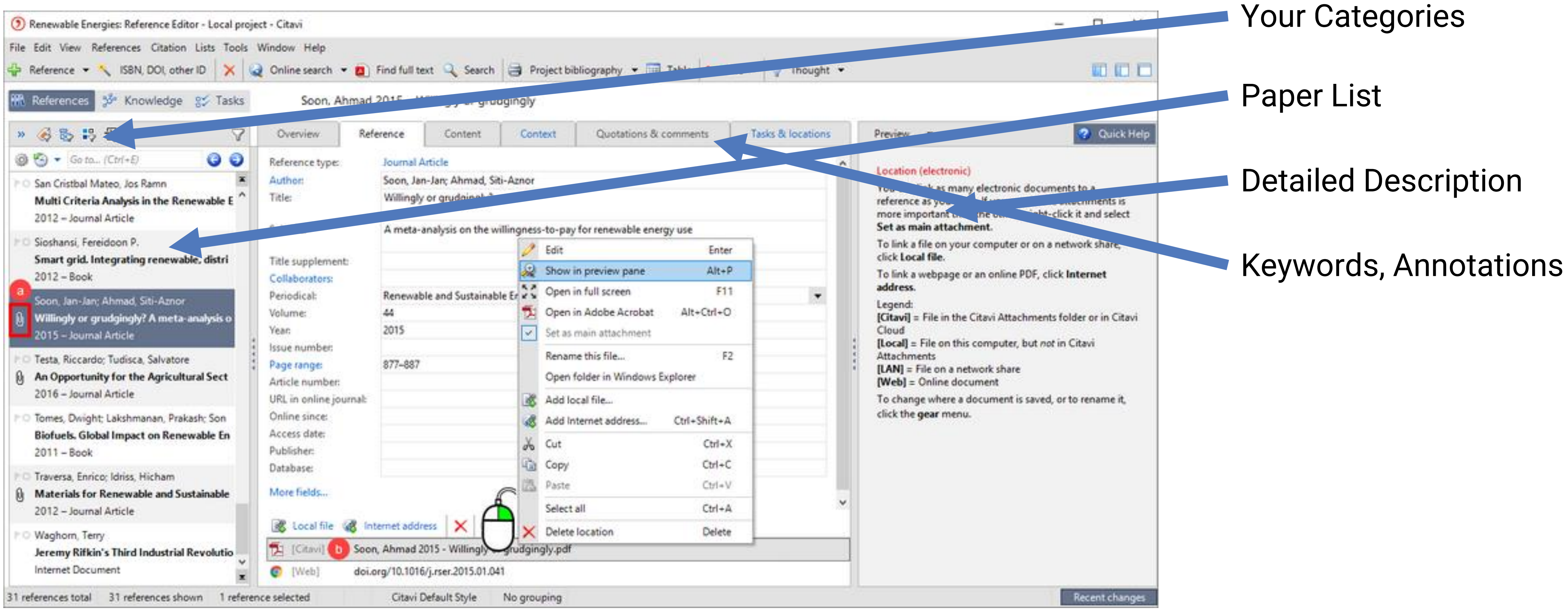

Understanding References

totype's user experience [6, 35] and investigate the context of use [34]. Further, advances in technology enable researchers to use new technologies and study methods for the design and evaluation of early designs and concepts, e.g., by using augmented reality (AR) [33, 39] and virtual reality (VR) [25].
When evaluating prototypes and systems, it is important

Authors

Year of publishing

Title

[33] Shane R. Porter, Michael R. Marner, Ross T. Smith, Joanne E. Zucco, and Bruce H. Thomas. 2010. Validating Spatial Augmented Reality for interactive rapid prototyping. In *IEEE International Symposium on Mixed and Augmented Reality*. 265–266. https://doi.org/10.1109/ISMAR.2010.5643599

Proceedings

Pages

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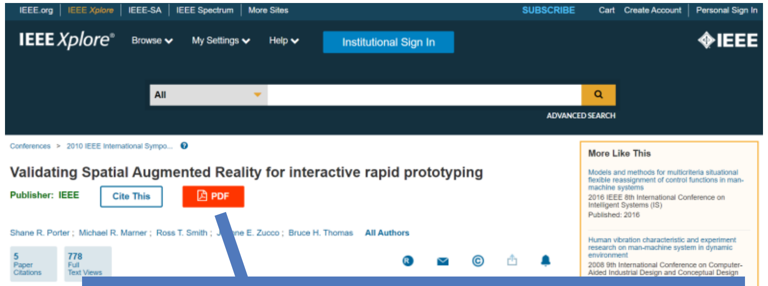

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Validating Spatial Augmented Reality for Interactive Rapid Prototyping

Shane R. Porter, Michael R. Marner, Ross T. Smith, Joanne E. Zucco, Bruce H. Thomas

University of South Australia
Wearable Computer Laboratory

Abstract

1 Introduction

2 Background

3 Evaluation

Identify Themes, Debates, and Gaps

- Understand the connections and relationships between the research sources: **Who did what, why, and when?**
- Take notes:
  - **Trends and patterns** (theory, method, results): do certain approaches become more or less popular over time?
  - **Themes**: what questions or concepts recur across the literature?
  - **Debates, conflicts and contradictions**: where do sources disagree?
  - **Pivotal publications**: are there any influential theories or studies that changed the direction of the field?
  - **Research Gaps**: what is missing from the literature? Are there weaknesses that need to be addressed?

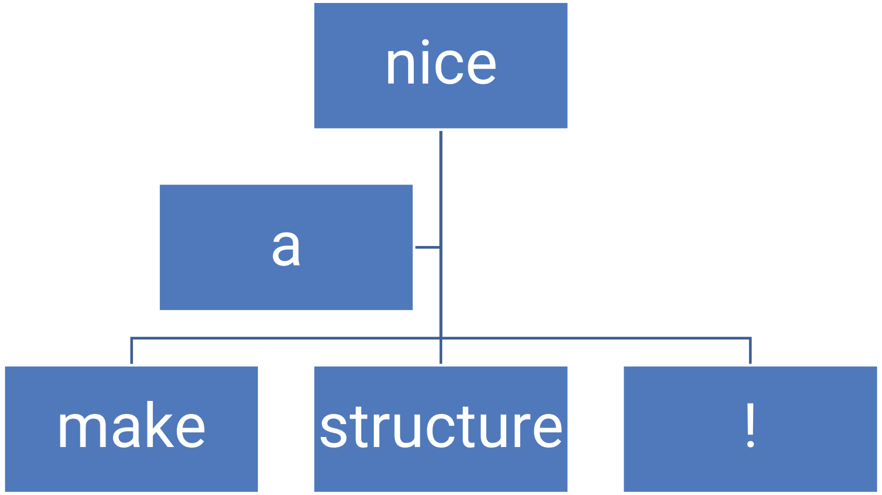
About others' Future Work

- Examples:
  - Many researches in computer sciences **recommend to further investigate stuff** like the effects of gender, culture, or age **but never do this → why?**
  - Search for concise hints: *"There is an increasing interest in the visual aspects of social media on young women. But there is still a lack of robust research on highly visual platforms like Instagram and Snapchat"*
    - Example: https://www.scribbr.com/dissertation/literature-review/
  - HCI Researchers often found that their research highly depends on the task. Which categories of tasks are being used in the domain of HCI, how robust are they, and which provide high external validity?

Structure your Related Work

- Depending on the length of your literature review, you can combine several of these strategies
  - **Chronological** (not recommended in computer sciences)
  - **Thematic and Central Aspects** (e.g., machine learning and adaptive user interfaces)
  - **Methodological** (e.g., results in qualitative vs quantitative research)
  - **Theoretical Framework** (e.g., theories, models, and definitions of key concepts)
    - Theories, models, and definitions of key concepts can form the structure of your review

Finding Structures



Target selection techniques

Target selection in virtual reality

Target selection/ input with EMG

Example: **You develop and investigate a target selection technique in virtual reality using electromyography (EMG)**

Write your Related Work

- Like any other academic text, **your literature review should have**:
  - **Very short introduction**: establishes and motivates the focus and purpose of the literature review)
    - Theses: provide a context, highlight a gap
    - Literature Reviews: new insight you draw from the literature
  - **Main Body**: divides the body into subsections, synthesize from their findings
    - e.g., themes, frameworks, fields of research, time period, or methodological approaches
  - **Summary and Conclusion**: summarizes the key findings you have taken from the literature and emphasize their significance

Writing Tips

- **Summarize and synthesize**: give an overview of the main points of each source and combine them into a coherent whole
- **Analyze and interpret**: don’t just paraphrase other researchers—add your own interpretations where possible, discussing the significance of findings in relation to the literature as a whole
- **Critically evaluate**: mention the strengths and weaknesses of your sources
- **Write in well-structured paragraphs**: use transition words and topic sentences to draw connections, comparisons and contrasts

Example: A Related Work

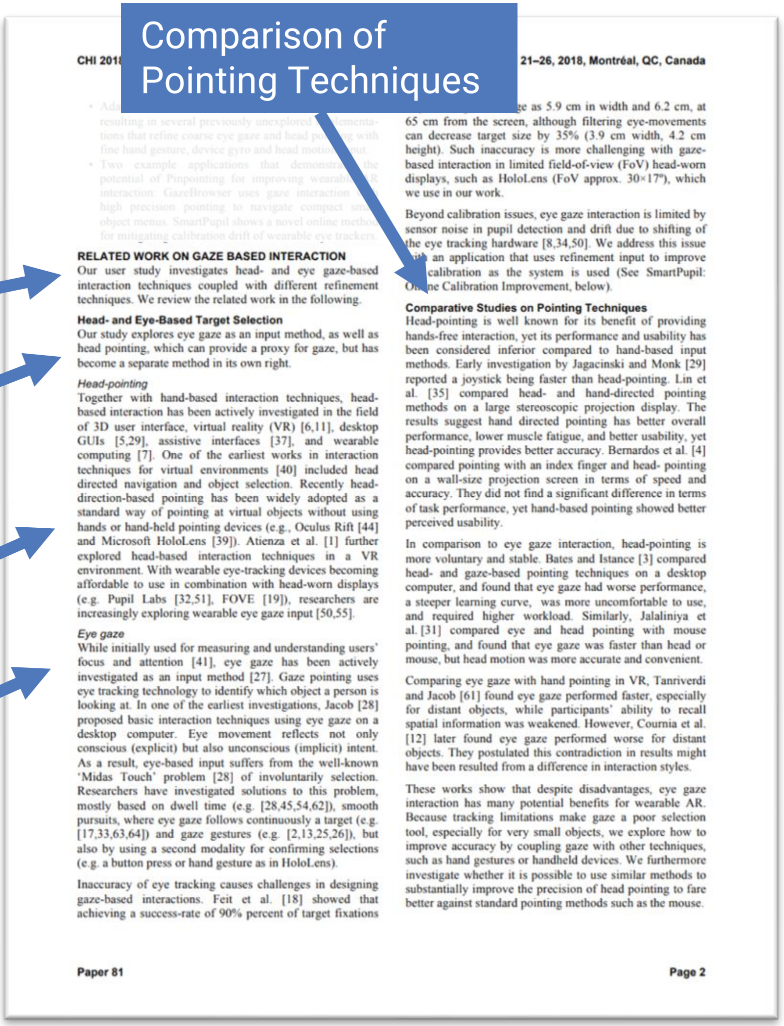
What we are reading and why?

Head- and Eye-Based Target Selection

Pointing with the head

Pointing with eye gaze

Comparison of Pointing Techniques



CHI 2018 … 21–26, 2018, Montréal, QC, Canada

RELATED WORK ON GAZE BASED INTERACTION

Our user study investigates head- and eye gaze-based interaction techniques coupled with different refinement techniques. We review the related work in the following.

Head- and Eye-Based Target Selection

Our study explores eye gaze as an input method, as well as head pointing, which can provide a proxy for gaze, but has become a separate method in its own right.

Head-pointing

Together with hand-based interaction techniques, head-based interaction has been actively investigated in the field of 3D user interface, virtual reality (VR) [6,11], desktop GUIs [5,29], assistive interfaces [37], and wearable computing [7]. One of the earliest works in interaction techniques for virtual environments [40] included head directed navigation and object selection. Recently head-direction-based pointing has been widely adopted as a standard way of pointing at virtual objects without using hands or hand-held pointing devices (e.g., Oculus Rift [44] and Microsoft HoloLens [39]). Atienza et al. [1] further explored head-based interaction techniques in a VR environment. With wearable eye-tracking devices becoming affordable to use in combination with head-worn displays (e.g. Pupil Labs [32,51], FOVE [19]), researchers are increasingly exploring wearable eye gaze input [50,55].

Eye gaze

While initially used for measuring and understanding users' focus and attention [41], eye gaze has been actively investigated as an input method [27]. Gaze pointing uses eye tracking technology to identify which object a person is looking at. In one of the earliest investigations, Jacob [28] proposed basic interaction techniques using eye gaze on a desktop computer. Eye movement reflects not only conscious (explicit) but also unconscious (implicit) intent. As a result, eye-based input suffers from the well-known 'Midas Touch' problem [28] of involuntarily selection. Researchers have investigated solutions to this problem, mostly based on dwell time (e.g. [28,45,54,62]), smooth pursuits, where eye gaze follows continuously a target (e.g. [17,33,63,64]) and gaze gestures (e.g. [2,13,25,26]), but also by using a second modality for confirming selections (e.g. a button press or hand gesture as in HoloLens).

Inaccuracy of eye tracking causes challenges in designing gaze-based interactions. Feit et al. [18] showed that achieving a success-rate of 90% percent of target fixations …ge as 5.9 cm in width and 6.2 cm, at 65 cm from the screen, although filtering eye-movements can decrease target size by 35% (3.9 cm width, 4.2 cm height). Such inaccuracy is more challenging with gaze-based interaction in limited field-of-view (FoV) head-worn displays, such as HoloLens (FoV approx. 30×17°), which we use in our work.

Beyond calibration issues, eye gaze interaction is limited by sensor noise in pupil detection and drift due to shifting of the eye tracking hardware [8,34,50]. We address this issue … an application that uses refinement input to improve … calibration as the system is used (See SmartPupil: On…ne Calibration Improvement, below).

Comparative Studies on Pointing Techniques

Head-pointing is well known for its benefit of providing hands-free interaction, yet its performance and usability has been considered inferior compared to hand-based input methods. Early investigation by Jagacinski and Monk [29] reported a joystick being faster than head-pointing. Lin et al. [35] compared head- and hand-directed pointing methods on a large stereoscopic projection display. The results suggest hand directed pointing has better overall performance, lower muscle fatigue, and better usability, yet head-pointing provides better accuracy. Bernardos et al. [4] compared pointing with an index finger and head- pointing on a wall-size projection screen in terms of speed and accuracy. They did not find a significant difference in terms of task performance, yet hand-based pointing showed better perceived usability.

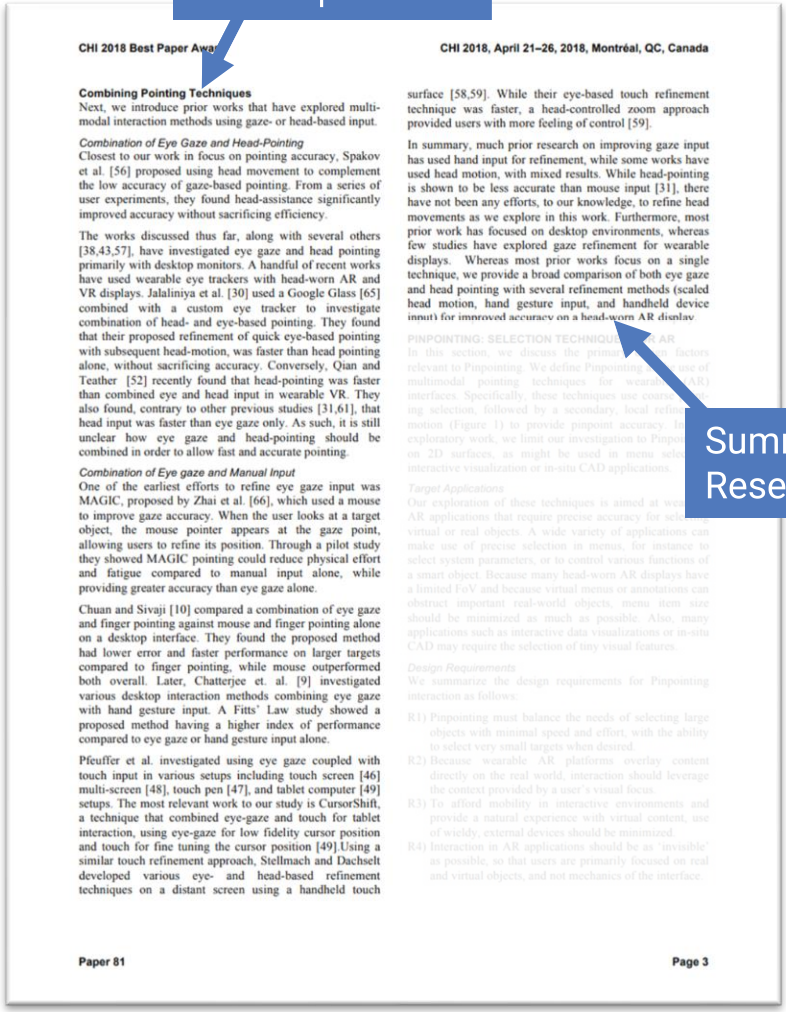
In comparison to eye gaze interaction, head-pointing is more voluntary and stable. Bates and Istance [3] compared head- and gaze-based pointing techniques on a desktop computer, and found that eye gaze had worse performance, a steeper learning curve, was more uncomfortable to use, and required higher workload. Similarly, Jalaliniya et al. [31] compared eye and head pointing with mouse pointing, and found that eye gaze was faster than head or mouse, but head motion was more accurate and convenient.

Comparing eye gaze with hand pointing in VR, Tanriverdi and Jacob [61] found eye gaze performed faster, especially for distant objects, while participants' ability to recall spatial information was weakened. However, Cournia et al. [12] later found eye gaze performed worse for distant objects. They postulated this contradiction in results might have been resulted from a difference in interaction styles.

These works show that despite disadvantages, eye gaze interaction has many potential benefits for wearable AR. Because tracking limitations make gaze a poor selection tool, especially for very small objects, we explore how to improve accuracy by coupling gaze with other techniques, such as hand gestures or handheld devices. We furthermore investigate whether it is possible to use similar methods to substantially improve the precision of head pointing to fare better against standard pointing methods such as the mouse.

Paper 81 Page 2

Combining Pointing Techniques



CHI 2018 Best Paper Awa… CHI 2018, April 21–26, 2018, Montréal, QC, Canada

Combining Pointing Techniques

Next, we introduce prior works that have explored multi-modal interaction methods using gaze- or head-based input.

Combination of Eye Gaze and Head-Pointing

Closest to our work in focus on pointing accuracy, Spakov et al. [56] proposed using head movement to complement the low accuracy of gaze-based pointing. From a series of user experiments, they found head-assistance significantly improved accuracy without sacrificing efficiency.

The works discussed thus far, along with several others [38,43,57], have investigated eye gaze and head pointing primarily with desktop monitors. A handful of recent works have used wearable eye trackers with head-worn AR and VR displays. Jalaliniya et al. [30] used a Google Glass [65] combined with a custom eye tracker to investigate combination of head- and eye-based pointing. They found that their proposed refinement of quick eye-based pointing with subsequent head-motion, was faster than head pointing alone, without sacrificing accuracy. Conversely, Qian and Teather [52] recently found that head-pointing was faster than combined eye and head input in wearable VR. They also found, contrary to other previous studies [31,61], that head input was faster than eye gaze only. As such, it is still unclear how eye gaze and head-pointing should be combined in order to allow fast and accurate pointing.

Combination of Eye gaze and Manual Input

One of the earliest efforts to refine eye gaze input was MAGIC, proposed by Zhai et al. [66], which used a mouse to improve gaze accuracy. When the user looks at a target object, the mouse pointer appears at the gaze point, allowing users to refine its position. Through a pilot study they showed MAGIC pointing could reduce physical effort and fatigue compared to manual input alone, while providing greater accuracy than eye gaze alone.

Chuan and Sivaji [10] compared a combination of eye gaze and finger pointing against mouse and finger pointing alone on a desktop interface. They found the proposed method had lower error and faster performance on larger targets compared to finger pointing, while mouse outperformed both overall. Later, Chatterjee et. al. [9] investigated various desktop interaction methods combining eye gaze with hand gesture input. A Fitts' Law study showed a proposed method having a higher index of performance compared to eye gaze or hand gesture input alone.

Pfeuffer et al. investigated using eye gaze coupled with touch input in various setups including touch screen [46] multi-screen [48], touch pen [47], and tablet computer [49] setups. The most relevant work to our study is CursorShift, a technique that combined eye-gaze and touch for tablet interaction, using eye-gaze for low fidelity cursor position and touch for fine tuning the cursor position [49].Using a similar touch refinement approach, Stellmach and Dachselt developed various eye- and head-based refinement techniques on a distant screen using a handheld touch surface [58,59]. While their eye-based touch refinement technique was faster, a head-controlled zoom approach provided users with more feeling of control [59].

In summary, much prior research on improving gaze input has used hand input for refinement, while some works have used head motion, with mixed results. While head-pointing is shown to be less accurate than mouse input [31], there have not been any efforts, to our knowledge, to refine head movements as we explore in this work. Furthermore, most prior work has focused on desktop environments, whereas few studies have explored gaze refinement for wearable displays. Whereas most prior works focus on a single technique, we provide a broad comparison of both eye gaze and head pointing with several refinement methods (scaled head motion, hand gesture input, and handheld device input) for improved accuracy on a head-worn AR display.

Target Applications

Our exploration of these techniques is aimed at wea… AR applications that require precise accuracy for sele… virtual or real objects. A wide variety of applications can make use of precise selection in menus, for instance to select system parameters, or to control various functions of a smart object. Because many head-worn AR displays have a limited FoV and because virtual menus or annotations can obstruct important real-world objects, menu item size should be minimized as much as possible. Also, many applications such as interactive data visualizations or in-situ CAD may require the selection of tiny visual features.

Design Requirements

We summarize the design requirements for Pinpointing interaction as follows:

R1) Pinpointing must balance the needs of selecting large objects with minimal speed and effort, with the ability to select very small targets when desired.

R2) Because wearable AR platforms overlay content directly on the real world, interaction should leverage the context provided by a user's visual focus.

R3) To afford mobility in interactive environments and provide a natural experience with virtual content, use of wieldy, external devices should be minimized.

R4) Interaction in AR applications should be as 'invisible' as possible, so that users are primarily focused on real and virtual objects, and not mechanics of the interface.

Paper 81 Page 3

Summary and Research Gap

Mikko Kytö, Barrett Ens, Thammathip Piumsomboon, Gun A. Lee, and Mark Billinghurst. 2018. Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 81, 1–14. https://doi.org/10.1145/3173574.3173655

Example: A Related Work Section

Head- and Eye-Based Target Selection
Our study explores eye gaze as an input method, as well as head pointing, which can provide a proxy for gaze, but has become a separate method in its own right.

Head-pointing
Together with hand-based interaction techniques, head-based interaction has been actively investigated in the field of 3D user interface, virtual reality (VR) [6,11], desktop GUIs [5,29], assistive interfaces [37], and wearable computing [7]. One of the earliest works in interaction techniques for virtual environments [40] included head directed navigation and object selection. Recently head-direction-based pointing has been widely adopted as a standard way of pointing at virtual objects without using hands or hand-held pointing devices (e.g., Oculus Rift [44] and Microsoft HoloLens [39]). Atienza et al. [1] further explored head-based interaction techniques in a VR environment. With wearable eye-tracking devices becoming affordable to use in combination with head-worn displays (e.g. Pupil Labs [32,51], FOVE [19]), researchers are increasingly exploring wearable eye gaze input [50,55].

Mikko Kytö, Barrett Ens, Thammathip Piumsomboon, Gun A. Lee, and Mark Billinghurst. 2018. Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 81, 1–14. https://doi.org/10.1145/3173574.3173655

Here they are enumerating research activities and put the references behind them

Here, they do mention the authors (*Lastname et al.*)

Here, they refer to an acronym (a system) from another work

Mikko Kytö, Barrett Ens, Thammathip Piumsomboon, Gun A. Lee, and Mark Billinghurst. 2018. Pinpointing: Precise Head- and Eye-Based Target Selection for Augmented Reality. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 81, 1–14. https://doi.org/10.1145/3173574.3173655

Example: A Related Work Summary

In summary, much prior research on improving gaze input has used hand input for refinement, while some works have used head motion, with mixed results. While head-pointing is shown to be less accurate than mouse input [31], there have not been any efforts, to our knowledge, to refine head movements as we explore in this work. Furthermore, most prior work has focused on desktop environments, whereas few studies have explored gaze refinement for wearable displays. Whereas most prior works focus on a single technique, we provide a broad comparison of both eye gaze and head pointing with several refinement methods (scaled head motion, hand gesture input, and handheld device input) for improved accuracy on a head-worn AR display.

Related work is always great!

A claim. Needs reference.

The research gap!

Another research gap!

What they address

„We are great, too!“

ett Ens, msomboon, Gun A. llinghurst. 2018. cise Head- and Eye-Based Target Selection for ity. In Proceedings Conference on in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 81, 1–14. https://doi.org/10.1145/3173574.3173655

Summarizing the Student‘s Approach

- Summary: 4 steps easy to follow:
  - Search for relevant keywords and databases
  - Search, evaluate, and filter your results
  - Find a structure (identify fields, themes, categories,…)
  - Write your literature review
- The Student‘s Approach is mostly called **Narrative Review**
  - No standards. Not scientific, but we like this!
- Is there any scientific method?

The Scientific Approach

- Writing literature reviews has **its own scientific field**:
  - Empirical study of literature (Empirische Literaturwissenschaft)
  - There are at least 14 literature review types [1]
- The main types of literature reviews in HCI are
  - **Scoping Review**
  - **Systematic Review**
  - **Meta Review/Meta Analysis**
- Methodological literature review approaches **depend on the discipline**
  - e.g., medicine != computer sciences

[1] Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. Health Information and Libraries Journal, 26(2), 91-108.

Scoping Reviews

- Serve to **assess and provide and overview** about the literature **scope of a topic**.
- The scoping review **can have multiple goals**:
  - Can provide and set definitions within a scope (“What is an intelligent user interface?”)
  - Can answer general research questions (“What makes devices socially acceptable?”)
  - Provide an (quantitative) overview of the existing evidence, regardless of its quality
  - Often used in the field of computer science and engineering to quickly get a broader picture
    - e.g., devices, systems, interactions, etc.
- The search method **can iteratively be adjusted** to synthesize evidence
- Two approaches
  - The **JBI Method** (rather for engineers and systems) [1]
  - The **PRISMA-Sc** Method (rather for original research) [2]

[1] https://journals.lww.com/ijebh/fulltext/2015/09000/guidance_for_conducting_systematic_scoping_reviews.5.aspx
[2] https://prisma-statement.org/Extensions/ScopingReviews

Systematic Review

- Systematic reviews answer **one specific research question and have a defined outcome**
  - e.g., the effectiveness of an intervention („How can VR support disabled people?")
- Contains a complete protocol and **transparent approach**
  - A **set of analytical methods** to collect secondary data and analyze it
  - Provides **an exhaustive and complete summary**
  - Minimize biases, no iterations, paper selection **performed independently by at least two review authors**
    - Discrepancies should be resolved by consensus or by the decision of **a third review author**
- Three approaches
  - **The Kitchenham Procedure** (rather for software engineers) [1]
  - **The PRISMA Method** (rather for empirical research) [2]
  - **The APISSER Methodology** (rather for medical sciences) [3]

[1] https://journals.lww.com/ijebh/fulltext/2015/09000/guidance_for_conducting_systematic_scoping_reviews.5.aspx
[2] https://prisma-statement.org/Extensions/ScopingReviews
[3] https://ieeexplore.ieee.org/document/9698182

Meta-Analysis

- A meta-analysis is an exhaustive and complete summary of literature and **performing** a **statistical analysis** aggregating the results of scientific studies
  - **Looking for evidence** of original research
  - Meta-analysis **systematically assesses** the results of previous research to derive conclusions about that body of research
  - Often, but not always, important **part of a systematic review procedure**
  - Mainly **conducted in medical research** on **clinical trials** to find evidence of treatment
- One main approach
  - **The PRISMA Method** (rather for empirical research) [1]

[1] https://journals.lww.com/ijebh/fulltext/2015/09000/guidance_for_conducting_systematic_scoping_reviews.5.aspx

PRISMA

- **PRISMA** = **P**referred **R**eporting **I**tems for **S**ystematic **R**eviews and **M**eta-**A**nalyses
- **Standard** and **state-of-the art procedure** for literature reviews in science
- An evidence-based **set of items** aimed at helping scientific authors to report a wide array of systematic reviews and meta-analyses [1]
- The PRISMA methodology can be applied to
  - Systematic Reviews
  - Scoping Reviews (PRISMA-Sc)
  - Meta Reviews / Meta Analysis

[1] https://www.prisma-statement.org

PRISMA: What you should know…

- **Review Time**: 6-8 weeks, depending on: number of databases, complexity, papers
- **Resources**: Appropriate research databases for the research question
- **Team**: Three people required for screening
- **Searching strategy**: exhaustive, comprehensive searching
- **Appraisal**: determine inclusion/exclusion
- **Results synthesis**: Typically, narrative (based on concepts) with tabular accompaniment
- **Analysis**: Characterizes quantity and breadth of literature. Attempts to specify the viability of more focused reviews (what is known; recommendations for practice. what remains unknown; uncertainty around findings, recommendations for future research)

PRISMA Checklist

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	

PRISMA 2020 Checklist

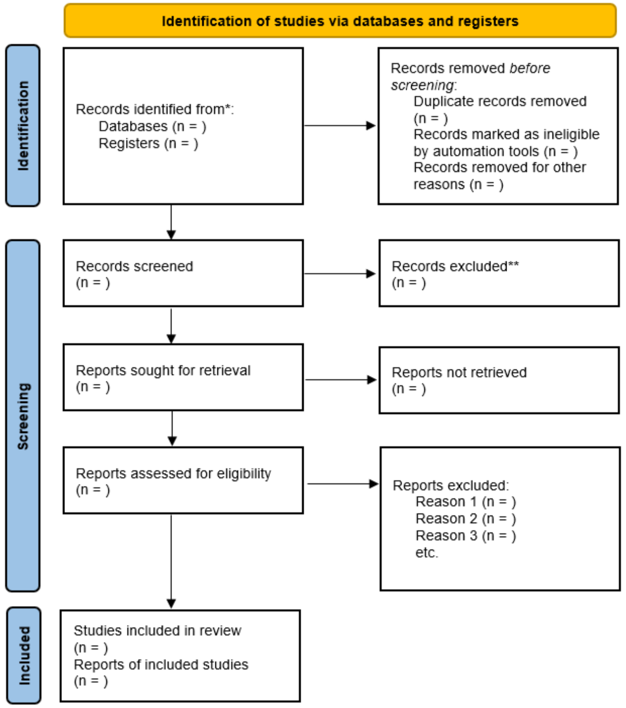
Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

https://prisma-statement.org/documents/PRISMA_2020_checklist.pdf

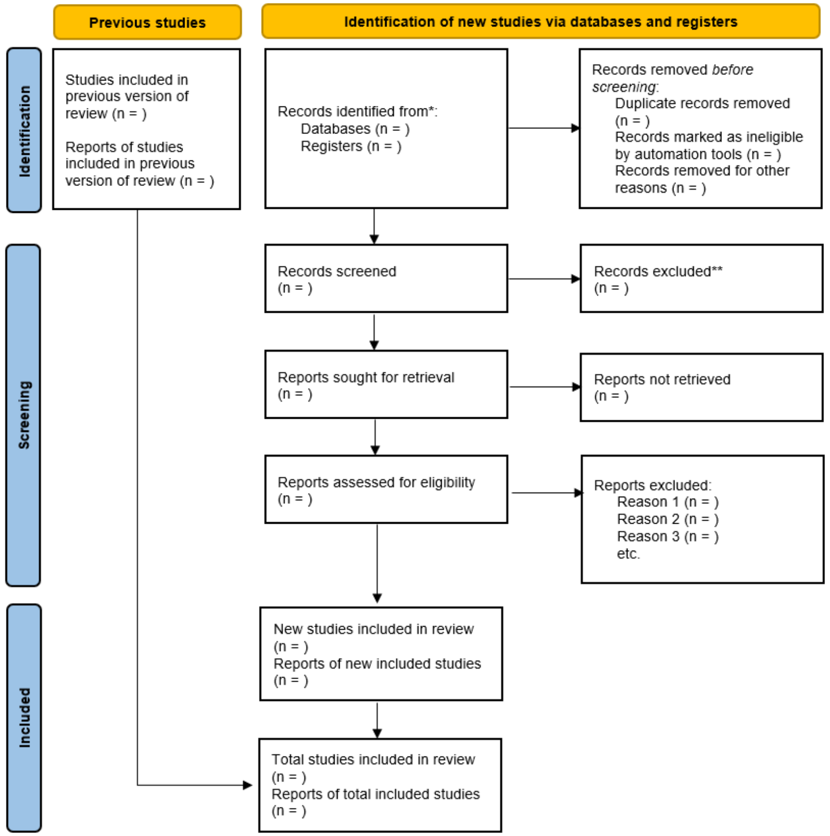
PRISMA Flow Diagram



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

https://prisma-statement.org/PRISMAStatement/FlowDiagram



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

Search Strategy & Study Selection: Example

3 METHODS

3.1 Search strategies

The literature search was undertaken in June 2020. Seven electronic databases were searched (ACM Digital Library, Compendex, IEEE Xplore, Inspec, PubMed, Scopus, and Web of Science). The search terms consisted of the following keywords and logical operations: (ageing OR aging OR "aged care" OR elderly OR "older adults" OR "older people") AND ("Virtual Reality" OR VR). The search terms were applied for the article titles or abstracts. The results were restricted to publications written in English.

Table 1: Results from the initial search of included databases

Electronic research database	Results
ACM Digital Library	233
Compendex	2048
IEEE Xplore	263
Inspec	565
PubMed	451
Scopus	639
Web of Science	893

3.2 Study selection

The study selection for this review was conducted in a 4-step process following the PRISMA 2009 flow diagram [52]. Firstly, articles in included databases were searched electronically for search terms. The initial search of included databases at this step yielded 5092 articles. Table 1 presents the details of results. A snowballing method, which was applied by checking papers that had been cited in the articles reviewed, was employed to identify additional relevant articles. Secondly, duplicates were removed electronically and manually across databases. Additionally, the title and abstract of those distinct articles were screened to determine whether the paper focuses on responses of older adults in using VR as an enrichment experience. In other words, papers which were using VR for detecting, treating, or rehabilitating from any health-related conditions were not included. Thirdly, full texts of the remaining papers were assessed for eligibility of inclusion. This step did not exclude papers based on the actual technologies used. If the authors referred to

Kong Saoane Thach, Reeva Lederman, and Jenny Waycott. 2020. How older adults respond to the use of Virtual Reality for enrichment: a systematic review. In Proceedings of the 32nd Australian Conference on Human-Computer Interaction (OzCHI '20). Association for Computing Machinery, New York, NY, USA, 303–313. https://doi.org/10.1145/3441000.3441003

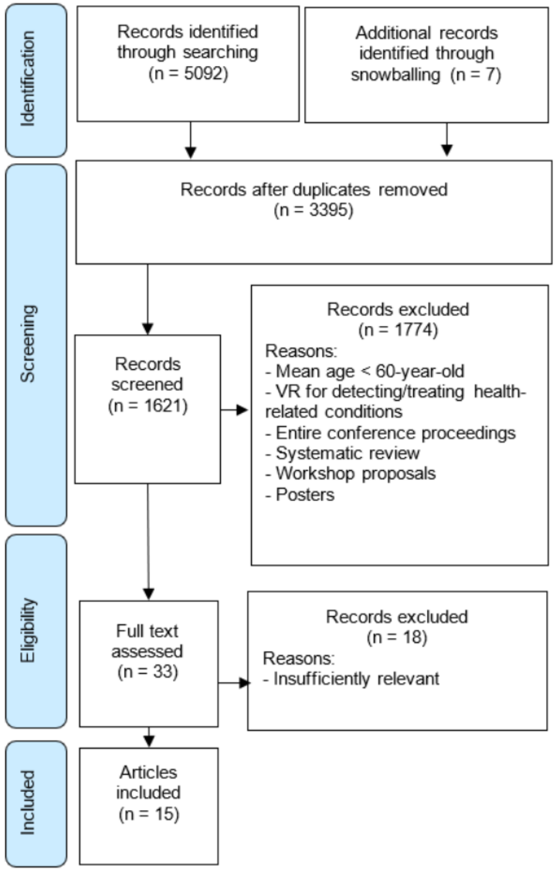


Figure 1: Flow diagram for study selection

Data Collection: Example

the technology as VR, the paper would be included. This inclusion enables us to investigate how authors from varied disciplines have interpreted the term "VR". Finally, relevant data in included papers were extracted for review purposes.

A flow diagram (Figure 1) for study selection outlines the process of article selection for this systematic review.

As illustrated in Figure 1, a number of articles were excluded based on several reasons. For instance, articles that did not study older adults (mean age less than 60-years old) were excluded. Also, as noted earlier, a range of papers were from studies investigating the use of VR for detecting and/or treating a specific health-related condition. These were eliminated. In this review, we also excluded records that are the entire proceedings of a conference. That is, some of the database searches returned entire proceedings containing relevant individual conference papers. Thus, we decided to include the individual conference papers while excluding the entire proceedings. Other exclusion criteria were records that comprised systematic reviews of the literature, workshop proposals, papers not sufficiently relevant to the topic, and posters. We excluded posters because they were short and did not provide sufficient information and quality to report. At the completion of the study selection process, fifteen articles were included for in-depth review [4; 8-11; 14; 47; 49; 51; 53-58].

3.3 Data collection and analysis

The primary aim of this study was to understand older adults' responses and perceptions of benefits and drawbacks, if any, in using VR as an enrichment experience. Papers were not selected on the basis of methods used. Papers using both qualitative and quantitative data are included. All data related to older adults' responses to the use of VR were extracted. In this review, a meta-analysis was not conducted as a large variability of study design and outcome measures were adopted in the papers reviewed. Drawing on the data extracted from included studies, a comparative thematic analysis on their findings was conducted. The findings of this thematic analysis are presented below as primary outcomes of this review. The thematic analysis is coded based on similarities in the papers reviewed [59].

Kong Saoane Thach, Reeva Lederman, and Jenny Waycott. 2020. How older adults respond to the use of Virtual Reality for enrichment: a systematic review. In Proceedings of the 32nd Australian Conference on Human-Computer Interaction (OzCHI '20). Association for Computing Machinery, New York, NY, USA, 303–313. https://doi.org/10.1145/3441000.3441003

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