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## **AUGMENTED REALITY DISCOURSES AND DIVIDES: APPS AND APPLICATIONS**

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### **Introduction**

Although the majority of Augmented Reality (AR) scholarship is based in Computer Science disciplines, it is nevertheless important to consider emergent trends in AR discourses as research and development shifts from technology labs to media markets. While technical understandings of AR are necessary, they are insufficient to understand how networked spatial computing is augmenting everyday life. The dearth of systematic knowledge on AR's role in shaping and being shaped in society arrests our ability to steer AR's social impact (Liao 2019)

In response, this paper maps and compares two specific AR discourses for nodes of power and authority. First, it systematically reviews how AR research citations are shifting from science and technical foci to applied uses of AR via a systematic scientometric review. That work allows, among other insights, consideration of the extent disciplinary boundaries shaped how AR is understood and innovated. Second is contrasting these evolving patterns with current consumer exposure to AR via a critical technocultural discourse analysis (CTDA) of the presentation of phone-based AR apps available on the iOS App Store and Google Play. Comparative discussion of these inquiries adds to understandings of how AR is conceptualised in research and commercial discourses, and how these data might inform future research and practice in the socialisation of AR systems, media, and experience.

The paper is novel in how it critically maps the properties and dynamics of an evolving set of digital networked media at the advent of their interface with society. We define AR as media that create digital relations in the physical world (Heemsbergen et al. 2020; Schraffenberger 2018; Raja & Calvo 2017). More than just layering over physical reality with virtual information (cf Azuma 1997), AR helps us perceive and act in ways that were previously unavailable. This paper lays groundwork to map shifts in patterns of

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research that are shaping AR technology and media on the one hand, and the current commercial discourses of AR products that users experience on the other.

## **Existing Literature**

The interdisciplinary work required emerges from two tracks. The first is reviewing retrospective histories of AR research (see Kim et al. 2018) via mixed methods to make science and technology relationships visible in new ways. Cipresso et al. (2018; p15) use Web of Science (WoS) data - up to 2016 - to track the evolution of networks and cluster in AR research, stressing that as hardware becomes commodified (i.e. scalable to market) concerns are shifting to interaction potentials measured through a clinical phase of AR research. We extend and revise their approach to the present.

While methods of systematic scientometric review are useful to map the scope of AR research, they do not by their large n alone, account for critical questions that surround AR research and its applications in media-technologies (see Liao 2019; Katell et al. 2019). Extant critical-normative research helps frame our inquiry from implied privacy concerns of specific prototypes (Applin and Flick 2021) to consideration of AR as media infrastructures (Saker, 2019), and larger epistemological and ontological critique of AR (Ariso, 2017). Inspired by these critiques, we seek to contextualise up-to-date WoS data clusters of research activity to critical-normative concerns.

We note while that a growing cluster of marketing research examines how consumers react to AR usage (Harborth 2019) it does not consider how users come to *adopt* AR apps in the first place (see Gera et al. 2020). Our response to this second lacuna is to gather data on how AR apps are being presented to consumers via a CTDA.

The combination of these approaches synthesizes new knowledge between how experts are positioning AR's evolving use cases and how consumers are being told AR media technologies fit in society.

## **Methods**

We synthesise methods of visualisation of fields of research citation analysis (Chen and Song 2019) as pioneered in VR and AR by Cipresso et al. (2018), with a CTDA (Brock 2018) of how these fields transcribe to user-accessible products found in app stores.

For the former we utilised Citespace to map Web of Science AR research (n:12,328) up to 2020 in a systematic scientometric analysis of networks and clusters themes via Log-likelihood ratio (LLR) labelling. These visual patterns are themselves made more sensible by analysis of their DCA cluster summaries (n: 23) which more acutely map language, intentions, and boundaries of each cluster (see Figure 1 and Table 1).

Our use of CTDA focusses its multimodal data capture (in April 2021) and critical thematic analysis on the top 20 apps returned via search of "AR" on both Google and Apple's App stores. This second portion of the paper is ongoing due to lockdowns (3) and natural disasters (1) in the authors' home state.

## Preliminary Findings

Our findings are evolving (data captured, analysis ongoing) but our extant work suggests that AR research continues to move further from foundational clusters of technical science towards new forms of applied social sciences (ie. education, social acceptance). Further, the citation clusters present clear disciplinary divides in how AR is imagined and applied by researchers to society, even as clusters bleed into each other.

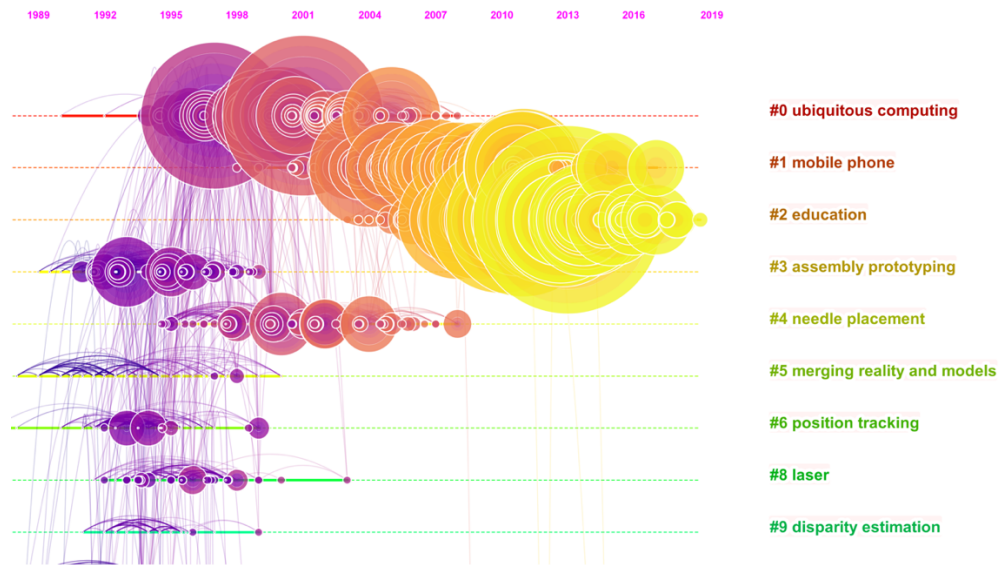


Figure 1

Notably, the patterns in cluster (Figure 1, Table 1) seem at odds with initial popular cultural-commercial interpretations of AR that pervade App stores. The paper’s analysis details ways to make sense of these divides of discourse and consider their effects in the accelerating socialisation of AR.

Median Year	Clusters	(LLR) labelling	Explanatory discourse
~2015	(2) Education	augmented reality; cultural heritage; digital media; visitor experience; mental imagery; cluster analysis; mobile technologies; smart tourism; technology acceptance model; mental rotation   virtual reality; hospitality; digital marketing; configurations; human factors; <u>palmto ranch</u> ; visitor experience; digital technologies; literature analysis; game-challenge reactions	Where and how humans are interacting with AR to build experiences outside of clinical spaces.....
~2011	(1) Mobile Phones	augmented reality; mixed reality; industrial process; process innovation; production environment; physical education; construction defect management; social business; artificial intelligence; evaluation   virtual reality; teacher preparation; professional learning; methods courses; entertainment, social interaction; sociability; physical education; construction defect management; social business	Fun and training and did you hear of <u>Pokemon!</u> ?
~2006	(0) Ubiquitous Computing	augmented reality; template-based tracking; optical tracking; information technology; multi-modal visualization; mobile phones; augmented reality visualization; vocabulary tree; surface reconstruction; video analysis   computer vision; information interfaces; image processing; virtual realities; multimedia information systems; computer; scene analysis; local binary descriptors; information technology; multi-modal visualization	...the ways in which we will design....
~2000	(5) Merging Reality and Models	augmented reality; visualization; gesture recognition; human-building interaction; speech recognition; interaction techniques; real-time rendering; localization; adaptive protocols; head-mounted display   virtual reality; system design; virtual training; localization; adaptive protocols; head-mounted display; physical interfaces; video tracking; speech input; tracking	...the ways that our technology straddles the virtuality-reality continuum
~2000	(4) "Needle Placement"	augmented reality; head-mounted display; frameless <u>stereolaxy</u> ; stereoscopic vision; computer-aided surgery; registration; image-guided therapy; endoscopic procedures; simulated annealing; port placement   virtual reality; mixed reality; <u>dicom viewer osirix</u> ; <u>choleystectomy</u> ; surface volume; image overlay navigation surgery; kidney cancer; laparoscopic partial nephrectomy; medical visualization; head-mounted projective display	Surgery/

Table 1

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