How Often Are HCI Papers Cited by Non-HCI Papers?

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ABSTRACT

Not that often. Probably decreased over recent years.

CCS CONCEPTS

• **Human-centered computing**;

KEYWORDS

HCI, citation metrics, discipline, impact

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1 INTRODUCTION

Human-Computer Interaction (HCI) is often considered as one of the most interdisciplinary research fields. Thus we hypothesize that HCI papers must have impact beyond HCI, which can be indicated by how often an HCI paper is cited by non-HCI papers. Unfortunately, conventional citation metrics, such as h-index or i-10-index, cannot indicate such impact because they only count the number of citations but not the sources of citations.

To address this, we propose `X-index` —a simple metric that measures how often a paper's citations cross the disciplinary boundaries. Given a set of venues representing a specific research field, X-index is defined as the proportion of citations *not* coming these venues.

← **XAC**: todo: briefly describe dataset
← **XAC**: todo: summarize findings
← **XAC**: todo: show github link

2 DATA

2.1 Core HCI Venues

To calculate HCI's `X-index` , we first need to define what is considered an HCI paper so that we can know which are HCI *vs.* non-HCI citations. To the best of our knowledge, there is no existing 'catalog' of all HCI venues that publish HCI papers. Thus we refer to two sources to compile a list of core HCI venues: the SIGCHI-(co)sponsored conferences [4] and Google Scholar's top publications under the "Engineering & Computer Science - Human Computer Interaction" category [3].

Table 1 shows the resultant core HCI venues[1]. For each venue, we manually extract a subset of words from its official name to serve as unique identifier, which we later use in keyword-matching to determine whether a citation is HCI or not.

Admittedly, what is not in this list is not necessarily "non-HCI"; it is just not included by the two sources we chose. Nonetheless, we argue that this list approximates the "boundary" between HCI and the non-HCI world. The more we see citations of an HCI paper coming outside of this list (*i.e.*, higher `X-index`), the more likely this HCI paper is having an impact across this "boundary". We refer to papers published outside of this list as 'non-HCI papers'.

2.2 Citations of CHI, UIST, and CSCW Papers

Next, we collected DOI data of CHI, UIST and CSCW papers between 2010 to 2020[2] from the "What The HCI" [5] website maintained by Kashyap Todi. We chose CHI, UIST and CSCW because they are three of the most well-recognized HCI venues—we hereafter refer to papers published in these three venues as "HCI papers" [3]. It is certainly possible to acquire DOI data of other HCI venues (*e.g.*, TOCHI) from other sources (*e.g.*, ACM Digital Library).

Then, we port the DOI data into the Citation Chaser app [1] developed by Neal Haddaway, which uses the Lens.org API [2] to retrieve citations of a paper based on its DOI. All the citation data was in the `.ris` format and collected in January 2023. We did find that this API did not seem top find all the citations—the total count was smaller than Google Scholar's. Thus it is best thought of as a sampling, rather than an exhaustive retrieval, of papers' citations. We do not believe such a caveat invalidates the subsequent `X-index` calculation unless the missing citations were biased (*e.g.*, missing citations mostly came from just HCI venues).

3 ANALYSES & FINDINGS

Given a set of papers' citations (total number N), we count the number (n_{HCI}) of citations that came from one of our core HCI venues. Then, `X-index` is simply $1 - n_{\text{HCI}}/N$. Specifically, for a paper that cites an HCI paper, we use simple keyword matching to determine whether that paper belongs to our list of core HCI venues.

3.1 `X-index` of HCI Papers Published Over the Years

We calculate the `X-index` of each year's HCI papers (*e.g.*, 11 years of UIST papers between 2010 and 2020), as shown in Figure 1. Each point in Figure 1 is the `X-index` value based on citations of that year's published HCI papers up to when the data was collected

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[1] Some venues changed their name at some point, thus we at times included multiple identifiers for the same venue.
[2] Except for CSCW 2020 papers, which the website did not provide.
[3] Another reason for selecting these three venues is due to convenience because their data was readily available from [5].

Acronym	Identifier
AH	Augmented Human International Conference
ASSETS	Computers and Accessibility
ASSETS	Accessibility and Computing
AutomotiveUI	Automotive User Interfaces and Interactive Vehicular Applications
AVI	Advanced Visual Interfaces
C&C	Creativity and Cognition
CHI	Human Factors in Computing Systems
CHI PLAY	Computer-Human Interaction in Play
CI	Collective Intelligence
COMPASS	Computing and Sustainable Societies
CSCW	Computer-Supported Cooperative Work
CSCW	Proceedings of the ACM on Human-Computer Interaction
DIS	Designing Interactive Systems
EICS	Engineering Interactive Computing Systems
EICS	Engineering interactive computing systems
ETRA	Eye Tracking Research and Applications
GI	Graphics Interface
GROUP	Supporting Group Work
HCII	HCI International
HRI	Human Robot Interaction
ICMI	Multimodal Interaction
IDC	Interaction Design and Children
IJHCI	Journal of Human-Computer Interaction
IJHCS	Human-Computer Studies
IMWUT	Interactive, Mobile, Wearable and Ubiquitous Technologies
IMX	Interactive Media Experiences
INTERACT	Human-Computer Interaction – INTERACT
ISMAR	International Symposium on Mixed and Augmented Reality
ISS	Interactive Surfaces and Spaces
ISWC	International Symposium on Wearable Computers
ITS	Interactive Tabletops and Surfaces
IUI	Intelligent User Interfaces
MobileHCI	Mobile Human-Computer Interaction
MobileHCI	Human-Computer Interaction with Mobile Devices and Services
NA	IEEE Pervasive Computing
NA	Interacting with Computers
NA	Mensch und Computer
NA	Behaviour and Information Technology
NA	Interactive Mobile Technologies
NA	Universal Access in the Information Society
NordiCHI	Nordic Conference on Human-Computer Interaction
NordiCHI	Nordic Human-Computer Interaction Conference
OzCHI	Australian Conference on Computer-Human Interaction
RecSys	Recommender Systems
SMC	Transactions on Human-Machine Systems
SUI	Spatial User Interaction
TAC	Transactions on Affective Computing
TACCESS	Transactions on Accessible Computing
TEI	Tangible, Embedded, and Embodied Interaction
TOCHI	Transactions on Computer-Human Interaction
Ubicomp	Pervasive and ubiquitous computing
UIST	User Interface Software and Technology
UMAP	User Modeling, Adaptation and Personalization
VL/HCC	Visual Languages and Human-Centric Computing
VR	Virtual Reality and 3D User Interfaces
VRST	Virtual Reality Software and Technology

Table 1: A list of core HCI venues.

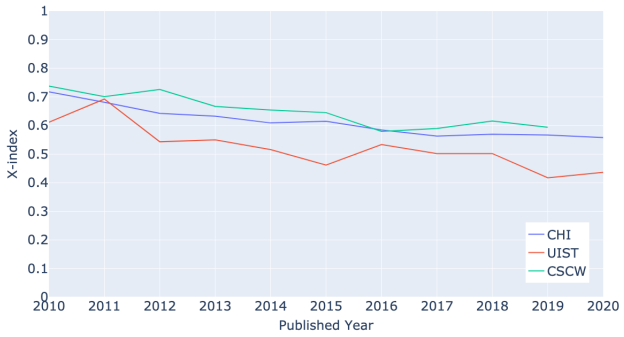

Figure 1: .

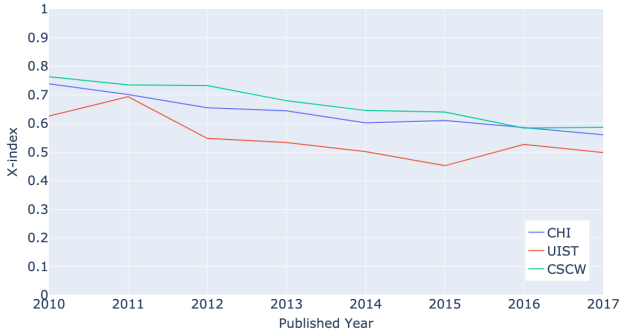

Figure 2: .

(January 2023). We can see that all three HCI venues' papers have an decreasing `X-index` over the years. In other words, HCI papers published later tended to be cited less often by papers outside of the core HCI venues.

One might question that, since citation count is also a function of time, the more recent HCI papers might be disadvantaged simply because they have not existed long enough to attract citations. To resolve this doubt, we perform the next analysis.

3.2 `X-index` of HCI Papers in the Five Years After Publication

To balance the playing field, we now consider citations that occurred only within the first five years after an HCI paper was published. For example, for CHI 2015 papers, we only consider citations of them that occurred between 2016 and 2020. This constraint narrows us down to only HCI papers published from 2010 to 2017 because, later than that, our data (collected in January 2023) has less than five years of citation information.

As shown in Figure 2, the result indicates that, even accounting for how long an HCI paper has been around, the overall `X-index` still seems to decrease over the years.

3.3 X-index Break-Down Over Each HCI Venue Each Year

To delve deeper into the previous two analyses and results that show a decreasing X-index of HCI papers, we now break down citations into individual publishing years for each of the three HCI venues. For each HCI venue on a particular year (*e.g.*, CSCW 2014), we plot the X-index for each of the subsequent year (including the publication year, *e.g.*, 2014-2022 for CSCW 2014), as shown in Figure 3.

Note that the *x*-axis in Figure 3 has changed: it is now citation year, not publication year. For example, when some papers in 2019 cite a CSCW 2013 paper, the citation year is 2019 whereas 2013 is the publication year. The results show that, for most years' HCI papers, their X-index tends to flatten or slightly decrease over time, except for a few 'local' cases, *e.g.*, UIST 2011's X-index increased until 2014.

Amongst HCI papers cited in a given citation year, the earlier papers tend to have a higher X-index than the later ones. Consider the year 2020. For CHI, the top-3 X-index in 2020 are papers published in 2010, 2011, and 2012 whereas the bottom-3 are 2019, 2018, and 2017; For UIST, the top-3 X-index in 2020 are papers published in 2011, 2010, and 2013 whereas the bottom-3 are 2019, 2015, and 2012; For CSCW, the top-3 X-index in 2020 are papers published in 2012, 2010, and 2014 whereas the bottom-3 are 2019, 2018, and 2016.

3.4 X-index Based on Each Year's Citations of HCI Papers

The previous analysis suggests that we can aggregate each year's citations of HCI papers so that we can see how the non-HCI papers' interest in citing HCI papers changed over the years.

For each year, we consider that year's citations of HCI papers published in previous five years. Since our HCI papers start earliest in 2010, our analysis can only begin from 2015 (A 2014 paper might cite a CHI 2009 paper but we do not have CHI 2009's citation information in our dataset).

Figure 4 shows the results, which also exhibit a decreasing pattern over the years. In other words, in the more recent years, HCI papers seem less likely to be cited by papers outside of our core HCI venue list.

4 DISCUSSION

alternative interpretation - maybe hci becomes more interdisciplinary

Remove this citation later: [**?**].

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Figure 3: .

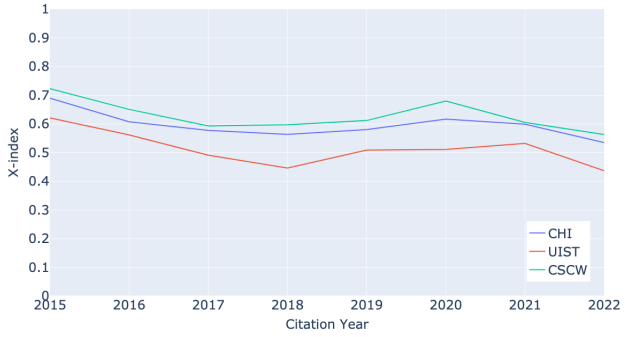

Figure 4: .