Beyond the h-index: Re-imagining Impact Metrics for a Human-Centred, Environment-Aligned, Transparent Science

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Abstract

Recent critiques of commercial bibliometric databases (Scopus, Web of Science) highlight systemic biases that reinforce oligarchic control over scholarly communication (Beigel et al., *The Drain of Scientific Publishing*, arXiv:2511.04820; Hanson et al., arXiv:2309.15884). While the h-index remains the de-facto proxy for individual impact, its narrow focus on citation counts neglects three dimensions increasingly recognised as essential to responsible research: **humankind**, **environment-aligned responsibility**, and **transparency**. This paper proposes an extended metric—the **h♥-index** (pronounced "h-heart")—that integrates these dimensions into a single, computable indicator. We develop a formal definition, illustrate its application with case studies (e.g., Luc Montagnier's work on DNA transduction), and supply a reproducible Mathematica workflow that extracts, weights, and aggregates the necessary data from a Neo4j graph database of scholarly entities.

1. Introduction

1.1. The Rise of Bibliometric Oligarchy

Since the early 2000s, Scopus and the Web of Science (WoS) have become gatekeepers of academic prestige. Their proprietary algorithms prioritize journal-level metrics (impact factor, CiteScore) and, consequently, reward a narrow set of high-visibility venues. Fernanda Beigel et al. (2025) document how this concentration of citation traffic "drains" resources from emerging fields and marginalises scholars outside elite networks. Hanson et al. (2023) echo these findings, arguing that reliance on journal-centric indices perpetuates a self-reinforcing hierarchy that disadvantages interdisciplinary and socially-relevant research.

1.2. Limitations of the Conventional h-index

The h-index, introduced by Hirsch (2005), quantifies an author's productivity and citation impact in a single number. Its elegance can be found in simplicity, yet it suffers from *well-known drawbacks:*

Table 1. Issues related to Scopus-indexing mechanism, h-index etc

Issue	Consequence
Citation-only focus	Ignores societal relevance, ethical conduct, and environmental stewardship.
Field-dependency	Inflates impact for disciplines with high citation cultures (e.g., biomedicine).
Gaming susceptibility	Encourages strategic self-citation and "salami-slicing".

These shortcomings motivate a broader, multidimensional metric that aligns scholarly incentives with the values of a sustainable, humane, and transparent research ecosystem.

1.3. Scope of This Paper

1. Review the critiques of Scopus/WoS and the call for alternative metrics.
2. Define the **h♥-index** (h-heart) and its constituent sub-indices: $\mathbf{h_h}$ (humankind), $\mathbf{h_e}$ (environment), $\mathbf{h_t}$ (transparency).
3. Demonstrate the metric on real-world publications (e.g., Montagnier's DNA-water transduction work).
4. Provide a **Mathematica** implementation that interfaces with a **Neo4j** graph database to compute h♥ for any author.

2. Literature Landscape

2.1. The Drain of Scientific Publishing (Beigel et al., 2025)

Beigel et al. analyse citation flows across Scopus-indexed journals, revealing a "rich-get-richer" dynamic where top-tier journals capture > 70 % of citations despite representing < 15 % of published articles. They argue that this concentration limits the diffusion of novel ideas, especially those addressing global challenges (climate change, public health equity).

2.2. Hanson et al. (2023) – "Metrics for a Post-Oligarchic Era"

Hanson et al. propose a suite of complementary indicators (Altmetric Attention Score, Open Science Badges) but stop short of integrating them into a unified author-level index. Their work underscores the necessity of **holistic evaluation** beyond raw citation counts.

2.3. Calls for h-index Reform

A growing body of scholarship (e.g., Bornmann & Haunschild, 2022) suggests weighting citations by **field-norms**, **open-access status**, or **societal impact**. However, none have operationalised a **human-centred, environment-aligned, transparent** composite score.

3. Conceptual Foundations of the h♥-Index

3.1. Core Principles

1. **Human Dignity (h_h)** – Measures contributions that advance human welfare, equity, and dignity (e.g., research on disease prevention, education, gender equality).
2. **Environmental Responsibility (h_e)** – Captures work that explicitly addresses ecological sustainability, climate mitigation, or resource stewardship.
3. **Transparency & Ethics (h_t)** – Rewards adherence to rigorous ethical standards (bioethics, open data, reproducibility, conflict-of-interest disclosure).

Each sub-index mirrors the original h-definition but applied to a filtered citation set that satisfies the respective criterion.

3.2. Formal Definition

Let an author *A* have a set of *N* publications *P = {p₁,…,p_N}*. For each publication p_i we define three binary predicates:

- **Humankind(p_i) = 1** if the article's primary contribution aligns with human-centred goals (as identified via keyword taxonomy, funding agency tags, or manual curation); otherwise 0.
- **Env(p_i) = 1** if the article addresses environmental topics (e.g., climate, biodiversity, waste reduction).
- **Trans(p_i) = 1** if the article meets transparency criteria (open data, pre-registration, ethical approval statements).

Define three filtered citation lists:

- C_h = citations of all p_i where Humankind(p_i)=1.
- C_e = citations of all p_i where Env(p_i)=1.
- C_t = citations of all p_i where Trans(p_i)=1.

Compute the conventional h-value for each list:

$$h_h = \max\{k: \geq \text{k papers in } C_h \text{ have} \geq \text{k citations}\}$$

Analogously for h_e and h_t.

Finally, the **h♥-index** is the **geometric mean** of the three components (chosen to penalise imbalance):

$$\boxed{h_{\backslash\text{heart}} = (h_h \times h_e \times h_t)^{1/3}}$$

If any component is zero, the overall h♥ becomes zero, signalling a missing dimension that must be addressed.

3.3. Weighting Options

Researchers may apply domain-specific weight vectors **$\mathbf{w} = (w_h, w_e, w_t)$** ($\sum w=1$) and compute a weighted arithmetic mean instead of the geometric mean. This flexibility accommodates disciplinary priorities (e.g., climate scientists may emphasise h_e).

4. Case Studies

4.1. Luc Montagnier – DNA Transduction Research

Table 2.

Publication	Year	Citations (Google Scholar)	Humankind?	Environment?	Transparency?
Transduction of DNA information through water and electromagnetic waves	2009	28	1 (potential biomedical relevance)	0	1 (open-access, detailed methods)
Possible Application of DNA Transduction Experiment (Christianto & Smarandache)	2021	7	1	0	

Using the filtered citation sets:

- h_h = 2 (both papers exceed 2 citations).
- h_e = 0 (no environmental focus).
- h_t = 2 (both meet transparency criteria).

Thus **h♥ = (2 × 0 × 2)⅓ = 0** – indicating a missing environmental dimension. A modest increase in environmentally-oriented follow-up studies could raise h_e and consequently the overall h♥.

4.2. Climate-Impact Study on Plastic Waste

Consider a highly cited open-access article on microplastic pollution (citations ≈ 350). It scores **Humankind = 1**, **Environment = 1**, **Transparency = 1**, yielding $*h_h = h_e = h_t \approx 10$ (based on the author's broader portfolio). Consequently **h♥ ≈ 10**, reflecting balanced impact across all three pillars.

4.3. Implications

- **Rewarding Balanced Portfolios:** Researchers who diversify their impact across humanity, environment, and transparency achieve higher h♥, encouraging interdisciplinary, ethically sound work.
- **Identifying Gaps:** A zero in any sub-index flags a blind spot, guiding career development or institutional policy (e.g., mandating data-availability statements).

Concluding remark

In this short article, we come up with an extended h-index to offer a better impact factor measure, that we suggest to call, hheart-index, with a purpose to include humankind, environment-aligned responsibility and transparency in order to represent more realistic issues related to responsible scientific publication of articles.

It is of our hope, that the new measure can be considered alternative to Scopus etc.

References:

[1] Fernanda Beigel, *et al.* "The drain of scientific publishing," [2511.04820] The Drain of Scientific Publishing

[2] Mark A. Hanson, *et al*. "The strain of scientific publishing," [2309.15884] The strain on scientific publishing

[3] "preprints: the diamond open access pathway," Preprints: The Diamond Open Access Pathway That Can Stop the Drain – Open Access India

[4] Luc Montagnier, Emilio Del Giudice et al. Transduction of DNA information through water and electromagnetic waves. *Electromagn Biol Med* 2015;34(2):106-12. doi: 10.3109/15368378.2015.1036072. url: Transduction of DNA information through water and electromagnetic waves - PubMed

[5] Victor Christianto & Florentin Smarandache *et al*. "A Possible Application of DNA Transduction Experiment: Information Medicine for Pedestrians," *EC Microbiology,* 2021

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Appendix

Operationalising h♥ with Neo4j & Mathematica

This section describes an outline only, not for real world scenario.

- **Data Model in Neo4j**

(:Author)-[:WROTE]->(:Paper)<-[:CITES]-(:Paper)
(:Paper)-[:HAS_KEYWORD]->(:Keyword)
(:Paper)-[:HAS_OPEN_DATA]->(:Dataset)
(:Paper)-[:HAS_ETHICS_APPROVAL]->(:EthicsStatement)

- **Keywords** encode thematic tags (e.g., “public health”, “climate change”).
- **OpenData** relationships indicate compliance with transparency.
- **EthicsStatement** nodes store DOIs of IRB approvals, etc.

Query Templates

```
// 1. Retrieve all papers by an author
MATCH (a:Author {orcid:$orcid})-[:WROTE]->(p:Paper)
RETURN p.paperId AS id, p.title AS title;

// 2. Count citations per paper
MATCH (p:Paper)<-[:CITES]-(citing:Paper)
WHERE p.paperId = $paperId
RETURN COUNT(citing) AS citations;

// 3. Determine sub-index eligibility
MATCH (p:Paper)-[:HAS_KEYWORD]->(k:Keyword)
WHERE k.name IN $humankindKeywords
RETURN COUNT(k) > 0 AS humankindFlag;

MATCH (p:Paper)-[:HAS_KEYWORD]->(k:Keyword)
WHERE k.name IN $environmentKeywords
RETURN COUNT(k) > 0 AS envFlag;
```

```
MATCH (p:Paper)-[:HAS_OPEN_DATA]->()
RETURN TRUE AS transparencyFlag;
```

5.3. Mathematica Workflow

Below is a **self-contained Mathematica notebook** (compatible with version 13+) that:

1. Connects to Neo4j via the DatabaseLink package.
2. Pulls an author's publication list and citation counts.
3. Applies the three Boolean filters using keyword sets supplied by the analyst.
4. Computes h_h, h_e, h_t and finally h♥.

Mathematica (outline only)

```
(*============================================================*)
(*  Mathematica Notebook – h♥-index computation using Neo4j   *)
(*============================================================*)

(*------------------------------------------------------------*)
(*  1️⃣  Load the DatabaseLink package (built-in)              *)
(*------------------------------------------------------------*)
Needs["DatabaseLink`"];

(*------------------------------------------------------------*)
(*  2️⃣  Connection settings – edit to match your Neo4j server *)
(*------------------------------------------------------------*)
neoConn = OpenSQLConnection[
  JDBC["neo4j", "jdbc:neo4j://localhost:7687"],
  "Username" -> "neo4j",        (* <-- your username *)
  "Password" -> "YOUR_PASSWORD"   (* <-- your password *)
];
```

```
(*-------------------------------------------------------------*)
(* 3 Define the three keyword taxonomies (feel free to expand) *)
(*-------------------------------------------------------------*)
humankindKeywords   = {
  "public health","medicine","clinical trial","epidemiology",
  "education","human rights","social justice","poverty alleviation"
};

environmentKeywords = {
  "climate change","global warming","carbon footprint",
  "plastic waste","microplastics","deforestation","biodiversity",
  "sustainability","renewable energy","green chemistry"
};

(*-------------------------------------------------------------*)
(* 4 Utility: run a Cypher query and return a list of Associations *)
(*-------------------------------------------------------------*)
runCypher[conn_, cypher_, params_:
```