

Quantifying Bias in Library Classification Systems

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Introduction

- Categories reflect the needs and perspectives of those who create them.
- Previous works study biases associated with categories (Greenwald et al., 1998) and how categories bias perception (e.g., Park & Rothbart, 1981).
- Loehrlein (2012) specifically studies how a hierarchical category structure can encode bias but does not attempt to quantify it.
- Goal: Develop methods for quantifying how bias is reflected in the structure of hierarchical category systems.
- Use the Library of Congress Classification (LCC) and Dewey Decimal Classification (DDC) as examples of hierarchical category systems.
- Mean percentages of books per node suggest that relative differences in book frequencies do not entirely account for the differences in category proportions.



• Quantify western bias as an example in both systems.

Why Library Classification Systems?

- 1. Large-scale, accessible examples of hierarchical category systems.
- 2. Often perceived as neutral or objective.
- 3. Existing work documenting western bias in the LCC and DDC can be used to validate our methods.

Defining Bias

- **Bias:** preference for one group over another.
- Category Biases: biases built into the category (internal node) structure of a hierarchical category system. We define 3 kinds.



Western Non-Western

Figure 3: Node count bias in the LCC (top) and the DDC (bottom). Each bar is annotated with the proportion of nodes it represents. The labels below the x-axis are the mean percentage of books per node.

Level Bias

• Compared the distribution of western and non-western starting nodes depths using Jensen-Shannon Divergence (JSD).



Figure 4: Distribution of starting nodes in the LCC (top) and the DDC (bottom). Each plot is annotated with the JSD and the significance of the JSD in brackets. Significance was calculated with a permutation test.





(c) Level Bias

(d) Descendant Bias

Figure 1: An illustration of the 3 category biases contrasted with an unbiased system. The 3 biases are against blue categories and in favour of red categories. White categories cannot be categorized as either red or blue.

- **Starting Node:** First category in a subtree that can be tagged as red or blue.
- We assume an unbiased system treats each group roughly equally.

Methods

- Extracted the LCC and DDC numbers of 3.31 million books from MARC bibliographic records in the OhioLINK Circulation Data.
- Represented the LCC and DDC as trees with internal nodes representing categories and leaf nodes representing books.
- Selected categories in the LCC and DDC that classified subtopics of history, religion, or language & literature.
- Categories were tagged as western or non-western using a cultural/philosophical definition as opposed to a geographical one.



	Prob NW depth > W depth			
	LCC	DDC		
Religion	0.89	0.89		
Lang. & Lit.	0.95	0.76		
History	0.86	0.36		

Table 1: The probability that a randomly sampled non-western starting node is deeper in the classification scheme than a randomly selected western starting node, given the two nodes are not equal. Results are from 10,000 samples.

Descendant Bias

• Compared the average number of descendants between western and nonwestern starting nodes. Used a permutation test to determine significance.

	Avg. # of Descendants per Starting Node							
	LCC			DDC				
	W	NW	p-val	W	NW	p-val		
Religion	44.5	23.3	0.42	196.7	22.6	<0.001		
Lang. & Lit.	29.2	27.9	0.92	183.7	82.2	0.01		
History	53.2	54.1	0.96	231.0	51.9	0.62		

Table 2: Summary of descendant bias in the LCC and DDC.

Discussion

• Results confirm findings that the DDC is biased in its categorization of nonwestern languages and literatures (Kua, 2008), and that both systems are biased in their treatment of non-western religions (Zins & Santos, 2011).

Figure 2: A snapshot of the category structure of religion in the DDC. Red categories are tagged as western and blue as non-western.

Results

Node Count Bias

 Compared the proportion of western categories to non-western categories and used a permutation test to determine the significance of the difference.

- Found that the DDC shows a higher degree of western bias than the LCC.
- Overall, our methods allow us to systematically quantify and compare biases across hierarchical category systems.
- In the future, our proposed methods could be used to quantify cultural and individual differences in natural category systems.

References

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