

# Is science becoming more inter-disciplinary? A citation analysis of journal citation patterns in Scopus

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## Introduction

It is often stated that research is becoming increasingly inter-disciplinary (e.g. Braun & Schubert, 2007). Yet it is acknowledged that information is 'affective', and may influence the behaviour of those who use it (e.g. Albright, 2010). Researchers now regularly borrow ideas and approaches from other fields, and discuss their ideas and results with their colleagues, to inform and direct their own research. We wondered whether this alleged trend of increasing inter-disciplinarity would indeed be supported by an investigation of the direction of citations within the published literature.

Assuming that the direction of citations would provide supporting evidence for this statement, we further aimed to understand the driving force behind this trend. We considered that there could be two reasons and aimed to distinguish between them. Either:

- (i) Increased inter-disciplinarity is a response to an increased focus on such "trendy" research by funding bodies causing a drive in this direction, and consequently particular emphasis on its successes (e.g. Catney & Lerner, 2009), or
- (ii) Increased inter-disciplinarity has been driven by researchers themselves, and the increased focus on such research is a natural consequence of a pre-existing trend.

## Methodology

Our first step was to create a benchmark against which to judge whether the extent

of inter-disciplinarity has indeed increased over the last 10 years or so.

We will use the SciVerse Scopus database, with a data extraction date of July 2010, to determine the destinations of both first and second generation citations of cohorts of documents. Documents follow the journals they were published in, when being assigned to a category. The origin of citations is taken to be one of Scopus' 4 top level categories within its All-Science Journal Classification (ASJC), namely Life Sciences, Health Sciences, Physical Sciences, or Social Sciences & Humanities.

This abstract summarises preliminary results derived from the Life Sciences cohort, but the complete study to be presented in July will also include cohorts representing the other three areas.

The first generation destination of the citations from the Life Sciences cohort was recorded at the 27 category main level of the ASJC classification. The second generation origin and destination of citations were both recorded at the 27 category level; the Multidisciplinary category was excluded as an origin for second generation citations so as not to skew results from the majority of the database.

Our second step, having established a current benchmark, will be to inspect the degree of change over the years leading up to this benchmark by assessing the origin and destination of first and second generation citations in different sets of publication years. We will present data pertaining to the periods 1999-2001, 2003-

2005, as well as the current benchmark relating to 2009.

### Preliminary results

In this abstract we present preliminary data pertaining to the benchmarking of inter-disciplinarity in Life Sciences in the publication year 2009.

Table 1 (on the following page) shows the starting positions of documents within the Life Sciences. The majority of documents in Life Sciences sit, at the ASJC 27-category level, within Biochemistry, Genetics and Molecular Biology; Medicine; and Agricultural and Biological Sciences.

**Table 1. Initial distribution of documents belonging to Life Sciences top level category in publication year 2009 (most frequent 5 categories only shown here)**

ASJC 27-level category	Life Sciences docs in category
Biochemistry, Genetics and Molecular Biology	27.42%
Medicine	17.04%
Agricultural and Biological Sciences	15.73%
Pharmacology, Toxicology and Pharmaceutics	7.46%
Immunology and Microbiology	6.54%

Table 2 shows the destination of first generation citations from documents within the Life Sciences category. Citations are more concentrated within the core fields of Life Sciences, as defined by Table 1. Immunology and Microbiology has a disproportionately high influence on research published in the Life Sciences; Pharmacology, Toxicology and Pharmaceutics has a disproportionately low influence; and Chemistry, which was in 7<sup>th</sup> place in the initial document distribution containing 4.71% Life Sciences documents, is very influential indeed.

**Table 2. Destination of first generation citations from Life Sciences top level**

**category in publication year 2009 (most frequent 5 destination categories only shown here)**

ASJC 27-level category	Proportion of citations with this destination
Biochemistry, Genetics and Molecular Biology	37.33%
Medicine	36.67%
Agricultural and Biological Sciences	18.66%
Immunology and Microbiology	11.21%
Chemistry	10.90%

Table 3 displays the destination of second generation citations from documents originating within the Life Sciences category. These down-stream citations are clearly much less concentrated within their starting field than those in the first generation. Medicine and Chemistry are amongst the most multi-disciplinary fields affecting publications in the Life Sciences.

**Table 3. Destination of second generation citations from Life Sciences top level category in publication year 2009 (most frequent 5 destination categories only shown here)**

ASJC 27-level category	Proportion of citations with this destination
Medicine	13.54%
Biochemistry, Genetics and Molecular Biology	10.22%
Agricultural and Biological Sciences	4.89%
Chemistry	4.49%
Immunology and Microbiology	3.12%

We will present complete information regarding these 2009 benchmarks for all 4 top level categories, and also show trends over time.

### Discussion

These preliminary data, showing a recent state (2009) of the distribution and

direction of items and citations in the Life Sciences, indicate that multi-disciplinarity in this field is driven by the core areas Immunology and Microbiology, and Chemistry, rather than a more obviously applied area like Pharmacology, Toxicology and Pharmaceutics. We will validate or refute this early indication by a more complete investigation of fields ranked below fifth in frequency.

It remains to be seen, from research still to be completed, whether other fields will show a similar pattern, with one or two fields being very influential on output in that broad area. We will investigate whether these patterns, the influence of particular fields, and so on, has changed perceptibly over time.

## References

- Albright (2010), Multidisciplinarity in information behaviour: Expanding boundaries or fragmentation of the field? *Libri*, 60, 98-106
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- Catney & Lerner (2009), Managing multidisciplinary: Lessons from SUBR:IM, *Interdisciplinary Science Reviews*, 34, 290-308