

## A Bibliometric Analysis of Research in Psychopharmacology by Psychology Departments (1987-2007)

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From the very outset of scientific Psychology, psychologists have shown interest for drugs and their effects on behavior. This has given rise to numerous contributions, mostly in the form of Psychopharmacology publications. The aim of this study was to quantitatively evaluate these contributions and compare them with other academic disciplines related to Psychopharmacology. Using the PubMed database, we retrieved information about articles from 15 journals included in the Pharmacology and Pharmacy category of the Journal Citation Reports database for a 21-year period (1987 to 2007). There were 37540 articles which about 52% were represented by 3 journals. About 70% of psychology publications were represented by 2 of these journals. Psychology departments accounted for the 11% of the published papers, which places Psychology third behind Psychiatry and Pharmacology, which contributed to 22.69 and 13% respectively. Psychology contributed to the greatest number of studies in 3 journals, second in 3 and third in 8. This report represents the first effort to explore the contribution of academic Psychology to the multidisciplinary science of psychopharmacology. Although leaders of production of psychopharmacology research were from Psychiatry and Pharmacology, Psychology departments are an important source of studies and thus of knowledge in the field of Psychopharmacology

*Keywords: psychology, psychiatry, pharmacology, psychopharmacology, scientific journals, bibliometric study.*

Desde los mismos inicios de la Psicología científica los psicólogos han mostrado interés por los fármacos y el efecto de éstos sobre la conducta. Esto ha dado lugar a numerosas aportaciones, principalmente en forma de publicaciones de Psicofarmacología. El objetivo de este estudio fue evaluar cuantitativamente estas aportaciones y compararlas con las de otras disciplinas académicas relacionadas con la Psicofarmacología. Usando la base de datos PubMed se extrajo información sobre artículos publicados en 15 revistas incluidas en la categoría de Farmacología y Farmacia de la base de datos Journal Citation Reports durante un período de 21 años (1987-2007). Hubo 37.540 artículos de los cuales alrededor del 52% se publicaron en 3 revistas. El 70 % de las publicaciones de psicología se publicaron en 2 de estas revistas. Psicología, con el 11% de los artículos publicados, fue la tercera detrás de Psiquiatría y Farmacología, que contribuyeron con el 22,69 y el 13% respectivamente. Psicología contribuyó con el mayor número de estudios en 3 revistas, fue la segunda en 3 y la tercera en 8. Este estudio representa un primer intento por explorar la contribución de la Psicología académica a la ciencia multidisciplinar de la psicofarmacología. Aunque los líderes de producción en investigación psicofarmacológica fueron Psiquiatría y Farmacología, los departamentos de Psicología son una importante fuente de estudios y por tanto de conocimiento en el campo de la Psicofarmacología.

*Palabras clave: psicología, psiquiatría, farmacología, psicofarmacología, revistas científicas, estudio bibliométrico.*

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I am indebted to Drs José Miguel Vela and Francisco Navarro as well as the anonymous referees for valuable comments and suggestions on the manuscript.

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Existing revisions about the history of Psychopharmacology virtually ignore the contributions rendered by Psychology (Healy, 1998, 2000, 2001). However, scientific Psychology has been concerned with the effects of drugs on behavior of both animals and human subjects for many years. For instance, a recent article by Muller, Fletcher and Steinberg (2006) reported how the experimental research performed by Emil Kraepelin in the Wilhelm Wundt's laboratory of experimental psychology at Leipzig constituted the origin of psychopharmacology. Furthermore, historically, drugs studies were commonly reported in different journals of psychology. For example, the mayor experimental literature for the first 40 years of research in psychopharmacology can be found in the reviews by Hollingworth (1912a), Poffenberg (1914, 1916, 1917 & 1919), Meyer (1922), Darrow, (1927), Shock (1939) and Spragg (1941) which appeared in the *Psychological Bulletin*. In addition, during the 1920s and 1940s over a hundred pharmacological studies were published in different journals of psychology. Specifically, the effects of substances such as caffeine (Schilling; 1921; Peterson & Carter, 1936; Skinner & Heron, 1937), tobacco (Meyer, 1923), alcohol (Peterson & Carter, 1936), cocaine (Fowler, 1940), nicotine (Humphrey, 1942), peyote (Fernberger, 1932), atropine (Peterson & Carter, 1936), sodium phenobarbital (Williams & O'Brien, 1937), benzedrine (Searle & Brown, 1938; Wentink, 1938), adrenalin (Wentink, 1938; Fowler, 1941), sodium amytal (Settlege, 1936), metrazol (Karn, Lodowski & Patton, 1941), picrotoxine (Tainter, 1943), ephedrine (Wentink, 1938), insulin (Wentink, 1938; Stellar, 1943), coramine (Turchioe, 1945), pregnenolone (McGinnies, 1947) or opioids (Simon & Eddy, 1935; Eddy & Ahrens, 1935), among others, were widely tested on a varied plethora of aspects in both animals and humans. Particularly important in those earlier years of psychopharmacology were the studies by psychologist Harry L. Hollingworth which are cited as a standard for psychopharmacological research (Benjamin, Rogers & Rosenbaum, 1991; Hollingworth, 1912b; Hollingworth & Poffenberger, 1920).

Later on, in the 1950s, commitment to the experimental analysis of behavior by psychology led to the development of behavioral pharmacology (Blackman & Pellón, 1991; Barrett, 2002). A recent article by Laties (2003) highlighted the prominent role played by psychologists in this then-new field and how they started to assume leading positions as authors and editors for the *Journal of Pharmacology and Experimental Therapeutics* (the official journal of the *American Society for Pharmacology and Experimental Therapeutics*). During the same years, the discovery of chlorpromazine was a fundamental event in the development of clinical psychopharmacology and is frequently cited as the genesis of the so-called "psychopharmacological revolution" (López-

Muñoz, Alamo, Cuenca, Shen, Clervoy & Rubio, 2005; Rosenbloom, 2002). On consulting the APA database, using the term "chlorpromazine", there appear, from the year 1956 to 1965, over 40 reports published in different journals of psychology. In addition, some psychologists seem to have contributed with important studies of medication for psychiatric disorders. For instance, Solomon C. Goldberg, who received his PhD with a focus on social psychology, was involved in the first collaborative clinical trial in schizophrenia where the effects of several neuroleptics were compared and designed many others studies to test the therapeutic benefit of such drugs (Goldberg, Klerman, Cole, 1965; Goldberg, Schooler, Davidson & Kayce, 1966; Goldberg, Mattsson, Cole & Klerman, 1967). Similarly, Alberto DiMascio contributed enormously to the study of the effects of different drug families such as anxiolytics (oxazepam, chlordiazepoxide), antidepressants (imipramine, desipramine), stimulants (d-amphetamine) and neuroleptics (chlorpromazine, promethazine, trifluoperazine, and perphenazine), among others, in both normal and pathological subjects (DiMascio, Klerman, Rinkel, Greenblatt & Brown 1958; DiMascio, Havens & Klerman, 1963a, 1963b; DiMascio & Buie, 1964; DiMascio, Heninger & Klerman, 1964; DiMascio, Klerman & Prusoff, 1975; DiMascio, Bernardo, Greenblatt & Marder, 1976). Moreover, he was editor of important books of clinical psychopharmacology such as the *Clinical handbook of psychopharmacology* (Science House, New York, 1970) and *Butyrophenones in psychiatry* (Raven Press, New York, 1972). In 1978, DiMascio co-edited with Morris A. Lipton and Keith F. Killam one of the most influential and known books in psychopharmacology: *Psychopharmacology: A Generation of Progress* (Raven Press, New York, 1978). A final example is provided by Hannah Steinberg which was appointed to the first designated Chair in Psychopharmacology in Britain (Blackman, 1991). The Steinberg experiments provide an excellent example of how behavior is used to study drug action (Schmied, Steinberg & Sykes, 2006). She is well known for her earlier experiments on the effects of nitrous oxide on several behavioral functions and for the results of systematic experimental investigations of drug synergies as well as the effects of prior pharmacological and behavioral histories (Steinberg, 1954, 1955, 1956; Steinberg, Legge, Summerfield, 1961; Rushton, & Steinberg, 1963).

Collectively, examples described above can give us an initial perspective of the historical contributions of psychology to the field of psychopharmacology however do not provide a perspective of the current state of psychopharmacological research carried out by Psychology compared with other fields. We consider that the study of the current contributions made from a non-medical discipline such as Psychology to (Psycho) Pharmacology could be important to rationally tackle

complex problems that have been exhaustively debated, such as the clinical use of drugs by psychologists (Lavoie & Barone, 2006). Furthermore, appraisal of the scientific impact of researchers, teams and institutional affiliations with productivity and citation metrics are not only interesting *per se* but also can nowadays have major repercussions such as funding decisions and expert and public perceptions about science (Ioannidis, 2008). Consequently, the main aim of this study has been to evaluate the contemporary contributions of Psychology to Psychopharmacology and compared with other disciplines involved in psychopharmacological research.

## Method

### *Bibliometric perspective*

As a first attempt to accomplish that, a bibliometric analysis seems to be an adequate approach. Use of bibliometric assessments of research is growing worldwide. Bibliometrics is the scientific and quantitative study of publications and has been used increasingly to quantify the scientific production and for the evaluation of individual research groups or university departments (Moed, Burger, Frankfort & van Raan, 1985). In general, bibliometric studies have used two approaches: a) quantitative or descriptive, where aspects such as productivity or geographical, documental and thematic distribution are analysed (Soteriades & Falagas, 2005; Rahman, Haque & Fukui, 2005; Kondilis, Kiriaze, Athanasoulia & Falagas, 2008) and b) evaluative, which consist of applying specific criteria to assess scientific activity (Iñiguez-Rueda, Martínez-Martínez, Muñoz-Justicia, Peñaranda-Cólera, Sahagún-Padilla et al., 2008; Evans, 2008). In this quantitative study, the productivity of Psychology departments and faculties, based on the number of psychopharmacological papers, was analysed and compared with those published by other departments and faculties involved in psychopharmacological research such as Psychiatry, Pharmacology, Biology, Pharmacy and Chemistry. Studies using a similar methodology to evaluate the national contributions of different countries by others disciplines have been published (Lewison & Devey, 1999; Rahman et al., 2005; Maeda, Rahman & Fukui, 2003). Since the preferred kinds of publications by natural sciences consist of articles in specialists' journals, fifteen specialized psychopharmacology and three general pharmacology journals have been selected and the number of publications quantified according to the affiliation of the first author.

In the case of Psychology a year per year search was carried out to estimate the time-course evolution of the articles for this affiliation during the period 1987-2007. To assess whether the data conforms to Price's Law of

exponential growth (this bibliometric indicator reflects an essential fact of scientific production, which is its exponential growth), we carried out a linear adjustment of the values and another adjustment to an exponential curve. Furthermore, the search was repeated for each year in eight journals of Psychopharmacology (those where Psychology published at least 100 articles).

Finally, to evaluate the research effort of each affiliation, we included an "index of effort". This was done by calculating the ratio between the scientific production of each discipline (expressed as the sum of all indexed papers in PubMed between 1987 and 2007) and the number of articles collected in our documental repertory by each discipline. This data can be considered as an index of the efforts internally done by each field in psychopharmacology and, by extension, of the importance that research in psychopharmacology involves for each discipline.

### *Database and selected period*

The methodology employed involved searching for the institutional affiliation of the first author using the Medline database (PubMed Central database). The PubMed database does not include the affiliation of the authors until 1987, for this reason the search was limited to the period 1987-2007. The PubMed database has recently been used by others authors for similar bibliometrics analysis (Kondilis et al., 2008; Soteriades, Rosmarakis, Paraschakis & Falagas, 2006).

### *Affiliations and selected key words*

The "Affiliation" as well as the search limitation option for years or periods were done using the *Limits* option of the database. The affiliations chosen were "Psychology", "Psychiatry", "Pharmacology", "Biology", "Pharmacy" and "Chemistry", which were defined in the search according to a series of key words relating to the specific disciplines and using specific commands to "filter" and avoid crossover as much as possible (Table 1).

### *Selected journals*

The selected journals fall all into the category of *Pharmacology and Pharmacy* according to the *Journal Citation Reports* (Thomson Scientific). The journals selected are shown in Table 2 (parenthesis show the 2007 impact factor of each journal). Nine of them are also included into the category of *Psychiatry*. For the selection of Psychopharmacology journals in this category we taken into account: a) The name of the journal (all journals psychopharmacologically oriented were selected) and b) journal must be available at PubMed database (all journals

Table 1

*Affiliation, key words and commands relating to the specific disciplines*

Afiliation	Key Words And Comands
Psychology	Psychology OR Psychological NOT Medical NOT Medicine
Psychiatry	Psychiatry OR Psychiatric
Pharmacology	Pharmacology NOT Pharmacy NOT Pharmaceutical
Biology	Biology OR Biological NOT Psychology NOT Psychological NOT Medicine NOT Medical
Pharmacy	Pharmacy OR Pharmaceuticals
Chemistry	Chemistry OR Chemical NOT Biology NOT Biological

Table 2

*Selected journals and impact factor (Institute for Scientific Information, ISI)*

Journals of Psychopharmacology (impact factor, 2007)	Journals of Pharmacology (impact factor, 2007)
1. Neuropsychopharmacology (6.15)	1. Journal of Pharmacology and Experimental Therapeutics (JPET) (4)
2. Int J Neuropsychopharmacol (4.9)	2. British Journal of Pharmacology (BJP) (3.76)
3. European Neuropsychopharmacology (4.43)	3. European Journal of Pharmacology (EJP) (2.37)
4. J Clin Psychopharmacol (3.87)	
5. J Psychopharmacol (3.78)	
6. Psychopharmacology (3.56)	
7. Neuropharmacology (3.21)	
8. Int Clin Psychopharmacol (3.26)	
9. Pharmacopsychiatry (3.23)	
10. Progress in neuro-psychopharmacology & biological psychiatry (2.58)	
11. Behavioral Pharmacology (2.39)	
12. Pharmacology Biochemistry and Behavior (2.35)	
13. Clin Neuropharmacol (2.31)	
14. Human Psychopharmacology (2.04)	
15. Experimental and Clinical Psychopharmacology (2.03)	

selected by the previous name criteria were available). For general Pharmacology journals, three were chosen publishing the greatest number of articles and having a high impact factor.

### Results

The total number of articles published in the selected journals was 82728 of which 4,510 came from Psychology departments. This result is that with 5.45 % of all articles Psychology would be the fourth discipline in number of articles behind Pharmacology (18178 articles, 21.97 %), Psychiatry (9568 articles, 11.57%) and Pharmacy (5931 articles, 7.17%) (Fig.1). If we analyzed the data excluding the 3 general journals of Pharmacology (NO *EJP/JPET/BJP*), the total number of articles published decreased from 82728 to 37540 of which 4143 came from Psychology departments, causing a significant increase in percentage from 5.45 % to 11.04 %. This places Psychology in third

place behind Psychiatry, which pass from 11.57 to 22.69 %, and Pharmacology, which places second decreasing from 21.97 to 13 % (Fig. 1).

Total number of psychopharmacology publications including Psychology contribution is showed in Figure 2. The number of psychopharmacology publications was consistent until 2003 when a progressive increase was observed (from 2079 in 2003 to 3009 articles in 2007, an increase of 31%). Psychology contribution was fairly consistent over the timeline with a mean of  $196.52 \pm 10.35$  publications per year ( $10.66 \pm .42$  %). The increase in productivity observed between 2003 and 2007 was accompanied by a similar increase in the production by Psychology (from 199 in 2003 to 289 in 2007, same increase of 31%) and the percentage of articles published by this discipline was stable.

Table 3 shows that more than 50% of the publications were represented by 3 of the 15 journals of psychopharmacology: *Pharmacology, Biochemistry and*

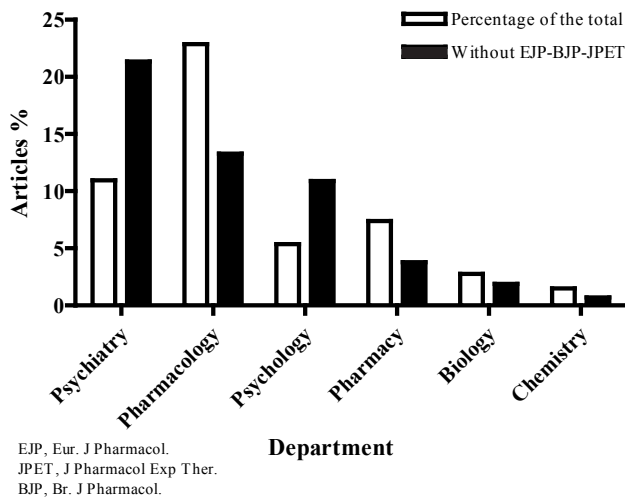


Figure 1. Percentage of articles published in the total of journals according to discipline.

Behavior, Psychopharmacology and Neuropharmacology. In the case of Psychology, around 70% of the articles were represented by Pharmacology, Biochemistry and Behavior and Psychopharmacology (Table 4).

A graphic representation of the percentage of articles published in each journal and for each discipline can be seen in Figure 3. The greatest percentage of articles published (almost 40%) by Psychology departments was in the journal *Experimental and Clinical Psychopharmacology* followed by *Behavioral Pharmacology*, *Psychopharmacology* and *Pharmacology*, *Biochemistry and Behavior*, *Journal*

of *Psychopharmacology*, *Human Psychopharmacology*, *Neuropsychopharmacology*, with percentages of 24.5, 19.87, 19.64, 10.83, 8.67 and 7.21 %, respectively. Finally, there are the rest of journals with percentages less than 5%. Psychiatry leads the percentage of articles published in all psychopharmacology journals except for *Experimental and Clinical Psychopharmacology*, *Behavioral Pharmacology* and *Pharmacology*, *Biochemistry and Behavior*; where the highest number of articles was published by Psychology departments, and *Neuropharmacology*; where Pharmacology scored first. Psychology placed second in percentage of published papers in *Psychopharmacology*, *Journal of Psychopharmacology* and *Human Psychopharmacology*. The differences compared with Psychiatry were greater for *Journal of Psychopharmacology* (30.31 % vs. 10.8 %; ratio: 2.8) and *Human Psychopharmacology* (31.46 vs 8.67%; ratio: 3.62) than for *Psychopharmacology* (22.89 vs 19.88%; ratio: 1.15). The lowest percentage of articles published for Psychology corresponds to the three general journals of Pharmacology (1.14 %, *EJP*; 1.01 %, *JPET* and .16 % *BJP*) and to *Journal of Clinical Psychopharmacology* (.38%). On the other hand, Pharmacy placed second in the three general journals of Pharmacology and in *Neuropharmacology* behind Pharmacology (23.8 % vs. 6.88 %; ratio: 3.44). Biology placed third in 2 general journals and fourth in *Neuropharmacology* and *Neuropsychopharmacology*.

In Figure 4 the number of articles published by Psychology departments in 8 Psychopharmacology journals is shown year by year. The progressive rise seen in the journals *Neuropsychopharmacology* and *Journal of Psychopharmacology* stands out. The journal *Psychopharmacology* published only 11 articles in the

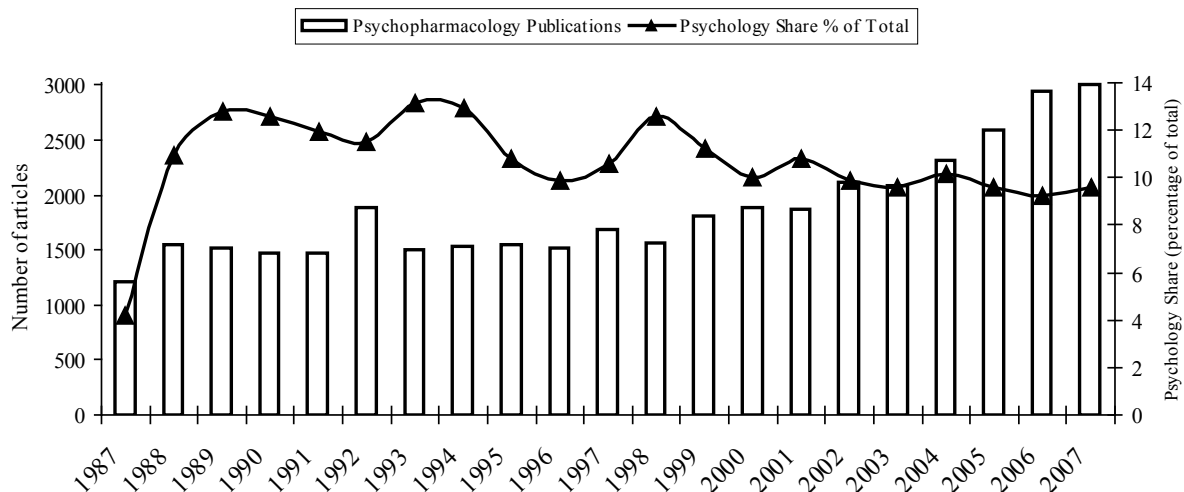


Figure 2. Total number of publications including Psychology contribution. Psychology contribution is expressed as percent of total (line trend with scale on y axis on right).

Table 3  
*Percentage distribution across psychopharmacology journals*

Journal	N° of articles	%
Pharmacol Biochem Behav	7561	20.14
Psychopharmacology	7143	19.03
Neuropharmacology	4619	12.30
Neuropsychopharmacology	2964	7.90
J Clin Psychopharmacol	2874	7.66
Prog Neur Biol Psychiatry	2681	7.14
Clin Neuropharmacol	1781	4.74
Pharmacopsychiatry	1406	3.75
Int Clin Psychopharmacol	1387	3.69
Behavioral Pharmacology	1301	3.47
European Neuropsychopharmacology	1157	3.08
J Psychopharmacol	914	2.43
Int J Neuropsychopharmacol	638	1.70
Hum Psychopharmacol	588	1.57
Exp Clin Psychopharmacol	526	1.40
Total	37540	100

Table 4  
*Percentage distribution across psychopharmacology journals for Psychology departments*

Journal	N° of articles	%
Pharmacol Biochem Behav	1485	35.84
Psychopharmacology	1420	34.27
Behavioral Pharmacology	319	7.70
Neuropsychopharmacology	214	5.17
Exp Clin Psychopharmacol	198	4.78
Neuropharmacology	128	3.09
Prog Neur Biol Psychiatry	122	2.94
J Psychopharmacol	99	2.39
Hum Psychopharmacol	51	1.23
Clin Neuropharmacol	22	.53
Pharmacopsychiatry	20	.48
Int Clin Psychopharmacol	20	.48
European Neuropsychopharmacology	20	.48
Int J Neuropsychopharmacol	14	.34
J Clin Psychopharmacol	11	.27
Total	4143	100

Table 5

Research effort by each affiliation (ratio between psychopharmacological production by each affiliation and total research production indexed in PubMed during 1987-2007)

Affiliation	Total articles PubMed 1987-2007	Total PsychoPharmacol	Effort Index
Psychology	107852	4143	3.84
Psychiatry	123154	8519	6.92
Pharmacology	161547	4880	3.02
Biology	365791	792	.22
Pharmacy	167975	1471	.88
Chemistry	300806	251	.08
Total	1227125	20056	1.63

first year under study (1987) but 63 the next year, which represents an increase of almost six times. There was a steady rise after 1997 in this journal and in 2007 the number of articles increased to 88. On the other hand, the pattern in the journal *Pharmacology, Biochemistry and Behavior* showed a constant rise in the number of articles, peaking at 120 articles in 1990, but declining afterwards until 54 articles in 2007. In the journals *Progress in Neuro-psychopharmacology and Biological Psychiatry*, *Neuropharmacology*, *Behavioral Pharmacology* and *Experimental and Clinical Psychopharmacology* the tendencies are not so clear and a more irregular patterns can be observed with rises and declines in the number of articles published every year.

If we take into account all the articles in all the journals, the total number of articles exceeded 150 after 1988 and stays at that rate (150-200 per year) until 2003 (Figure 5). From 2004 this rate is surpassed and in the last year of the study, 2007, the number of articles was 289 in what seems to be a steady growth. A linear adjustment of data and another adjustment to an exponential curve performed to verify whether the analyzed production adjustments Price's Law showed that the repertoire analyzed, despite its growth, does not fulfil the proposals of Price's law. This data was possibly owing to a previous saturation point ( $y = 5.620e-021$ ,  $r$  linear vs exponential = .726 vs .73).

Finally, we included an "index of effort" by calculating the ratio between the scientific production of each discipline (expressed as the sum of all indexed papers in PubMed between 1987 and 2007) and the number of articles collected in our psychopharmacological repertory (Table 5). Results showed that Psychiatry was the first discipline with 6.92% while Psychology (3.84%) and Pharmacology (3.02%) places second and third respectively.

## Discussion

In an attempt to evaluate the contributions rendered by psychologists to psychopharmacological research,

the number of psychopharmacology papers published by Psychology departments or faculties has been quantified and, at the same time, compared with the number of papers coming from other disciplines-related departments. The results obtained in the fifteen specific journals for Psychopharmacology placed Psychology third behind Psychiatry which published about 11 points more in percentage (21.69 % vs. 11.04 %) and Pharmacology (13 % vs 11.04%) and far ahead in comparison with other disciplines (3.84%, 1.86%, .67% for Pharmacy, Biology, and Chemistry, respectively). Furthermore, in three of the studied journals, Psychology was the first affiliation in the number of articles and three in second place. We also found that the number of psychopharmacology publications was consistent until 2003 when a progressive increase was observed. The contribution by Psychology was consistent over the timeline and the increase in general productivity observed between 2003 and 2007 was accompanied by a similar increase in the production by Psychology. Interestingly, if we carry out again a linear adjustment of data and another adjustment to an exponential curve to verify whether the analyzed production fits Price's Law for the period 1997-2007, we do indeed observe a fit with Price's law of exponential growth of scientific literature for this material ( $r = .92$  in the exponential adjustment versus  $r = .9$  in the linear adjustment).

With regard to the articles distribution, we found that 52% of articles were concentrated in the journals *Pharmacology, Biochemistry & Behavior*, *Psychopharmacology*, *Neuropharmacology*. Interestingly, Psychology departments preferentially published their results in the two first (70%). A deeper analysis by a year per year search in the journal *Pharmacology, Biochemistry & Behavior* showed that publication by Psychology departments declined from 120 articles in 1990 to 54 articles in 2007. However, publication in *Psychopharmacology* showed the opposite pattern, from 42 in 1990 to 88 in 2007. This data suggests a change in the publication pattern by Psychology departments. A plausible explanation is that

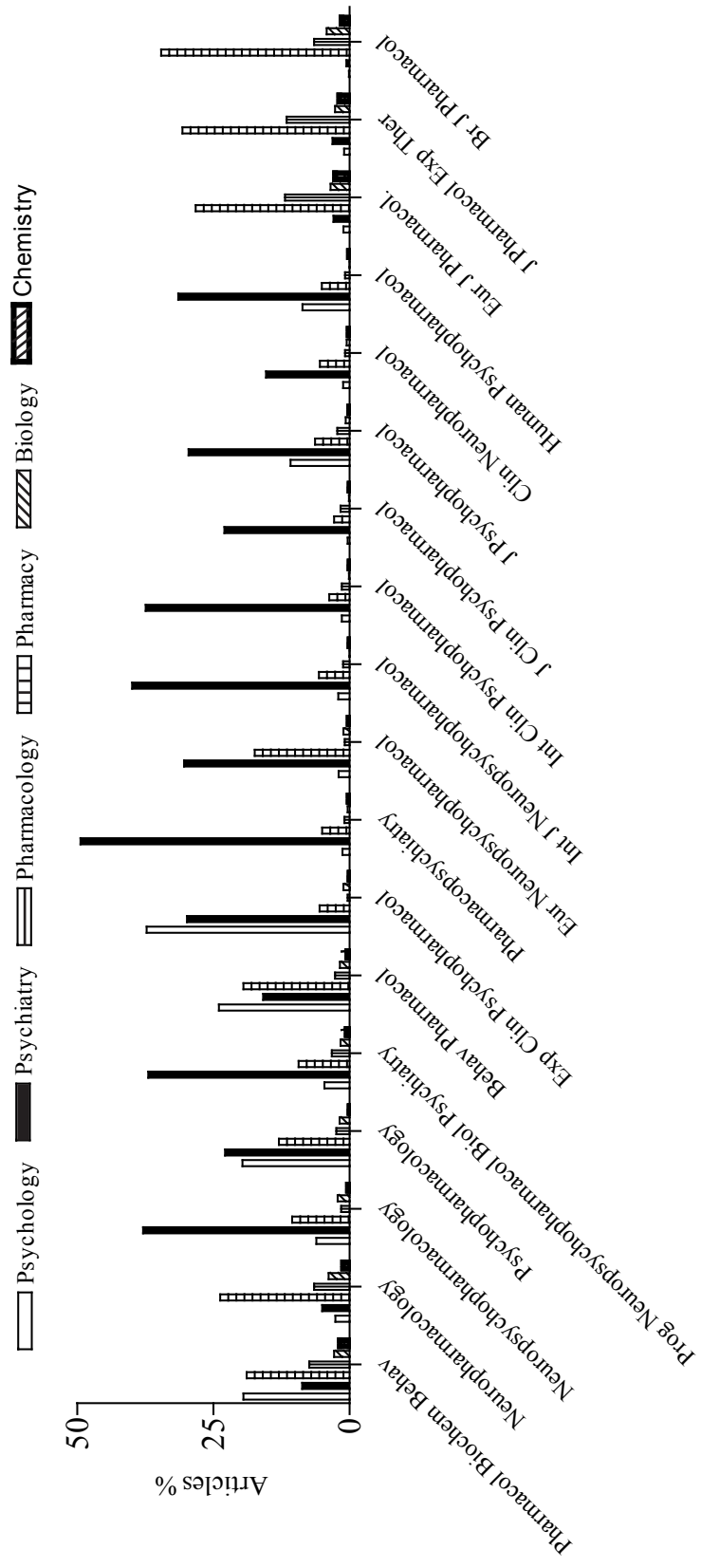


Figure 3. Percentage of articles published in each journal and for each discipline.



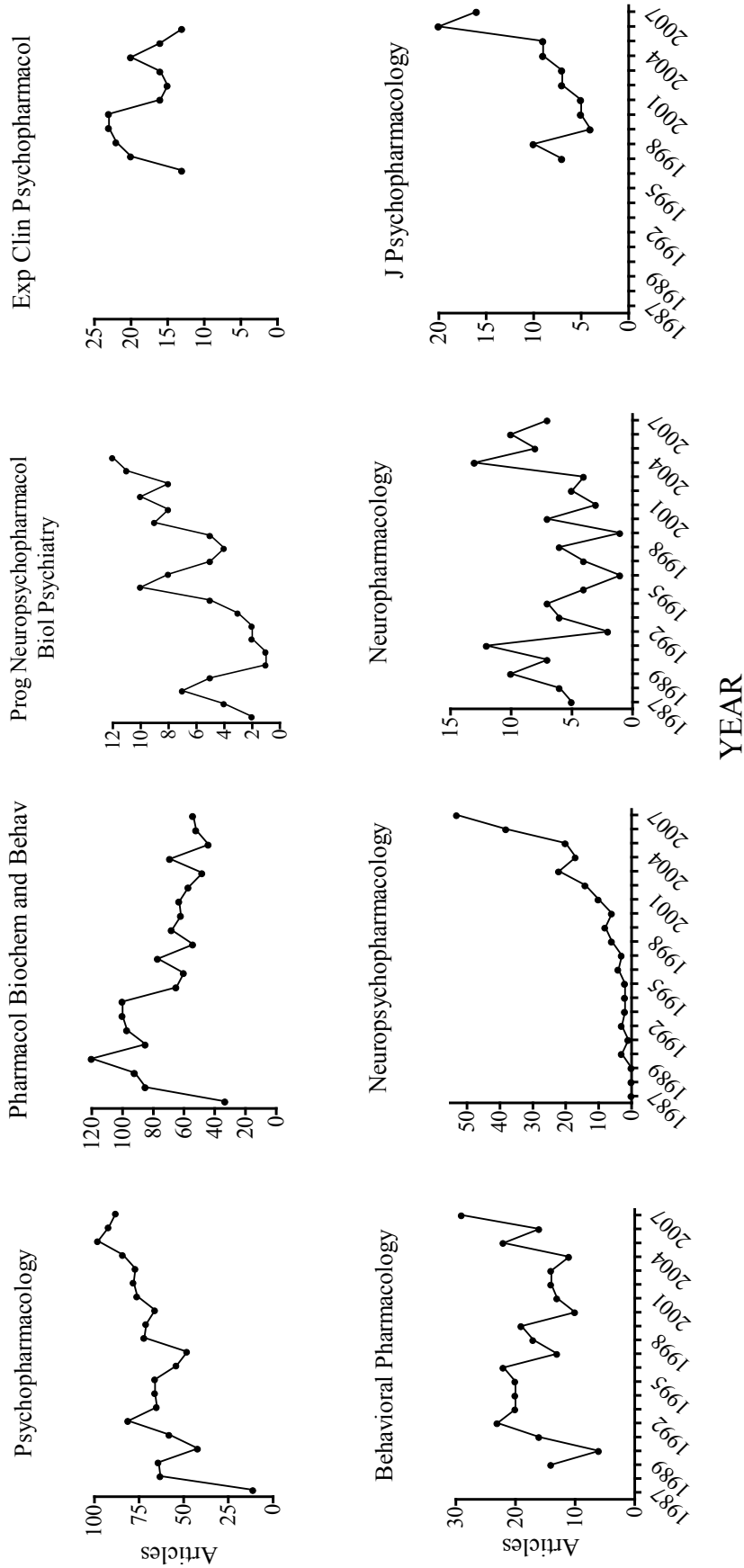


Figure 4. Number of articles published year by year by Psychology departments in main Psychopharmacology journals.

different impact factor of the journals, 2.35 vs 3.56, have led to a preference for *Psychopharmacology* instead *Pharmacology, Biochemistry & Behavior*. The same would also apply for the journal *Neuropsychopharmacology*. Clearly, the publication pattern obtained in this journal indicated that it seems to be a favourite target for the dissemination of psychopharmacological research done by Psychology departments. The strong increase of published articles by Psychology could be due to the impact factor of this journal, which is the highest one. By extension this data also shows the influential role of impact factor in the selection of journals by scientists.

We also calculated the ratio between the global scientific production of each discipline and the number of articles published in the 15 journals of psychopharmacology. This data can be considered as index of the efforts internally done by each field in psychopharmacology and, by extension, of the importance that research in psychopharmacology involve for each discipline. 6.92% and 3.84% of the scientific production by Psychiatry and Psychology respectively was published in the 15 psychopharmacology journals of this study. This result suggests that research in psychopharmacology seems to be important for Psychology (and even more for Psychiatry). Interestingly, Pharmacology published 3.02 % suggesting a much broader interest possibly due to the efforts done in others pharmacological areas.

In this regard, the study also included three general journals for Pharmacology (*EJP*, *BJP* and *JPET*), which alone publish more than 50% of the studies. As expected, Pharmacology scored first in these general journals of pharmacology. In the three cases, the lowest number of articles published in these journals corresponded to Psychology, which suggests a preference by the specific Psychopharmacology journals or a high rejection rate for articles sent by psychologists. This last possibility seems less probable due to the high quality of the specific Psychopharmacology journals studied, some of them with higher impact factor than the general ones. The number of articles published by Psychology in *EJP* and *JPET*, 215 and 148 articles respectively, means an average of 10.75 and 7.4 articles per year. Regarding *JPET*, Victor Laties (2003) has compiled data showing an increasing rate of publications by psychologists in this journal. According to this author, the first article published by a psychologist was in 1931 (Richter et al., 1931) and cites 10 other later studies published by psychologists in *JPET* over the following 25 years. According to Laties (2003), between 1956 and 1970 a significant increase occurs and 67 studies are published by psychologists in the journal *JPET*, which means an average of 4.78 articles per year compared with the 7.4 articles in this study. This data would suggest an increase of publications in this journal. There are no similar studies for *EJP* where the average of 10.8 studies per year

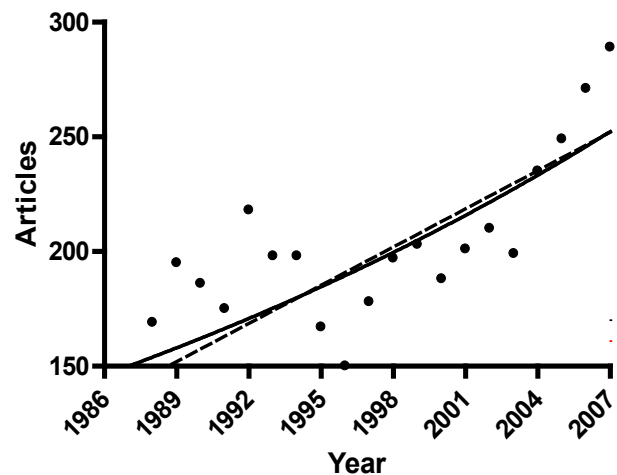


Figure 5. Total articles published year by year by Psychology departments in all psychopharmacology journals analyzed. Linear adjustment of data and another adjustment to an exponential curve were performed to verify whether the analyzed production fits Price's law.

still remains relevant. The low rate of papers published by Psychology in *BJP* (only 21 during the entire period) may be explained by the absence of a specific category for "Psychopharmacology" or "Behavioral Pharmacology" as it is included in *EJP* and *JPET*.

Furthermore, a low number of articles have been published by Psychology departments in the group formed by *Clinical Neuropharmacology*, *International Clinical Psychopharmacology*, *European Neuropsychopharmacology*, *Pharmacopsychiatry*, *Journal of Clinical Psychopharmacology* and *International Journal of Neuropsychopharmacology*. 9243 articles were published by these journals (24.62%) and only 107 were published by Psychology departments (1.15%). 4 of these journals are mainly clinical, *Clinical Neuropharmacology*, *International Clinical Psychopharmacology*, *Pharmacopsychiatry* and *Journal of Clinical Psychopharmacology*, which published 7448 articles. Only 73 articles had origin from Psychology departments (.98%). This low rate of publications could be due to a preference by the non specific clinical journals or also could be indicative of a low research activity in clinical psychopharmacology. To further understand these issues an additional search was performed to find clinical studies reported by Psychology in our documental repertoire. We limited the search to "Clinical Trial, Randomized Controlled Trial, Clinical Trial, Phase I, Clinical Trial, Phase II, Clinical Trial, Phase III, Clinical Trial, Phase IV or Controlled Clinical Trial". We found 6434 clinical

articles (17.13%) and 453 corresponded to Psychology (7.05%). This percentage points to a preference for others journals instead the specific clinical journals and that clinical psychopharmacology research by Psychology departments is not so negligible, as suggested by the data obtained in the specific clinical journals included in this study. On this basis it seems reasonable to suggest that the results of this study support the view that Psychology affiliation provide a high number of studies, and thus, of knowledge in the field of Psychopharmacology.

### Limitations

Clearly, there are limitations in this type of bibliometric analysis: a) Traditionally, subfields as “psychopharmacology” have been defined in terms of sets of specialist journals but this process could not be totally satisfactory because authors can publish in a very wide range of journals and influential papers can be published in general rather than specialist ones. In fact, general Psychiatry journals must obviously be important contributors to disseminate drugs studies and these journals were not included in this study. b) The search has been performed in English, since this is the main language in the database and all the journals in the study. This means that those affiliations written in the PubMed database in other languages such as Spanish, Italian, and German are not included in this report. c) Studies in which many departments have collaborated are assigned exclusively to the affiliation that appears in the PubMed database, which in most cases is by the first author. d) Finally, the analyses of publications are only one measure by which research output can be judged. However, to carry out a broad survey in a particular discipline, as described here, this analysis allows trends to be monitored over several years. It can also be used to monitor the contribution of the different disciplines and globally allows comparison between them.

In spite of these limitations, a clear datum of this study is that Psychology participates about 11% of papers of the fifteen psychopharmacology journals of this study. To our knowledge, this report represents the first effort to explore the contribution of academic Psychology to the multidisciplinary science of psychopharmacology. Furthermore, the study also brings, for the first time, a general perspective of the development in the field of psychopharmacology and provides a first comparative analysis between different disciplines. A descriptive analysis comparing disciplines offers valuable information that enables a discipline to define its position with respect to others. These surveys offer a broad overview of the existing data and help to gather impressions of the visibility of a discipline’s production. Obviously, this quantitative result does not imply that more is necessarily better, without assessing the quality of the research produced by

the respective affiliations. Thus, additional qualitative and quantitative analyses need to be done by each affiliation focusing on the quality of these psychopharmacological studies. Although citations, as indicators of scientific merit, have had many critics (Cozzens, 1989; Seglen, 1997) a possible next approach could be to study the global impact as a proportion of citations received.

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Received October 22, 2008

Revision received March 24, 2009

Accepted June 15, 2009