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Kuhn's *Structure of Scientific Revolutions* in the Psychological Journal Literature, 1969-1983: A Descriptive Study

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The impact of T.S. Kuhn's *Structure of Scientific Revolutions* (Kuhn, 1962, 1970) on psychological-journal literature was assessed through a descriptive-actuarial study of 652 articles that cited Kuhn's monograph between 1969 and 1983, and that were published in "psychology journals," as defined by *Social Science Citation Index*. Citation frequencies, ratings of agreement and disagreement with Kuhn, a content analysis, and other data were obtained from the articles. Reception of Kuhn's monograph was found to be highly favorable but somewhat superficial, chronologically stable over the 15-year period, and marked by "revisionist" uses. Kuhn's concepts and claims were used selectively, with paradigm, crisis, revolution, and anti-positivistic themes most frequently referenced. Kuhn was cited most often in philosophical-methodological articles, but infrequently in the experimental-psychology literature. The practice of citing Kuhn was discussed, and questions were raised about the depth of Kuhn's impact on the literature.

No historian or philosopher of science can match T.S. Kuhn's visibility in psychology over the last two decades. Though he published several historical studies in the physical sciences before (e.g., Kuhn, 1957) and after (e.g., Kuhn, 1978) his *Structure of Scientific Revolutions* (Kuhn, 1962; rev. ed., 1970), that monograph has been by far the most influential of his writings among psychologists and social scientists. Kuhn's (1962, 1970) historiographic model of paradigmatic normal science and scientific revolutions was based entirely on natural-science case histories, and he explicitly discouraged application of his historical theory to the development of the social and behavioral sciences (Kuhn, 1962, pp. 160-165). Nevertheless, in the late 1960s and early 1970s, a number of writers began to use his theory and constructs in the social sciences (e.g., Stocking, 1968, pp. 7-8, 302-303; see Heyl, 1975; Hollinger, 1973; Wade,

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1977) and in psychology as well, especially experimental psychology (e.g., Boring, 1963a, 1963b, 1964; Dulaney, 1968, p. 362; Horton and Dixon, 1968, p. 578; Keehn and Webster, 1969; Kendler, 1968; pp. 390–391; Kessel, 1969; Krasner, 1971; Palermo, 1970; Singer, 1971; Tyler, 1970; see Brozek, Watson, and Ross, 1970, pp. 30–31).

It is not difficult to guess at the features of Kuhn's (1962, 1970) monograph that appealed to psychologists: for example, his use of concepts from the psychology of perception; the importance he gave to social-influence processes in scientific work; the accessibility and brevity of his principal monograph (Kuhn, 1962, 1970); and the congruence of his anti-positivistic message with various developments in psychology that promised a "fresh start" for the discipline in the 1960s and 1970s. For various reasons, a Kuhnian approach came eventually to provide many psychologists with a new model for the recent history of psychology (e.g., Bolles, 1985; Lachman, Lachman, and Butterfield, 1979; Leahey, 1980 [but see Leahey's, 1987, abandonment of a Kuhnian model]; Palermo, 1978; Rieber and Vetter, 1980; Segal and Lachman, 1972; Weimer and Palermo, 1973) and for reinterpreting the more distant origins of psychology (e.g., Buss, 1978; Kirsch, 1977; Leahey, 1980; Thieman and Brewer, 1978).

In addition to providing an historical theory of scientific change, Kuhn's *Structure of Scientific Revolutions* put into circulation the concepts of paradigm, normal science, crisis, anomaly, and revolution, which have been employed as quasi-descriptive terms to characterize a variety of research specializations, methodologies, lines of investigation, philosophical commitments, schools of thought, and trends in contemporary psychology. In addition to such descriptive/interpretive uses, Kuhn's constructs have figured in the criticism of opponents (e.g., as blindly devoted defenders of a discredited paradigm; see Kuhn, 1962, pp. 150–152) and in the legitimization of preferred alternatives among theories or frameworks. The ambiguity and elasticity of Kuhn's concepts (Kuhn, 1974, pp. 459–460) probably facilitated Kuhnian applications in psychology but, at the same time, have made it difficult to evaluate such applications (Samelson, 1973).

In the present paper, we will not attempt a general evaluation of the legitimacy and worth of Kuhn's influence on psychology, which would probably include a case-by-case assessment of the major applications of Kuhn to psychology. Instead, we will describe the *overall* pattern of usage of Kuhn's ideas in the psychological-journal literature. We limited ourselves to the psychological-journal literature, because it was more easily delimited operationally than the entire "psychological literature." Among our objectives were: (1) to distinguish between casual and systematic uses of Kuhn's monograph; (2) to describe the chronological trend of agreement and disagreement with his ideas; (3) to determine what parts of his monograph have drawn the greatest amount of attention; (4) to determine what psychological specialties

have appealed most frequently to that book; and (5) to ascertain characteristics of the use to which Kuhn has been put in the literature. The results of our investigation are propaedeutic to a more evaluative assessment of the worth of Kuhn's ideas for understanding psychology's past and present.

Method

We examined the *Social Science Citation Index* from its first volume in 1969 through its 16th volume in 1984 to find articles (a) that were published between 1969 and 1983 in "the psychological-journal literature" and (b) that cited any *English-language edition* of Kuhn's *Structure of Scientific Revolutions*. The "psychological-journal literature" was compiled from the category lists of full-coverage source journals in the *Index*, by including journals that the *Index* categorized under any "Psychology" category, or under "Behavioral Science," or under "Human Development." Given that the categories of the *Index* changed during the 15 years covered in our study, this seemed the most defensible procedure, yielding a large number of citations and minimizing (though it did not completely eliminate) year-to-year change in the source journals we included as "psychological-journal literature."

The search yielded a total of 678 articles, of which 26 articles either could not be located (one article), included Kuhn (1962, 1970) in the reference lists but not in the text of the articles (nine articles), or were in a foreign language that neither author could read (16 articles). The 26 articles were not included in any analysis except the reference-list analysis below. Each article was read by two judges (the authors), who independently applied a four-category rating scale that assessed the article's agreement or disagreement with the general validity of Kuhn's ideas or with a specific application of them—or an application of modified versions that might be called "Kuhnian ideas" (Gholson and Barker, 1985)—to psychology or to other social sciences. The categories were: Enthusiastic Endorsement, Endorsement with Reservations, Disagreement, and Rejection. (The judges employ the description of each category provided in Appendix A.) A separate category of "Mention Only" was also employed, without the four-category evaluative scale. An article was assigned to the "Mention Only" category if Kuhn's name occurred no more than twice in the text (and notes) of the article, *unless* both readers judged that Kuhn's ideas (or "Kuhnian ideas") played an important role in the article.[1] "Mention Only"

[1]This judgment—both readers judged that Kuhn's ideas played an important role in the article—occurred in 2.4% of the 501 articles that would otherwise have qualified as "Mention Only," reducing thereby the number of "Mention Only" articles to 489. Correspondingly, of 163 articles rated on the four-category scale, 23 articles (14.1%) were regarded by one or both authors as more properly cases of "Mention Only." Because these 23 satisfied the numerical criterion for inclusion among the ratable articles, they were retained among the 163.

articles were judged to be either favorable, critical, or neutral in their evaluation of Kuhn.

To protect against the differential effect of reading-and-rating practice upon the chronological sequence of articles, the 15 publication years were scrambled by using a random-number table (Winer, 1962), to generate a non-chronological reading sequence. Within each publication year, all articles were read and evaluated before the articles of the next year in the random sequence were read. The inter-judge reliability of the ratings was assessed after all the articles were read. The judges agreed on 92.5% of the rating-scale vs. mention-only judgments of the 652 articles, and agreed on 54% of the four-category ratings of articles to which each originally had assigned a rating. The readers agreed on 94% of the judgments of favorable, critical, or neutral for the 471 articles that *both* had independently assigned to the "Mention Only" category. All discrepancies were handled in the following way: the judges discussed the article, consulted their notes, and, when necessary, read the article again, whereupon they agreed on a revised rating that was entered into subsequent analyses.

Chronological Change

In order to determine whether the rate of citation of Kuhn's major work has been increasing or decreasing, the cumulative number of psychological-journal articles that cited his *Structure of Scientific Revolutions* is plotted against publication year as the filled-circle function in Figure 1.

The function clearly shows positive acceleration in its first portion, with approximately linear growth from about 1976 to 1981, and with about 60 citations per year from 1978 through 1983. A number of writers have studied the mathematical properties of the "growth" of science (e.g., Price, 1961, 1963; Rescher, 1978, chap. 4; Tague, Beheshti, and Rees-Potter, 1981) and have found that a useful indicator of growth is the doubling time: for any pair of *y*-axis values (the "size" of the citing literature) one can calculate the number of years required for the "size" to double if it continues to grow at that rate (cf. Rescher, 1978, Table 4, p. 65). Doubling times (for periods of varied length) calculated from the cumulative citations of Figure 1 are plotted as open circles over the midpoints of the periods, with a least-squares straight line fitted to these data. The slope of the straight line indicates that the period of time for Kuhn's citations to double has been increasing by half a year (actually 5 months) every year of the 15-year period we surveyed. That feature is implied in the cumulative function: keeping in mind that the doubling time will lengthen unless positive acceleration is maintained, one can readily see that the initially sharp positive acceleration of the cumulative function in Figure 1 progressively diminishes, and the function becomes almost linear from 1976 to 1981. (Number of citations for 1984 and 1985 were obtained after the project

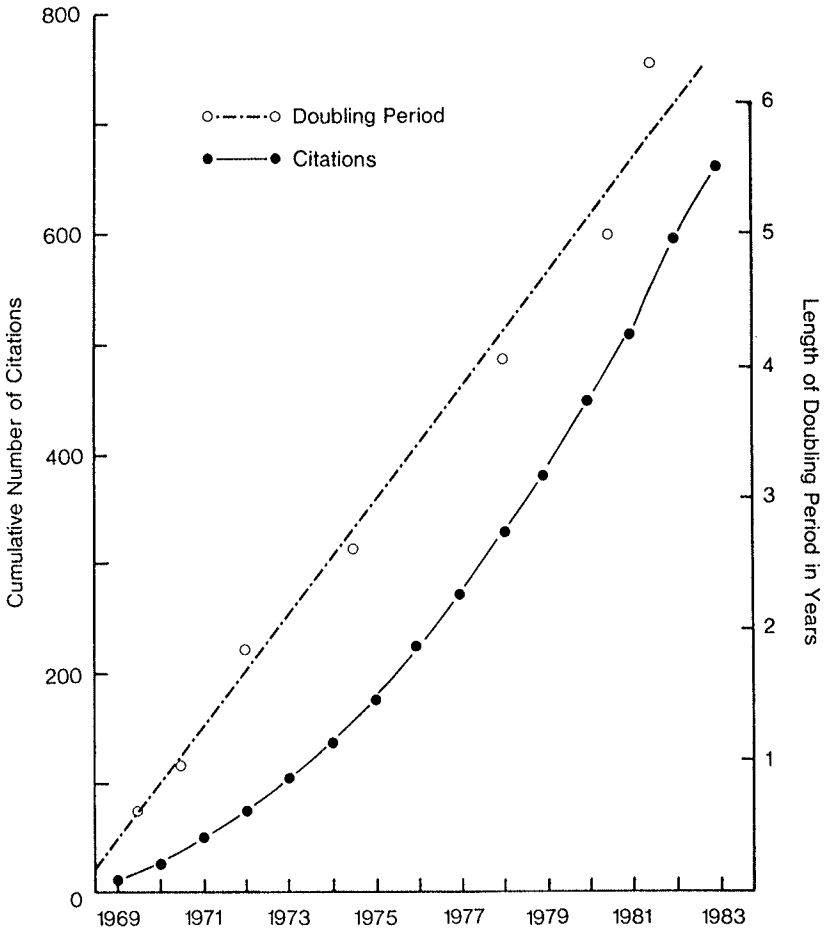

Figure 1. Cumulative number of citations of English-language editions of Kuhn's *Structure of Scientific Revolutions* in the psychological-journal literature, as defined in the present article (solid line). The dashed function is the least-squares line fitted to open-circle data points, which are the calculated number of years for citations to double, for different sections of the cumulative curve.

had been completed; the cumulative values fall roughly on an extension of the 1976–1981 straight-line section—data not shown in Figure 1. It is apparent that a downturn in the visibility of Kuhn's *Structure of Scientific Revolutions* had not yet occurred by 1985.)

Agreement and Disagreement

Table 1 shows the degree of endorsement found in the 163 articles whose use of Kuhn was sufficiently extensive to be rated on the four-category scale.

Table 1

Summary of Rated Articles and of Agreement/Disagreement with Kuhn

Number of articles in the sample		678
Number of unusable articles		26
Number of articles examined		652
Percentage of articles rated on four-category scale		25%
Percentage of 163 articles in each of the four categories		
Category 1: Enthusiastic Endorsement		29%
Category 2: Endorsement With Reservations		54%
Category 3: Disagreement		12%
Category 4: Rejection		5%
Percentage of articles judged "Mention Only"		75%
Percentage of 489 "Mention Only" articles in each subcategory		
Favorable	95%	
Critical	3%	
Neutral	2%	

Years	Total Agreement	Total Disagreement
1969–1971	96%	4%
1972–1974	92%	8%
1975–1977	92%	8%
1978–1980	95%	5%
1981–1983	92%	8%

These 163 articles comprised 25% of the articles examined. Of the 163 articles, 29% expressed "Enthusiastic Endorsement," and only 5% involved "Rejection" of Kuhnian themes, concepts, or claims. The table shows that over half the rated articles expressed "Endorsement with Reservations," and that over 10% expressed "Disagreement" without the author(s) going so far as to endorse an alternative viewpoint or historical model. Collapsing the four-category scale into Overall Agreement (Categories 1 and 2) and Overall Disagreement (Categories 3 and 4) resulted in 83% of articles on the Overall Agreement side. An even stronger margin of agreement was found in the 489 articles that only mentioned Kuhn: 95% of these "Mention Only" articles were judged as favorable mention, only 3% were judged as critical, and 2% were neutral. In "Mention Only" articles, Kuhn was usually presented as an authority (therefore "favorably") in regard to some concept or idea that he had authored or defended. A combination of Category 1 and 2 articles and of favorable-mention articles produced a Total Agreement percentage of 92% of the 652 articles.

When the 15 years of our survey were aggregated into either three-year or five-year periods, evaluations of Kuhn were found to be quite stable. Overall Agreement in the four-category rating scale varied only from 83% to 86% in five-year periods; Total Agreement (favorable "Mention Only" articles plus articles in Categories 1 and 2) was between 92% and 96% in the five three-

year periods of our survey. Even the proportion of articles that only mentioned Kuhn showed moderate stability—ranging from 69% to 80% in the five three-year periods. None of these data showed detectable chronological trends.

Intensity of Usage

Given that Kuhn is a scholar in a specialty (history and philosophy of science) that is distant from psychology, one might expect to find that his ideas were used but were not the object of intensive scrutiny. The fact that 75% of the articles were "Mention Only" is congruent with this expectation. For similar reasons, one might also expect psychological-journal authors to be somewhat inattentive to changes in Kuhn's ideas. The second edition of *Revolutions* (Kuhn, 1970) retained the original text almost unchanged; but in a "Postscript" appended to the second edition (Kuhn, 1970, pp. 174–210) and in other publications (e.g., Kuhn, 1974), Kuhn made important changes in the historical model of the first edition, as various writers have observed (e.g., Heyl, 1975, pp. 62, 64; Langsdorf and Reeder, 1985, p. 179; Lugg, 1979, p. 294; Musgrave, 1971; Paniagua and Baer, 1981; Shapere, 1971; Wade, 1977, p. 145) and as he himself has acknowledged (Kuhn, 1970, pp. 174–175, 179). Once the second edition had been published, scholarly standards would call for citing the newer edition, thereby implicitly acknowledging changes in Kuhn's formulation; on the other hand, one might expect social-science writers to be less than closely responsive to such shifts.

To test these expectations, citations of the first edition (Kuhn, 1962), the second edition (Kuhn, 1970), and other works by Kuhn were distinguished. Figure 2 plots the percentage of articles that cited only the earlier edition and the percentage that cited more than one work by Kuhn, in five periods of three years each. It is apparent from Figure 2 that over a decade after the second edition (Kuhn, 1970) had appeared, more than 40% of the articles in the psychology-journal literature continued to cite only the earlier edition. Moreover, the number of articles in the psychological-journal literature that forcefully called the reader's attention to changes that Kuhn had made from 1962 to 1970 amounted only to a dozen articles (Blunt, 1977; Bond, 1974; Buss, 1978; Cutting, 1982; Eysenck, 1983; Geiger, 1975; Paniagua and Baer, 1981; Peterson, 1981; Postiglione and Scimecca, 1983; Secord, 1977; Snoeyenbos and Putney, 1980; Stehr, 1975). The proportion of articles that cited more than one publication by Kuhn never reached 10% during the period of our survey, as Figure 2 also shows. Moreover, there were very few references to, and virtually no discussion of, the large philosophical and historical literature of appraisal of Kuhn's historiography (e.g., Achinstein, 1968, pp. 91–105; Suppe, 1977, pp. 135–151, 483–499, 643–649). Finally, in reading this Kuhn-citing literature, we were struck by the frequent use of stock phrases, such as "a

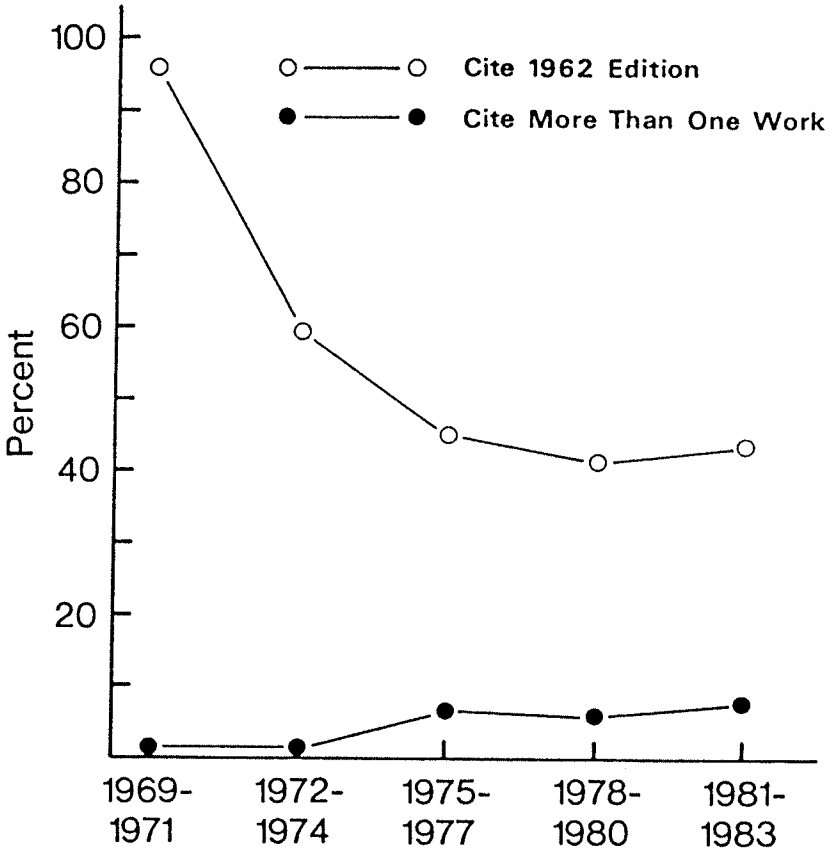

Figure 2. Percentage of the 678 articles in the original sample that cited only the first edition (Kuhn, 1962) of *Structure of Scientific Revolutions* (open circles); and percentage of articles that cited more than one of Kuhn's publications (filled circles).

paradigm, in the sense used by Kuhn." Given that Kuhn (1962, 1970) used the concept of paradigm in several senses (see, e.g., Masterman, 1970), such phrases are neither very informative nor specifically meaningful.

Among the rated articles—in which Kuhn was judged important, at least in the minimal sense of containing three or more occurrences of his name—only three articles in the literature, or about 0.5% of the 652 surveyed articles, were *strictly about Kuhn*. These were Peterson's (1981) study of the use of Kuhn in psychology, Postiglione and Scimecca's (1983) rejection of Kuhn's applicability to sociology, and Suls and Fletcher's (1983) test of Kuhn's ideas. Burgess (1972) would have qualified, if the journal in which that article appeared were included in the *Citation Index* definition of psychological-journal literature. Six articles (Burt, Farrell, Mentch, Morgan, Nelson, Patrick, Wallis,

and Masagatani, 1980; Paniagua and Baer, 1981; Reese and Overton, 1972; Ruse, 1983; Samelson, 1973; Segal and Lachman, 1972) were close to being *about Kuhn*, but they were all more concerned with a different subject, typically indicated in the title. Eight articles (Blunt, 1977; Dalby, 1980; Dooley, 1982; Eysenck, 1983; Gambino and Shaffer, 1979; Hoffman and Senter, 1978; Ramey and MacPhee, 1981; Thoresen, 1977) were *about the application* of Kuhn's ideas to some field or problem, but the field or problem was the principal subject in the papers, not Kuhn's ideas as such. The number of qualifying articles cited in this paragraph is 17, only 2.6% of the total of 652 articles examined.

Topical Analysis

Because they contained a limited and generally favorable discussion of Kuhn and of his concepts and claims, the 489 "Mention Only" articles afforded an opportunity to determine what Kuhnian concepts and claims had received the greatest amount of attention in this subset of the journal literature. The first author examined his notes and the relevant portions of these 489 articles in three successive and different yearly-random-order readings, and assigned the relevant sections of text in each article to content categories. The categories were created on the first reading, revised in the second, and checked during the third. (Appendix B contains the final category list.)

The content-category assignment procedure followed these guidelines: (1) the reader searched a given article for unitary ideas or concepts that occurred *in conjunction with Kuhn's name*; (2) textual occurrences of "Kuhn" were assigned to different content categories if they could not be brought under a single idea; (3) in the assignment, mention of the specific concept in the sentence containing Kuhn's name (or in the immediately preceding or following sentence) was crucial in the categorization; (4) the more specific category was to be preferred over the more general, and miscellaneous-type assignment (Categories 1 and 8) was to be minimized; (5) because a maximum of two occurrences of Kuhn's name were in each article, a tentative ceiling of three categories per article was set. (This limit was exceeded by one category in six of the 489 articles.)

The 489 "Mention Only" articles yielded a total of 628 distinct unitary-idea comments. These were assigned, in the three successive readings, to 53 categories, including 16 distinguishable uses of "paradigm," seven ways of referring to Kuhn as a scholar, and eight features of the anomaly-crisis-revolution component of Kuhn's historiographical model (see Appendix B).

Because chronological trends were not evident in the frequency distributions for the three five-year periods, the results of the content-analysis were combined across the three time-periods and are presented as pie-charts in Figure 3. The 628 comments were classified, by combining related categories listed in Appendix B, into the following groupings: mentions of "paradigm"

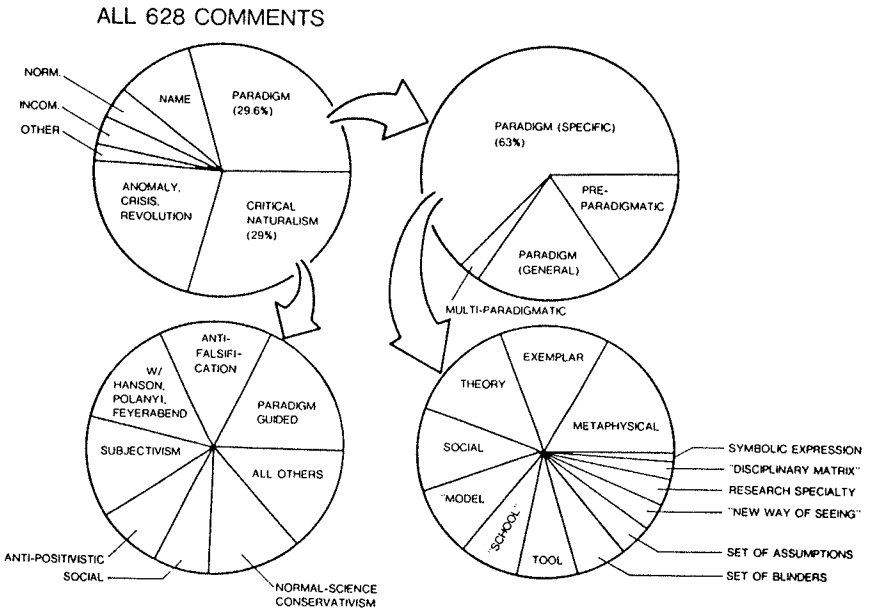

Figure 3. The upper-left pie-chart shows the proportion of 628 "unitary-idea commentaries" in "Mention Only" articles that were assigned to different groupings of content categories in Appendix A. The lower-left pie-chart classifies into distinct categories the proportion (29%) that were assigned to "Critical Naturalism." The upper-right chart divides the references to "paradigm" into four groupings, including a category of specific meanings of "paradigm." The lower-right chart distinguishes the various specific meanings of "paradigm," and shows the proportion of comments referring to each.

(Categories 10–25); discussion of Kuhnian theses that reflect a critical, naturalistic, and anti-positivistic stance (Categories 5, 27, 28, 34, 36–44, 47, 50–52); comments on anomaly, crisis, revolutionary science, and paradigm shifts (Categories 29–33, 35, 46); general discussion of normal science (Category 26); discussion of Kuhn's incommensurability thesis (Category 45; see Kuhn, 1962, pp. 147–151); thesis-free references to Kuhn (Categories 1–4, 6–8; "Name" in Figure 3); and four remaining categories (Categories 9, 48, 49, 53) that were combined as "Other" in the upper-left pie-chart in Figure 3.

The upper-left pie-chart shows that nearly 30% of the comments specifically concerned paradigms, and that 29% were comments on naturalistic/subjectivistic/relativistic/anti-positivistic themes in Kuhn's monograph. Slightly less (22%) concerned the interrelated concepts of anomaly, crisis, revolutionary science, and paradigm shift. These three clusters accounted for more than 75% of the comments. Nonevaluative, noncontroversial reference to normal science (Category 26) was the content of 27 comments or 4.3% of the total. Category 45, Kuhn's thesis of paradigmatic incommensurability, claimed 3.5% of the 628 comments.

The 186 comments on paradigms are differentiated in the upper-right pie-chart. Of this total, 16% explicitly referenced the idea of preparadigmatic research fields, most often in claims or admissions that psychology as a whole or some psychological specialty or other social science is preparadigmatic. Only 3% of the 186 comments *explicitly referenced* the notion of multiple contemporaneous paradigms in psychology or in other social-science disciplines (see Kuhn, 1970, pp. 178–179). Of all the references to paradigm, 19% were nonspecific references, in which a particular meaning of "paradigm" did not occur in the text; 63% (117 comments) referred to a particular meaning or interpretation of the concept of paradigm, and these were subdivided into distinguishable meanings displayed in the lower-right pie-chart.

Meanings of "paradigm" indicated in Categories 13, 19, 20, and 22 (see Appendix B) were relatable to portions of Kuhn's 1970 "Postscript" (pp. 182–187, 176–181, 178–179, and 182–183, respectively). The other meanings of "paradigm" were related to those Masterman (1970) found among Kuhn's (1962) original uses of "paradigm." On the other hand, some of Masterman's (1970) categories were never used in the psychological-journal literature.

The most common specific reference to paradigm was to its metaphysical meaning (see Kuhn, 1962, pp. 4–5, 17–18; Masterman, 1970, pp. 68–73), with paradigm as "exemplar" taking second place. Many of these comments designated a specific piece of research as having exemplary status. The proportion of mentions that treated paradigm as a theory (e.g., Biglan, 1973; Kovach, 1978; Staats, Minke, Martin, and Higa, 1972; compare the comments in Kuhn, 1970, p. 182), or as a family of related theories, is shown in the chart to be smaller, but to exceed the proportion of mentions that concerned the social-sociological functions that paradigms serve (e.g., Rosenberg and Gara, 1983; van de Vall and Bolas, 1982). Still fewer mentions (9.4% of the 117 references to a specific meaning of "paradigm") explicitly used the term "model" in describing what a paradigm is (e.g., Hultsch and Pentz, 1980; London, 1972), and 9% designated as paradigmatic some school of psychology such as behaviorism, psychoanalysis, or Gestalt psychology (e.g., Kegan, 1978; Mackenzie and Mackenzie, 1974; cf. Samelson, 1981). Nine percent of the 117 specific references proposed that a "tool," a method or procedure—most often a statistical procedure (e.g., Endler, 1973; but see Rucci and Tweney, 1980, pp. 180–181, for a dissenting opinion)—served as a paradigm. The remaining distinguishable meanings and their respective proportions are indicated in the chart. Less than 3% *explicitly referenced* Kuhn's notion that a paradigm is a "disciplinary matrix" (e.g., Hilbert and Wright, 1982; see Kuhn, 1970, pp. 181–187).[2]

[2]Given that Kuhn (1970, p. 182) explicitly introduced the notion of "disciplinary matrix" and used it eleven times in his "Postscript" (Kuhn, 1970, pp. 174–210), one might have expected that construct to have been explicitly utilized in discussion, as some writers have done (e.g., Leahey, 1980, pp. 5–6, 206–209). Therefore, Category 13 required explicit use of "disciplinary matrix," even

Finally, out of the original 628 comments, 29% (a total of 182) mentioned Kuhn's proposals that appear to go against positivistic views of science as an objective, incrementally progressive, rational enterprise, relatively immune to social forces and to merely personal (i.e., "subjective") sources of error, as the upper-left pie-chart shows. These 182 comments are further categorized in the lower-left pie-chart. Category 37 (see Appendix B) contained 33 comments (amounting to 18% of the 182) proposing that scientific work (especially observation) is "paradigm-guided," that observation is affected (but *not determined*) by assumptions that ordinarily are taken for granted or are unnoticed (e.g., Bengston and Cohen, 1979; Jayewardene and Singh, 1979; Morrison, 1975). The epistemologically more extreme and relativistic proposal ("subjectivism" in the pie-chart, Category 42 in Appendix B) that scientific observation is radically subjective and that *all* scientific facts are perspectival claimed 13% of the 182 comments (e.g., Abroms, 1978; Carey, 1980). Fourteen percent of the 182 comments expressed the related strong claim (Category 44, and "anti-falsification" in the figure) that science, especially normal science, neglects embarrassing facts, does not test its core assumptions, or is defensive and immune to falsification (e.g., Fischoff and Beyth-Marom, 1983; Lifton, 1973). Kuhn was placed in the company of Hanson, Polanyi, and Feyerabend (in any combination) in 14% of the 182 "Critical Naturalism" comments. Specifically anti-positivistic conclusions (Category 51) totaled 7.7%, and the claim that science is an irreducibly social enterprise (Category 38) amounted to 7.1% of the 182. Various references to presumptive normal-science conservatism (combined Categories 27, 28, and 34 in Appendix B) was the theme in 11.5% of the 182 (e.g., Greenwald, 1980, p. 610; Palmer, 1974).

Having refined the list of topical categories on the "Mention Only" literature, the same categorizing procedures were tried out on the 163 articles that had been rated on the four-category scale of agreement and disagreement. The first author re-read these articles in two different random-order readings, and, employing the methods for content classification of "Mention Only" articles, applied the categories of Appendix B to each textual occurrence of "Kuhn," in order to ascertain what concept or claim was being attributed to or authorized by Kuhn. (The procedure was eventually found to be considerably more laborious and rather less clear-cut than was its application to the "Mention Only" literature, in which the use of Kuhn's concepts or ideas was typically delimited to the locations in the text at which his name appeared. Many of the rated articles discursively elaborated on Kuhn's concepts without specific attribution to him, a practice that made Kuhn's role in these articles more diffuse.)

The procedure yielded 990 comments, which were classified into the same

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though some articles referenced the sociological notions that "disciplinary matrix" covers without actually using the term; those were included in the Social category of "paradigm."

53 categories used for the "Mention Only" articles. Of the 990, there were 84 comments (about 8.5%) that could not be accommodated into the existing categories, leaving 906 categorized comments. Product-moment correlation coefficients were calculated between category frequencies of rated and "Mention Only" articles. All four correlations were significant beyond the .01 level: $r = .79$ for all 53 categories; $r = .96$ for the seven category groups in the upper-left pie-chart of Figure 3; $r = .81$ for the category groups of the lower-left pie-chart in Figure 3; $r = .76$ for categories of reference to the concept of paradigm (see the lower-right pie-chart of Figure 3). Given the magnitude of these correlations, it is reasonable to conclude that the 163 articles that made extensive use of Kuhn did so in a content-wise fashion that was moderately similar to that exhibited by articles that only mentioned Kuhn.

Kuhn's monograph seems to have lent itself to "revisionist" uses (see Leahey, 1980, p. 356; Peterson, 1981, pp. 11–15) in the sense of describing or defending some specific conceptual or theoretical change as a scientific revolution. Nearly half (48%) of the content-categorized comments in the 652 articles concerned crisis, anomaly, scientific revolution, and themes critical of positivistic portraits of science as rational, incrementally progressive, and nonmetaphysical. In order to identify the purported losers in presumptive scientific revolutions, all articles that referred to scientific revolution (Category 31 in Appendix B) were examined. There were 162 references to scientific revolution, of which 94 identified a specific loser or winner and 68 did not. Of the 94, the most frequently identified loser was behaviorism (13 cases); psychoanalysis (4 cases), pre-Chomskyan linguistics and functionalist-behaviorist psychology of language (6), Newtonian physics (4), and the "mechanistic" scientific worldview (5) were also identified as actual or possible losers in scientific revolutions. The most frequently identified victorious paradigms were predictable from a list of the losers, and they included cognitive psychology, behavior therapy, Chomskyan linguistics and psycholinguistics, Einsteinian physics, and psi physics (i.e., the presumptive physics of parapsychological phenomena). Although clearly favored targets existed, heterogeneity was even more the norm: the 94 targets of revolution required 44 categories, 61% of which were single-member categories such as *Naturphilosophie* (Chessick, 1977), blood-lipid research (Dimsdale, 1982), incest theory (van den Berghe, 1983), and Cartesian theory of disease (Frank, 1975).

Citation as a Function of Journal

The citations of Kuhn were distributed over psychology journals in an uneven fashion. A handful of journals contained many citations, and—at the other extreme—a large number of journals, 89 in all, contained only one or two articles apiece citing Kuhn's *Revolutions*. Figure 4 is a frequency distribution of the number of journals that contained various numbers of articles

referencing Kuhn's monograph in the 15-year period of our survey. The figure makes clear that most journals contained but one article (median = 1.75; mode = 1.00) that cited Kuhn's *Revolutions*, and that progressively fewer journals contained more articles.

To explore features associated with journals at the high- and low-frequency ends of the distribution, the 89 journals with one or two articles apiece and the five journals with 20 or more articles apiece were selected out. The low-frequency journals contained 104 articles, and the high-frequency journals yielded 159 articles. The articles were compared for whether Kuhn was only mentioned in a given article or was given sufficiently detailed treatment to qualify for the application of the four-category rating scale. The high-frequency and low-frequency journals did not differ significantly in the proportion of articles that treated Kuhn in enough detail to be rated ($\chi^2 = 1.51$; $df = 1$; $p > .20$). Nor did the high- and low-frequency journals differ significantly in terms of the proportion of articles that were in Total Agreement (i.e., Categories 1 and 2 and favorable Mention) or Total Disagreement (i.e., Categories 3 and 4 and critical Mention) with Kuhn ($\chi^2 = 1.94$; $df = 1$; $p > .15$).

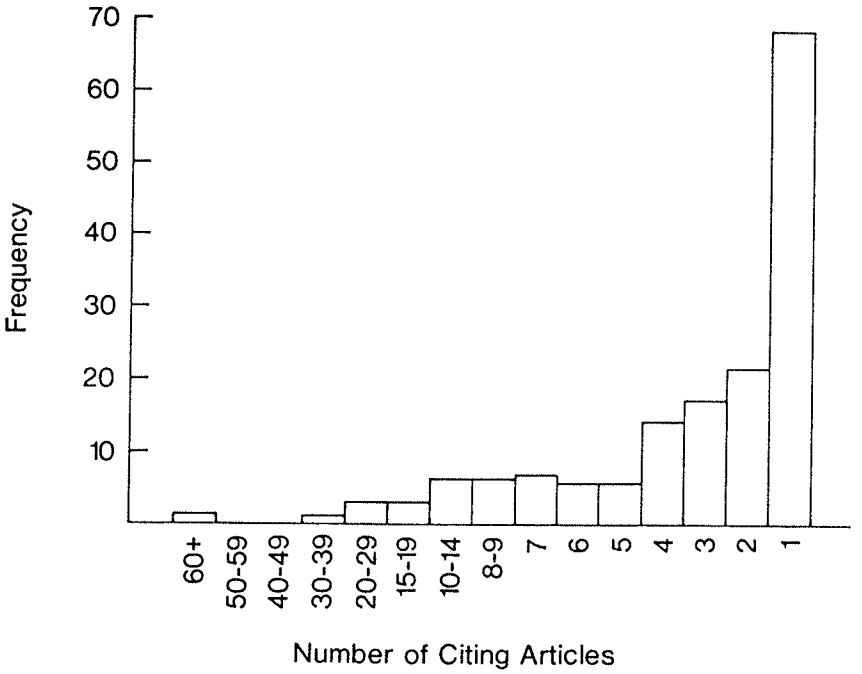

Figure 4. Frequency distribution of the number of journals containing various numbers of articles that cited Kuhn (1962 or 1970).

Table 2

Journals Most Frequently Citing Kuhn's Monograph and Number of Articles Citing It in Each Journal

Journal	Number
American Psychologist	62
Journal of the History of the Behavioral Sciences	35
Behavioral and Brain Sciences	25
American Behavioral Scientist	21
Personality and Social Psychology Bulletin	20
Counseling Psychologist	17
Human Development	16
Psychological Reports	16
Journal of Personality and Social Psychology	14
Behavioral Science	13
Bulletin of the British Psychological Society	12
Journal of Humanistic Psychology	12

The dozen journals that contained the greatest number of articles citing Kuhn's *Structure of Scientific Revolutions*, together with the number of Kuhn-citing articles in each journal, are identified in Table 2. These dozen journals contained 40% of the 652 articles in our survey. It is no surprise to find Kuhn's historical monograph cited often in the *Journal of the History of the Behavioral Sciences*. *American Psychologist* and *Behavioral and Brain Sciences*, especially the former, publish articles that typically discuss issues rather than presenting empirical findings, and are on subjects that are timely, controversial, and of interest to broad sections of the discipline.

The presence of two social psychology journals in Table 2 reflects the "crisis of social psychology" theme that was prominent in the mid-1970's. Articles in *Human Development* referenced Kuhn (1962, 1970)—and often Stephen Pepper (1942) and the Overton-Reese papers (Overton and Reese, 1973; Reese and Overton, 1970)—in debate over mechanistic and organismic paradigms or world-views for developmental psychology (e.g., Hultsch and Hickey, 1978), or in regard to the possibility that Piaget's work is paradigmatic (e.g., Hall, 1980). Journals that infrequently cited Kuhn included the exclusively empirical-experimental journals. Some other psychology specializations appear to have been relatively untouched by Kuhn's proposals, in the sense of not citing Kuhn's *Revolutions*, but no effort will be made here to enumerate all these areas by listing their journals.

Citation as a Function of Specialty Area

The judges together classified each of the 652 articles into a psychology specialty area to ascertain which specialties cited Kuhn's monograph most often and least often. Making classifications on the basis of the title of the

article, the journal in which it appeared, and the notes each judge had taken in reading it, the judges assigned each article to the specialty area about which it had been written. The "Philosophical" category was reserved for philosophy of science, methodological issues in psychology as a whole, and articles concerned with the progress, status, or problems of the discipline of psychology as a whole. "Behavior" included conditioning, animal learning, and behavior theory. "Developmental" included child, adolescent, life-span, Piaget, and the topic of play. All forms of therapy, including psychoanalysis, were included in "Therapy." The "Cognitive" category included attention, problem solving, psycholinguistics and language learning, reading research, decision processes, and so on, but not perception (itself a numerically small category). Seventy-five percent of the results of classification are encompassed in the frequency distribution in Figure 5.

Kuhn's monograph was most frequently cited in articles about philosophical, conceptual, and methodological issues, or about the progress or problems of psychology as a whole. Articles that concerned psychotherapy of all types were in second place. Cognitive, social, history of psychology, and developmental psychology were similar in overall frequency of citation, which was about 50 articles in the 15-year period of our survey. Not shown are specialties that cited Kuhn very infrequently by virtue of apparent inattention to Kuhn (e.g., perception research, motivation research, and biopsychological research) or because of the small number of journal outlets for that particular specialty at the time (e.g., sport psychology, psychology of women, and psychology of law).

Temporal patterns in the citation of Kuhn's *Revolutions* as a function of specialty area were minimal. Dividing the bar-graph data of Figure 5 into subtotals for three five-year periods (figure not shown) revealed almost linear increases in the number of Kuhn-citing articles over the three periods for all specialties except social psychology, in which a bulge during 1974–1978 reflected primarily the wave of Kuhn-citing papers on "the crisis in social psychology" (cf. Rosnow, 1981, pp. 73–95), especially in *Personality and Social Psychology Bulletin.*

Reference-List Analysis

Kuhn's *Structure of Scientific Revolutions* was preceded by Michael Polanyi's (1958) *Personal Knowledge* and Norwood Hanson's (1958) *Patterns of Discovery.* Both writers developed anti-positivistic arguments by calling into question the "traditional" picture of scientific work as objective, impersonal, and free of metaphysical prejudice; Kuhn has often been placed by philosophers in the same category with them and with Paul Feyerabend. It would be of interest, therefore, to see whether comparable frequencies of co-citation existed

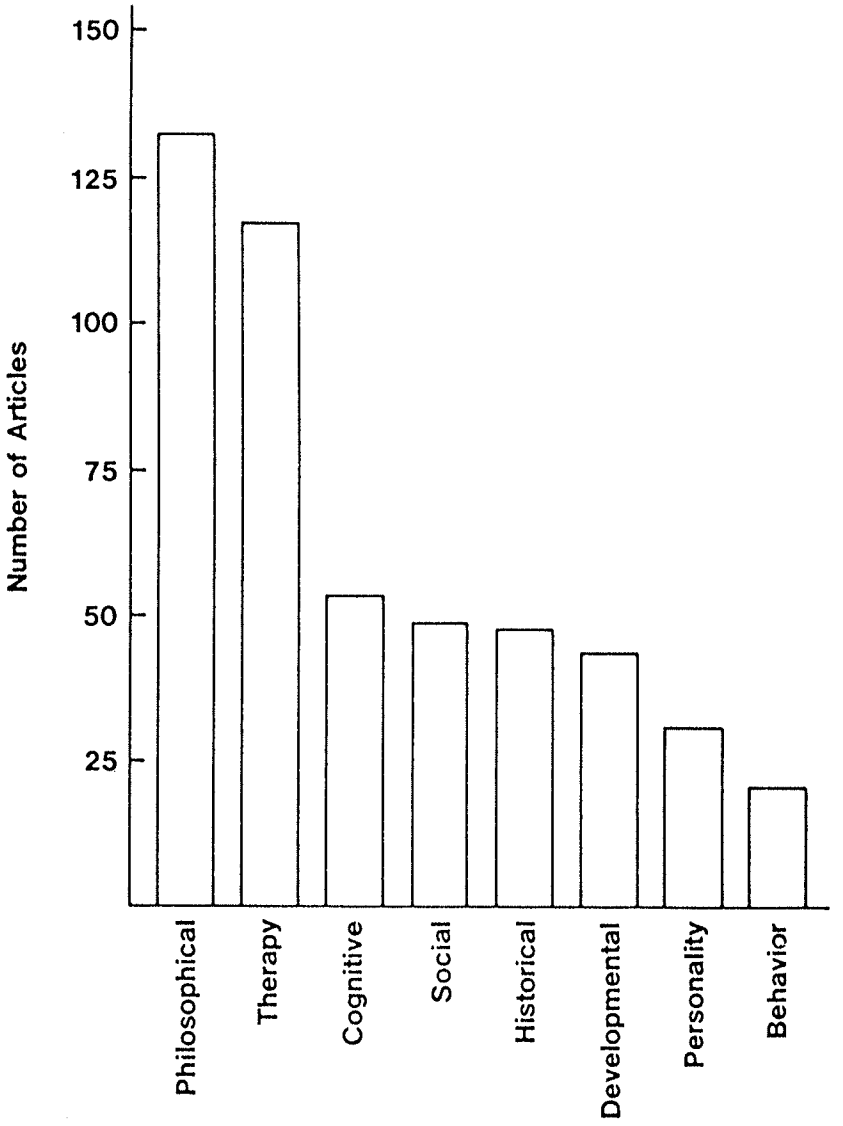

Figure 5. Frequency distribution of the number of articles citing Kuhn (1962 or 1970) as a function of the psychological specialty or subject area of each article.

in the psychological-journal literature. In order to determine this, the reference list of each article was searched for works in the category of philosophy of science broadly considered,[3] especially for Polanyi, Hanson, and Feyerabend,

[3]The "philosophy of science" included the writings of such figures as Popper, Lakatos, Feyera-

Table 3

Philosophers of Science Co-Cited in Articles Surveyed and Number of Articles Citing Each

Philosopher	Number
Popper	84
Polanyi	58
Feyerabend	47
Lakatos	42
Hanson	33
Nagel	28
Hempel	26
Toulmin	25
Bertalanffy	24
Harré	21
Kaplan	17
Overton and Reese (1973); Reese and Overton (1970)	17
Maslow (1966)	16
Habermas	15
E. Brunswik	14
Pepper (1942)	14
Quine	14
Scriven	14
Berger and Luckmann (1967)	13
Rychlak (1968)	13

and by others with whom he might be linked (e.g., Lakatos, Popper, and Toulmin). The overall percentage of articles that cited at least one philosophy-of-science work was 49%; and this percentage showed a decrease over the three five-year periods of our survey, with percentages of 60%, 52%, and 45% for the 1969–1973, 1974–1978, and 1979–1983 periods, respectively. Of the articles that cited at least one philosopher of science (broadly considered) other than Kuhn, 36% cited exactly one, 87% cited five or fewer, and 3% cited ten or more philosophers of science.

Table 3 lists the most frequently cited writers (or specific works) in the philosophy of science in the 678 articles[4] of our sample, and the number of articles citing them. By a substantial margin, Karl Popper was the most fre-

bend, Polanyi, Toulmin, Scriven, Hanson, Hempel, Carnap, Feigl, Reichenbach, Bergmann, Bridgman, Pap, Laudan, Suppe, Bhaskar, Harré, and others. Works in philosophical-conceptual problems in psychology (e.g., Brunswik, 1952; Fodor, 1968; Kessel, 1969; MacCorquodale and Meehl, 1948; Mahoney, 1976; Singer, 1971) were also included, but not work in the sociology of science (e.g., publications of Merton, Crane, Price, and the Coles). References, ranging in number from 2 to 84, to a total of 48 writers were collected (list and citation frequencies available on request). Seventy-one percent of the references appear in Table 3.

[4]The Source volumes of the *Social Science Citation Index* present complete reference lists of citing articles, thus permitting the lists to be analyzed in all 678 articles of our survey.

quently co-cited philosopher, and Polanyi, Feyerabend, Lakatos, and Hanson followed at a distance. A few neo-empiricist philosophers (Nagel, Hempel) were also cited, though somewhat less frequently. (Some writers simply included Kuhn in a heterogeneous listing of philosophers.) Psychologically based philosophies of science (Maslow, 1966; Rychlak, 1968) were also cited. Bertalanffy, a general-systems and organismic theorist, was co-cited primarily in articles that came from *Behavioral Science*; references to the Overton-Reese papers and Stephen Pepper (1942) came largely from the developmental psychology journals.

The fact that Popper was the most frequently co-cited of the philosophers suggested that a descriptive comparison of citations to Kuhn and Popper might be of interest. The total number of citations of *all* works by Popper and by Kuhn in the psychological-journal literature of the *Social Science Citation Index* was therefore obtained on a yearly basis, and the cumulative citations are plotted against journal-article publication year in Figure 6. It is apparent that Kuhn's quantitative impact began to surpass that of Popper in the mid-1970s, and that the resulting gap has slowly widened. At present Kuhn is the most frequently cited historian/philosopher of science in the psychological-journal literature.

Conclusions

Our intentions were to assess the kind of reception Kuhn's classic monograph had received in the journal literature and the uses to which some of Kuhn's ideas had been put. Because our objectives were primarily descriptive, our conclusions will not wander far beyond what our findings clearly warrant.

First of all, appeal to Kuhn has been chronologically stable at least for the decade of 1976–1985. No noticeable changes were found either in the favorableness of response to Kuhn or in specific ideas appropriated from him. Second, the journal literature was largely favorable in its use of Kuhn; 95% of articles casually citing Kuhn and 83% of those intensively using Kuhn were favorable toward his concepts or toward views attributed to him (see Table 1). Third, reference to Kuhn was frequent, in the sense that currently he stands as the most often cited philosopher of science in this literature (Figure 6).

Fourth, Kuhn was used selectively. Although "paradigm" was Kuhn's most popular concept, there were few explicit endorsements of the idea that psychology contains a number of different paradigms at any particular time. In view of the fact that "Schools of Psychology" is a time-honored construct for discussing the history of psychology (e.g., Fuchs and Kawash, 1974; Heidbreder, 1933; Woodworth, 1948), and particularly given Kuhn's discussion of

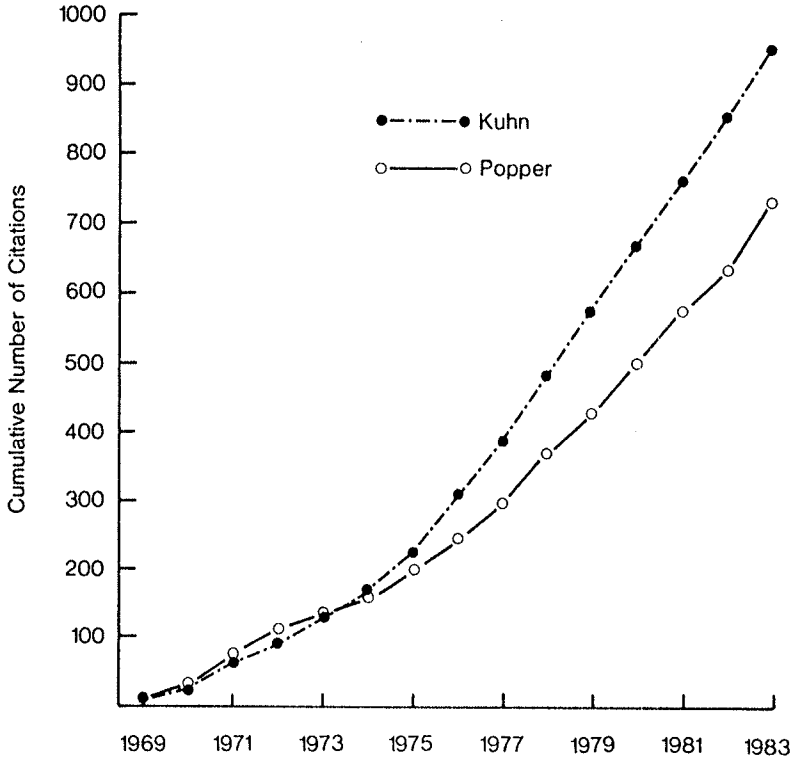

Figure 6. Cumulative number of articles in the psychological-journal literature citing any publication of T.S. Kuhn (dotted line) or any publication of K.R. Popper (solid line) as a function of the publication year of the article.

small paradigmatic communities (Kuhn, 1970, pp. 177–181), one might have expected more frequent acknowledgement of psychology's "paradigmatic" multiplicity. Kuhn's revised notion of paradigm as a disciplinary matrix (Kuhn, 1970, pp. 181–187) drew comparatively few explicit references (see Figure 3), perhaps because it was a revised claim presented in the "Postscript–1969" (Kuhn, 1970, pp. 174–210), and perhaps because it was the cornerstone of Kuhn's (1970) more sociological and less metaphysical re-identification of paradigms in the Postscript. (Metaphysical and theoretical meanings of "paradigm" were the favorites in the literature we surveyed.) *Critical* mention was also one-sided: the Kuhnian concepts most often singled out for unfavorable comment were "paradigm," "scientific revolution," and "crisis." Therefore, "selective" seems to be an appropriate summarizing term.

Fifth, despite such selectivity, applications of Kuhnian concepts were quite

heterogeneous. Specializations said to be paradigms and historical changes identified as scientific revolutions comprised heterogeneous categories, as noted above. The elasticity of Kuhn's concepts surely facilitated such variety of application; but if Kuhn (1962) doubted that the social sciences had *any* paradigms (Kuhn, 1962, pp. 160–165; but see the change in the Postscript in Kuhn, 1970, pp. 176–181), then it is quite irregular for social-science writers to identify *so many and varied* paradigms.

Sixth, in sharp contrast with the impressive *number* of citations of Kuhn is the overall superficiality of the uses of Kuhn. The majority (75%) of articles merely mentioned Kuhn; abundant references solely to the earlier edition (Kuhn, 1962) persisted after the second edition (Kuhn, 1970) had appeared, and more than 90% of the articles cited just one of Kuhn's publications (see Figure 2); less than 3% of the articles were strictly about Kuhn or about the application of Kuhnian ideas. Only half of the Kuhn-citing articles cited any other works in the philosophy of science, and about 75% of these articles cited three or fewer philosophers of science.

The most convincing sign of superficiality is the failure, in the bulk of the journal literature we surveyed, to refine the Kuhnian message, retaining that which has proved valuable, and accommodating both the relevant critical literature of philosophers and historians of science and the relevant empirical findings of the few who have actually tested out Kuhn's ideas on happenings in the recent and remote past of psychology. In the majority of cases, a few of Kuhn's ideas or concepts were simply taken over without indication that the writer was aware of Kuhn's less obvious claims (Peterson, 1981), or was sensitive to the subtlety of some of Kuhn's distinctions (Kuhn, 1974), or was acquainted with the critical literature in the history and philosophy of science. Though informed voices can be heard (e.g., Gholson and Barker, Overton, Peterson, Reese, Samelson, and Weimer), a cumulative sophistication was not clearly apparent in the bulk of the journal literature.

If citing Kuhn did not arise typically from familiarity with the philosophy of science, then it must have come from other motives, some of which are easily imagined. Citing Kuhn (1962, 1970) minimally showed that the writer was *au courant* and, therefore, may have served more as a rhetorical strategy than as substantive assertion in most of the citations (Bavelas, 1978; Cronin, 1981, 1982). Further along the dimension of substantive use, citing Kuhn (1962, 1970) connected the author's subject to then-current concerns, a task often carried out in an article's introductory portion. (Both judges made the informal observation that the majority of articles referenced Kuhn in their first page or two.) Such conceptual links can, of course, be specious: to call something a paradigm is to amplify its importance by means of a rhetorical device. Widespread use of Kuhn for such a purpose can result in the scholarly equivalent of inflation. In this regard, the heterogeneity and singularity

of purported paradigms and of alleged scientific revolutions suggest that many invocations of Kuhn originated in the impulse to magnify the significance of the author's findings, conclusions, or reflections. Rhetoric is probably more important during periods in which new developments are entering the specialty. Particularly in the early 1970s, Kuhn was cited in appeals for alternatives to established but embattled systems, most frequently for alternatives to psychoanalysis and for the replacement of behaviorist with cognitivist programs (e.g., Palermo, 1971; Segal and Lachman, 1972). Kuhn was most often cited in the literatures of psychotherapy and of cognitive, developmental, and social psychology; all of these specialties underwent foundational changes or conflicts during the period of our survey.

Our techniques guaranteed that the great number of articles that casually cited Kuhn would outweigh the much smaller number of more detailed critical studies of Kuhn's model in the journal literature (e.g., Peterson, 1981; Postiglione and Scimecca, 1983). A careful analysis of those occasional critical studies, though clearly a worthwhile undertaking, lies outside the scope of the present project. Because many evaluative questions are questions about the discipline generally, our findings are pertinent to such assessment, even though our procedures—because they were directed at an entire Kuhn-citing literature—do not entail an appraisal of the worth of Kuhn's ideas in *particular* psychological specialties or of the uses to which Kuhn has been put in the comparatively few studies that have borrowed most intensively from his monograph. Moreover, macro-level shortcomings in the journal literature do not preclude the possibility that some applications of Kuhn, especially in the literature of monographs and edited books, will be judged to be sophisticated and fruitful. However, our results do indicate that the mere fact of Kuhn's high visibility in the journal literature does not imply that psychology and the social sciences have digested Kuhn's ideas about the history of science.

There are signs of growing interest in reassessing Kuhn's value for psychology (e.g., Gholson and Barker, 1985; Manicas and Secord, 1983; Reese, 1984) and in exploring the applicability of other philosophies of science (e.g., Bhaskar, 1975; Harré, 1972; Lakatos, 1970, 1978; Laudan, 1977, 1984); even so, Kuhn's citability appears presently to be still quite high, as Figure 1 suggested, which implies that he is not likely to be replaced overnight. If a transition from one philosophy of science to another is in the offing, one hopes it will be based on informed appraisal of the demonstrated value of the contestants in their respective applications to psychology. We hope the present article will make a factual contribution to an appraisal of the value, for psychology, of the ideas of Kuhn's (1962, 1970) monograph.

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Appendix A

Four-Category Scale for Rating Articles

Category 1: Enthusiastic Endorsement. The author strongly endorses Kuhn's ideas; the author claims or assumes that Kuhn's ideas can be applied to the history or status of psychological or social/behavioral sciences. The endorsement is full, even enthusiastic. No reservations are expressed, or else reservations appear to be perfunctory. Kuhn is the central figure among the various authorities cited.

Category 2: Endorsement With Reservations. The author generally agrees with Kuhn's ideas or claims or with their applicability to psychological or social/behavioral sciences, but the endorsement is not strong enough to be Category 1; or Kuhn is not the most important figure cited or employed. The author is clearly not on the "disagreement" side; though the overall tone is one of agreement, it is not a full endorsement because reservations are expressed or else Kuhn is not important enough in the article.

Category 3: Disagreement. The author generally disagrees with Kuhn's ideas or Kuhnian ideas, either by themselves or in their application to psychological or social/behavioral sciences. The overall position is one of disagreement, and the reservations about Kuhn are strong; but Kuhn's views are not completely rejected, and the author does not go so far as to endorse and defend alternative views.

Category 4: Rejection. The author disagrees strongly with Kuhn's ideas or their applicability. The overall tone is one of criticism; the reservations are major, and the author presents them as major objections. The author rejects Kuhnian ideas and (typically) offers an alternative in place of Kuhn's ideas.

Appendix B

Categories for Content Analysis

No.	Description
	PERSONAL REFERENCE (Categories 1–8)
1	Name only.
2	Kuhn described as historian of science.
3	Kuhn described as philosopher of science.
4	Kuhn as a "rationalist" or "social constructionist."
5	Kuhn cited in text with Feyerabend, Hanson, or Polanyi.
6	Kuhn as a theorist of dialectical development.
7	Kuhn as a system theorist.
8	Global reference to "Kuhn's ideas" on scientific development, change, structure, etc., not necessarily accurate.
	SCIENTIFIC MATURITY (Categories 9–11)
9	Reference to Kuhn's division of natural and social sciences.
10	Preparadigmatic, especially for psychology or social sciences.
11	Multiparadigmatic status of a discipline.
	PARADIGM (Categories 12–25)
12	Generic reference to paradigm or paradigmatic science.
13	Paradigm as "disciplinary matrix" (Kuhn, 1970, pp. 182–187).
14	Paradigm as *Weltanschauung*, frame of reference, a Zeitgeist, a "super theory," or metaphysical system.
15	Paradigm as an exemplar (e.g., Kuhn, 1970, pp. 187–191).
16	Paradigm as a "model."
17	Paradigm as a theory or a family of related theories.
18	Paradigm as that which unifies a research area; paradigm as serving a sociological function (e.g., Kuhn, 1970, pp. 176–181; Masterman, 1970, pp. 65–66).
19	Paradigm as a discipline, subdiscipline, or research specialty.
20	Paradigm as a "School of Psychology," such as Functionalism, Behaviorism, or Gestalt.

21 Paradigm as a tool, a device, a method or technique, as opposed to a concrete problem solution.
22 Paradigm as a symbolic expression (Kuhn, 1970, pp. 182–183).
23 Paradigm as a set of "assumptions."
24 Paradigm as a set of "blinders."
25 Paradigm as "a new way of seeing."

NORMAL SCIENCE (Categories 26–28)

26 Generic reference to normal science; a condition in which there is characteristic activity, notable consensus, and problem solving (as distinct from "revolutionary science").
27 Normal science as a condition in which a paradigm is merely accepted but not tested critically or actively debated.
28 Normal science as science conducted under a set of blinders that are persistent and hard to change.

ANOMALY, CRISIS, AND REVOLUTION (Categories 29–34)

29 Anomaly; crisis; a particular anomaly, or a general state of crisis related to several anomalies.
30 Confrontation of theory or paradigm with data; the active testing of a paradigm; conflict between paradigm and data.
31 Scientific revolution; paradigm shift as a discontinuous change resulting from a scientific revolution.
32 Revolutionary science; science in a revolutionary period.
33 Paradigm clash; conflict between two paradigms; science as a competitive enterprise of conflict between rival paradigms.
34 Paradigm shift does not occur until a better paradigm exists.

THE QUESTION OF PROGRESS (Categories 35–36)

35 The *success* of the new paradigm, especially in accounting for the old paradigm's anomalies; progress through revolutions.
36 Scientific change is *not* cumulative-progressive, or does not follow a logical-conceptual progression.

PRESUPPOSITIONS AND "SUBJECTIVISM" (Categories 37–44)

37 Scientific work or observation is *paradigm-guided*, obeys a world model, involves interpretation guided by assumptions taken for granted or unnoticed.
38 Scientific work includes metaphysical issues/disagreements.
39 Science is a social enterprise.
40 Science is a historical phenomenon.
41 The societal matrix influences the conduct of science; the fact-value distinction is questioned.
42 Subjectivism: scientific observation is prone to error because it is radically subjective; all "facts" are perspectival and theory-laden; the fact-theory distinction is rejected; science is treated relativistically.
43 Normal science is marked by a strongly nonempirical or irrational component; choice of paradigm by a community is based not on empirical or rational groups but on "irrational" grounds.
44 Embarrassing facts are neglected; the paradigm is immune to falsification; *modus tollens* is not practiced; science is dogmatic and defensive; normal science is paradigm-conserving and actively resists falsification.

PARADIGM SHIFT AND THE PSYCHOLOGY OF THE SCIENTIST (Categories 45–49)

45 Incommensurability thesis: paradigms are radically different, making dialogue and comparison impossible.
46 A scientific revolution involves the experience of radical cognitive-perceptual discontinuity in the scientist, which is something like a "religious conversion" or a "Gestalt switch."
47 Psychology of the individual scientist: he or she is *committed* to certain views and therefore functions not as a detached theory-tester but more as a disciple.
48 "Planck's thesis": the dying out of the defenders of the old paradigm is the way in which a paradigm finally disappears.
49 Generational thesis: the young scientists are the ones who are most readily converted to the emerging paradigm.

AGAINST OBJECTIVISM (Categories 50–53)

50 Scientific textbooks involve distortion and indoctrination, serving conservational functions.
51 Anti-positivistic: actual scientific work does not fit a "positivist" (empiricistic, incrementalist, foundationalist, justificationist) philosophy of science.

52 Science, as it is actually practiced, cannot be seen as progress toward Truth or conformance with Reality.

53 Historical work reinterprets the past, rewrites the past.