



Lewis and Quine in context

Sander Verhaegh¹

Received: 19 March 2023 / Accepted: 17 May 2023 / Published online: 19 June 2023
© The Author(s) 2023, corrected publication 2023

Abstract

Robert Sinclair's *Quine, Conceptual Pragmatism, and the Analytic-Synthetic Distinction* persuasively argues that Quine's epistemology was deeply influenced by C. I. Lewis's pragmatism. Sinclair's account raises the question why Quine himself frequently downplayed Lewis's influence. Looking back, Quine has always said that Rudolf Carnap was his "greatest teacher" and that his 1933 meeting with the German philosopher was his "first experience of sustained intellectual engagement with anyone of an older generation" (1970, 41; 1985, 97-8, my emphasis). Quine's autobiographies contain only a handful of biographical references to Lewis and he regularly soft-pedaled the latter's influence in private correspondence. In this note, I discuss some archival evidence that helps us better understand Quine's reluctance to acknowledge Lewis's influence. I contextualize the relation between Lewis and Quine and argue that the latter viewed his teacher as a retrograde force in modern epistemology, impeding the more rigorous approach that Carnap had been developing in Europe. Next, I briefly discuss Lewis's contribution to the development of scientific philosophy in the United States and argue that Quine underestimated his teacher's role in this process. In doing so, I argue that Quine's zealous commitment to Carnap's approach negatively affected his assessment of Lewis's influence, thereby supplementing Sinclair's praiseworthy reconstruction with an explanation of why Quine himself underestimated Lewis's role.

Keywords Quine · Lewis · Carnap · Sinclair · Logical empiricism · Conceptual pragmatism

✉ Sander Verhaegh
A.A.Verhaegh@tilburguniversity.edu

¹ TiLPS, Department of Philosophy, Tilburg University, Tilburg, Warandelaan 2, 5032AB, The Netherlands

1 Introduction

Robert Sinclair's *Quine, Conceptual Pragmatism, and the Analytic-Synthetic Distinction* persuasively argues that Quine's epistemology was influenced by C. I. Lewis's pragmatism. Sinclair analyzes Quine's student papers, his first articles, and his philosophical publications up until "*Two Dogmas of Empiricism*" (Quine, 1951) and reconstructs to what degree they were informed by or a response to Lewis's epistemology. Several philosophers close to Quine—most notably Donald Davidson (Davidson, 2004, 237)—had hinted at the similarities between their views. But Sinclair is the first to trace in detail the influence of Lewis's work on Quine's ideas about meaning, analyticity, and the foundations of empirical knowledge.

Sinclair's account raises the question why Quine himself frequently downplayed Lewis's influence. Looking back, Quine has always said that Rudolf Carnap was his "greatest teacher" and that his 1933 meeting with the German philosopher was his "first experience of sustained intellectual engagement with *anyone* of an older generation" (Quine, 1970, 41; 1985, 97-8, my emphasis). Quine's autobiographies contain only a handful of biographical references to Lewis, and he regularly soft-pedaled the latter's influence in private correspondence. Quine wrote that he was "never particularly close to ... Lewis" (Quine to G. W. Corner, Feb. 17, 1964, W. V. Quine Papers (hereafter, WVQP), Houghton Library, Harvard University) and that he only read *Mind and the World Order* "with casual interest and uncritical approval" in a period when he was primarily interested in Whitehead and Russell's *Principia Mathematica* (Quine to G. G. Brittan, Nov. 9, 1991, WVQP, Item 133). In one letter, Quine claims never to have even read Lewis's *An Analysis of Knowledge and Valuation*, declining an invitation to contribute to a volume on the views of his former teacher (Quine to R. L. Greenwood, April 21, 1981, WVQP, Item 1296).¹

In this note, I discuss some archival evidence that helps us better understand Quine's reluctance to acknowledge Lewis's influence. I contextualize the relation between Lewis and Quine and argue that the latter viewed his teacher as a retrograde force in modern epistemology, impeding the more rigorous approach that Carnap had been developing in Europe. Next, I briefly discuss Lewis's contribution to the development of scientific philosophy in the United States and argue that Quine underestimated his teacher's role in this process. In doing so, I show that Quine's zealous commitment to Carnap's approach in the 1930s negatively affected his assessment of Lewis's influence, thereby supplementing Sinclair's praiseworthy reconstruction with an explanation of why Quine himself underestimated Lewis's role.²

¹ Quine also declined an invitation to contribute to the Library of Living Philosophers volume on Lewis, albeit for different reasons (Quine to P. A. Schilpp, Sep. 5, 1957, WVQP, Item 1303).

² A few people who knew Quine well recount that he and Lewis had a fall out in the mid-1940s because the latter disapproved of his divorce and remarriage (personal communication). I have not been able to find independent evidence supporting or disproving this story; but see White (1999, 105) for a published account of Lewis's conservative stance on marriage and divorce. This paper will ignore the issue and focus on their professional relation in the period before Quine's divorce. Naturally, the aforementioned dispute, if true, could have reinforced Quine's negative evaluation of Lewis's influence.

2 Lewis and Quine

Lewis had been at Harvard for about a decade when Quine entered graduate school. He had been hired in 1920, when he had just published *A Survey of Symbolic Logic* (Lewis, 1918) and had established himself as one of the most competent logicians in the country. His former teacher Josiah Royce had recently passed away and when Harvard's attempts to hire Bertrand Russell failed, the department had searched for an alternative candidate that could help the university attract "many of the cleverest of the youth with predilections for logic" (Woods to Russell, Jan. 5, 1916, Bertrand Russell Papers, RA1, Box 5.57). Together with A. N. Whitehead, who joined the department in 1924, and H. M. Sheffer, "Russell's most enthusiastic representative at Harvard" (Floyd, 2021, 33), Lewis helped the university acquire a reputation as a center of mathematical logic in the USA. By the late 1920s, Roy Wood Sellars wrote about the "efflorescence of mathematical logic so characteristic of Harvard" (Sellars, 1927, 513). And in an article about the department's development, George H. Palmer and Ralph Barton Perry boasted about Harvard's "unquestioned leadership in [the] field" (Palmer and Perry, 1930, 27).

Considering the department's status, it should be no surprise that Quine applied to Harvard graduate school. He had majored in mathematics with honors reading in mathematical logic at Oberlin College and was deeply impressed with Russell's "mathematical philosophy" (Quine, 1986, 7). He had acquainted himself with Whitehead and Russell's *Principia Mathematica* (PM) and had submitted his honors thesis—a proof, within PM, of a theorem about products and sums of classes of classes—as a writing sample for his graduate school application (Quine, 1933, 1986, 7). It was Lewis who was tasked with reading Quine's paper. He judged it to be "an extraordinary piece of work," particularly "for a man still in his undergraduate years," and wrote a strong letter of recommendation (Lewis to Hocking, Jan. 6, 1930, WVQP, Item 643).

Once at Harvard, Quine took two of Lewis' classes, one on Kant and one on theory of knowledge (Sinclair, 2022, 22). Still, it is clear from his early notes, papers, and publications that he was little concerned with epistemology. At the time, Quine saw himself as a logician and was primarily focused on studying *Principia Mathematica*. He rushed himself through graduate school, completing his MA and PhD in 2 years, and did as little work as possible for the more philosophically oriented courses. In a letter to his parents, Quine writes that he "managed to rip off the paper for Lewis ["Futurism and the Conceptual Pragmatist"] in record time—two and a half days" and that he just "picked a topic that [he] could dispose of in barely 3.300 words, and hurried through it" (May 7, 1931, WVQP, Box 141). Most of his time went into his logical investigations. He submitted one of his articles to a mathematical journal, had discussions with Sheffer about his logic class papers, and was over the moon when Whitehead told him that he "was the first pupil he had ever had whom he believed to understand exactly what they [Whitehead and Russell] had been up against in the *Principia*" (March 16, 1931, WVQP, Item 1215). Though Lewis was finishing a logic textbook at the time (Lewis and Langford, 1932), Quine

seems to have been closer to Whitehead and Sheffer, who regularly invited him (and his wife) for lunches and dinners (May 21, 1932, WVQP, Box 141).

3 Carnap and Quine

In a 1991 letter, Quine remembers that it was Carnap's *Der Logische Aufbau der Welt* (Carnap, 1928) and not "Lewis's epistemology" that "shifted [his] focus" from logic to theory of knowledge (Quine to G. G. Brittan, Nov. 9, WVQP, Item 133). Documents from the early 1930s confirm Quine's recollection. In August 1932, Quine received a letter from his friend John Cooley, who had just read Carnap's book. In the letter, Cooley described the *Aufbau* as an "ingenious and interesting piece of work" which tried to "use the methods of symbolic logic to work out a strictly positivistic philosophy, more or less on the lines which Russell indicated" in *Our Knowledge of the External World* (Cooley to Quine, Aug. 6, 1932, WVQP, Item 260). Naturally, Quine was curious to learn more. Herbert Feigl, the Austrian logical positivist, had already told him that Carnap was the Vienna Circle's "best logician" (Feigl to Quine, December 1931, WVQP, Item 345), and he had studied Russell's epistemology in college (Quine, 1985, 58).

Quine read the *Aufbau* in the first months of 1933, a few weeks before he would visit Carnap in Prague (Verhaegh, 2023). His reply to Cooley confirms that he immediately viewed the book as an intellectual masterpiece. Yet the letter also helps us to shed light on Quine's opinion about Lewis's epistemology. It is worth quoting the passage in full:

It seems ... that Carnap has developed into a science that which Lewis advances in the form of a philosophical intuition: that all that can be said must relate to concepts, and must depend for its truth on either (1) the circular, purely conceptual definitions by which those concepts are constituted (Carnap: *Konstitution*) or (2) the further connections between concepts, arising from their collective correlation with an uncontrollable Given (Carnap: *empirische Lehrsätze*). The *Aufbau* stands to these philosophical doctrines of ... Lewis as *Principia* stands to the antecedent purely philosophical suggestion that mathematics is a form of logic. The *Aufbau*, in so doing, adds not only conviction but definiteness and clarity to the philosophical claim in question, and clears the way for unlimited important advances of a rigorously scientific nature, just as *Principia* did in the field of mathematics. (Quine to Cooley, April 4, 1933, WVQP, Item 260)

Quine's letter reveals two important things about his relation with Lewis. First, it shows that the young logician judged Carnap's work to be intellectually superior. He compares the *Aufbau* with *Principia Mathematica* and describes Carnap's epistemology as clearer, more scientific, and more rigorous than the views of his former teacher. Yet the letter also shows that Quine, despite his self-described "casual and uncritical" reading of Lewis' work, used *Mind and the World-Order* (Lewis, 1929) as his main point of reference. Not only did he read the *Aufbau* as a similar project, he literally translated Carnap's terms into the concepts ("constitution," and "the given") he had acquainted himself with in Lewis's course.

One can detect a similar pattern in Quine's reading of *Logische Syntax der Sprache* (Carnap, 1934), the book Carnap was finishing in the very weeks Quine visited him in Prague. In a report about his period in Europe, Quine writes that Carnap's *Syntax* helped him find a satisfactory answer to the "perplexing question of the nature of ... philosophy" (Jan. 8, 1934, WVQP, Item 3254). Quine's letter to Cooley shows that he, again, used Lewis's work as his point of reference:

Every ... philosophy I know has the following difficulty. One reads the arguments of a given system of philosophy and perhaps agrees heartily throughout (this was my experience with Lewis's book), but at the end one remains with the problem of the status and the methods of the book which he has been reading, according to the philosophy set forth in that book itself ... How ... is the philosophy arrived at? Revelation, mysterious intuition, or arbitrary fiction? ... This whole bootstrap-tugging situation disappears in Carnap's view. He claims that philosophy is syntax; his claim is itself syntax and there is no circularity. (April 4, 1933, WVQP, Item 260)

And again:

Actually, when one reflects, this is the doctrine to which Lewis himself should logically have been driven. Lewis claims that all *a priori* truths are valid through definition, i.e. conventions regarding the use of words ... Further, Lewis would certainly admit that epistemology or anything else in philosophy cannot be empirical, for then it would simply be natural science. Hence ... Lewis himself [would] be faced [with] the conclusion that philosophical truths are only ... conventionally valid, i.e. are statements about the syntax of our chosen language. (ibid.)

Clearly, Quine had become Carnap's "disciple," as he himself would later express it in his *Homage to Carnap* (1970, 41). Yet considering these fragments, it should be no surprise that Sinclair has been able to trace Lewis's influence in Quine's reading of Carnap's work (2022, ch. 3). *Mind and the World-Order* was Quine's main point of reference and he used Lewis' work as the standard in his assessment of the advantages and disadvantage of Carnap's views and approach.

4 Lewis and Carnap

Lewis, meanwhile, was well aware of Carnap's work. He, too, had regularly talked with Feigl when the latter spent a year at Harvard. The Lewis archives at Stanford University contain a hand-written, 29-page summary of the *Aufbau* (collection M0174, Box 22, Folder 14), and his recommendation letter for Feigl reveals that he judged logical positivism "the most promising of present movements in Continental philosophy" (April 14, 1931, Herbert Feigl Papers, 03-53-01). In December 1933, a few months after Quine returned from his trip to Europe, Lewis held a keynote address at the APA Eastern meeting in which he compared "the conception of *Sinn*

in Carnap” with “own way of thinking about meaning” (Lewis, 1934; Lewis to Feigl, 12 October 1933, HFP, 03-52-06).

Unlike Quine, however, Lewis was quite critical of Carnap’s epistemology. Though he agreed with his German colleague that it is important to shield philosophy against “verbal nonsense”, he believed that Carnap went too far in repudiating all “traditional metaphysics” and all “value-theory and normative science” as meaningless. He dismissed Carnap’s “methodological solipsism” in his APA keynote and proposed a subtler theory of significance in which meaning “transcends” immediate first-person experience. All that is required for a meaningful assertion is that we should at least know *what it would take* for any future experience to verify it (Lewis, 1934, 144).³ In later work, Lewis also addressed Carnap’s non-cognitivism about normative statements. His magnum opus *An Analysis of Knowledge and Valuation*, for example, was in part an attempt to show that “evaluations are a form of empirical knowledge” (Lewis, 1946, 365) and explicitly dismissed Carnap’s non-cognitivism as “nihilistic”, because it “denies all truth or falsity to valuations” (Lewis, 1946, 399).

It is likely, therefore, that Lewis’s paper on Carnap’s *Aufbau* led Quine to conclude that his former teacher represented a retrograde force in modern epistemology. Quine had already concluded that Carnap had developed a more rigorous and more consistent version of empiricism. And now he was confronted with Lewis’ opposition to Carnap’s thesis that “all that is not meaningless in philosophy ... speaks, when properly analyzed, not of things or ‘reality’ but rather of syntax” (Quine to Cooley, April 4, 1933, WVQP, Item 260). Lewis’s efforts to safeguard valuational knowledge (Lewis, 1946) and attempts to legitimize certain types of metaphysical questions (Lewis, 1934, 146) felt very much like the traditional philosophy that scientific empiricists were trying to leave behind. What also did not help is that Quine was not impressed by Lewis’s work in logic. At the time, Lewis was best known for his contributions to the development of modal logic and Quine, as is well-known, had strong doubts about the value of intensional logics. Carnap, unlike Lewis, embraced the “principle of extensionality” (up until the mid-1930s) and so did many of the other logicians Quine had met in Europe. Looking back on the development of logic in the 1920s and 1930s, Quine has always downplayed Harvard’s contributions to the discipline. In his autobiography, Quine writes that the logic at Harvard “ran thinner than [he] had hoped” and that the real “action was in Europe”, where the work of Gödel, Skolem, and von Neumann was revolutionizing the field (1986, 9). Whereas Harvard logicians such as “Whitehead, Lewis and Sheffer all swore by properties and propositions,” Quine met like-minded spirits when he visited Carnap in Prague and “Tarski, Lesniewski and Łukasiewicz” in Warsaw. In Central Europe, Quine recalled, extensionalism “went without saying as a matter of course” (Quine, 2001, 504).

³ Carnap replied to Lewis in *Testability and Meaning* (Carnap, 1936, 1937). See Verhaegh (2020b) for a reconstruction of Lewis’s argument and Carnap’s response.

5 Carnap, Lewis, and Quine

Quine, in sum, viewed Lewis as a backward force in analytic philosophy, impeding the more rigorous approach that Carnap and affiliated philosophers-logicians had been developing in Europe. Yet Lewis can only be viewed as a conservative figure from Quine's relatively narrow, Carnap-focus perspective. Lewis played a prominent role in the development of analytic philosophy and modal logic. And many of his objections to logical positivism were remarkably astute (though it is questionable whether Carnap actually defended the position Lewis attributes to him in *Experience and Meaning*). American philosophy had rapidly been transitioning toward a more analytically-oriented philosophical culture in the 1920s and 1930s, and Lewis was an important, if not *the* most significant figure in this transition. He was one of the first Americans to take up the new, mathematical logic; one of the first to write an English-language logic textbook (Lewis and Langford, 1932); and one of the first to even signal the emergence of a "new movement in Philosophy". In a review, Lewis noted the "revolutionary advances in logic, in mathematical, and in physical theory" as well as its increasing influence on discussion in metaphysics and epistemology, observing that these advances "have been largely the work of those who are themselves engaged in Philosophy" (Lewis, 1925, 410).

In addition, Lewis played an important role in creating institutional momentum for the very movement Quine was supporting. He regularly corresponded with European scientific philosophers (e.g., Otto Neurath, Hans Reichenbach, and Moritz Schlick), he was instrumental in getting Feigl a position at the University of Iowa (Verhaegh, 2020a; Feigl, 1968, 74), and he tried to help Carnap find a job in the USA. He helped him with his Rockefeller application and wrote a letter of recommendation to get him a Harvard honorary doctorate when the latter's efforts to get an offer from a US university failed (October 13, 1934, HUA, Records of the Tercentenary Celebration Office, UAV 827.114, Box 26; Verhaegh, 2020b, §8). Ironically, Carnap was never offered a position at Harvard, despite Lewis's recommendation, because they already employed a promising young logician. In a letter discussing possible candidates for an appointment, Ernst Hocking wrote to the Dean of his school that "Carnap is an excellent logician, but has less promise of growth than Quine" (Hocking to Birkhoff, Sept. 16, 1936, Harvard University, Department of Philosophy Records, UAV. 687.10, Box 1).⁴

Quine's reluctance to acknowledge the influence of Lewis's epistemology is therefore indicative of his more general failure to recognize his teacher's contributions in steering American philosophy toward a new, more analytically oriented philosophical culture. Though European refugees such as Carnap, Feigl, and Hempel played an important role in helping the US transition toward a more

⁴ Only after World War II, Lewis changed his mind and started to oppose logical empiricism. White remembers "firm opposition of Lewis to Carnap" when the Harvard department (again) considered hiring Carnap in the late 1940s (White, 1999, 109). In a letter from this period, Lewis wrote that he had "become more and more convinced that ... neo-positivism ... is not only an unsound philosophic view but one whose effect is meretricious and runs counter to all that is best in the whole tradition of western thought" (Lewis to Stephen C. Pepper, December 10, 1954, cited in Murphey 2005, 333).

technically competent philosophical climate, it had been philosophers such as Lewis who had prepared Quine's generation for "a new philosophical era that was to grow from logic and semantics" (Langer, 1964, 306). Quine and contemporaries such as Ernest Nagel, Susanne Langer, and Charles Morris did not just recognize the value of the logical empiricists' approach because their teachers had helped pave the way for this new academic culture, their interpretation of the positivists' ideas, too, was strongly shaped by the perspectives of their teachers. Quine read Carnap's work through a Lewisian lens and Sinclair's book is an excellent first step toward helping us unearth this hidden influence.

Acknowledgements I would like to thank an anonymous referee and the Exiled Empiricists project team for their valuable feedback and suggestions.

Funding This research is funded by the European Research Council (ERC, grant 2021-STG) and the Dutch Research Council (NWO, grant VI.Vidi.201.115). The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Carnap, R. (1928). *Der Logische Aufbau der Welt*. Weltkreis-Verlag.
- Carnap, R. (1934). *Logische Syntax der Sprache*. Springer.
- Carnap, R. (1936). Testability and meaning. *Philosophy of Science*, 3(4), 419–471.
- Carnap, R. (1937). Testability and meaning—Continued. *Philosophy of Science*, 4(1), 1–40.
- Davidson, D. (2004). *Problems of rationality*. Clarendon Press.
- Feigl, H. (1968). The Wiener Kreis in America. In: Feigl (1981). *Inquiries and provocations: Selected writings, 1929–1974* (pp. 57–94). Reidel.
- Floyd, J. (2021). Sheffer, Lewis, and the 'Logocentric predicament'. In Q. Kammer, J. Narboux and H. Wagner. *C. I. Lewis: The a priori and the given* (pp. 27–103). Routledge.
- Langer, S. K. (1964). Henry M. Sheffer 1883–1964. *Philosophy and Phenomenological Research*, 25(2), 305–307.
- Lewis, C. I. (1918). *A survey of symbolic logic*. University of California Press.
- Lewis, C. I. (1925). Review of *scientific thought* by C. D. Broad. *The Philosophical Review*, 34(4), 406–11.
- Lewis, C. I. (1929). *Mind and the World-Order*. Charles Scribner's Sons.
- Lewis, C. I. (1934). Experience and meaning. *The Philosophical Review*, 43(2), 125–146.
- Lewis, C. I. (1946). *An analysis of knowledge and valuation*. Open Court.
- Lewis, C. I., & Langford, C. H. (1932). *Symbolic logic*. The Century Co.
- Murphey, M. G. (2005). *C. I. Lewis: The last great pragmatist*. State University of New York Press.
- Palmer, G. H. and Perry, R. B. (1930). Philosophy, 1870–1929. In S. E. Morison (ed.). *The development of Harvard University since the inauguration of President Eliot, 1869–1929* (pp. 3–32). Harvard University Press.

- Quine, W. V. (1933). A theorem in the calculus of classes. *Journal of the London Mathematical Society*, 8(30), 89–95.
- Quine, W. V. (1943). The United States and the revival of logic. In W. Carnielli, F. Janssen-Lauret, and W. Pickering (2020, eds.). *The significance of the new logic* (pp. 145–57). Cambridge University Press.
- Quine, W. V. (1951). Two dogmas of empiricism. *Philosophical Review*, 60(1), 20–43.
- Quine, W. V. (1970). Homage to Rudolf Carnap. In Quine (1976). *The ways of paradox and other essays* (pp. 40–3). Revised Edition. Harvard University Press.
- Quine, W. V. (1985). *The time of my life: An autobiography*. MIT Press.
- Quine, W. V. (1986). Autobiography of W. V. Quine. In Hahn & Schilpp (eds). *The philosophy of W. V. Quine. Library of living philosophers* (pp. 1–46). Open Court.
- Quine, W. V. (2001). Confessions of a confirmed extensionalist. In D. Føllesdal & D. B. Quine (Eds.), *Confessions of a confirmed extensionalist and other essays* (pp. 498–506). Harvard University Press.
- Sellars, R. W. (1927). Current realism in Great Britain and United States. *The Monist*, 37(4), 503–520.
- Sinclair, R. (2022). *Quine, conceptual pragmatism, and the analytic-synthetic distinction*. Rowman & Littlefield.
- Verhaegh, S. (2020a). The American reception of logical positivism: First encounters, 1929–1932. *HOPOS: The Journal of the International Society for the History of Philosophy of Science*, 10(1), 106–142.
- Verhaegh, S. (2020b). Coming to America: Carnap, Reichenbach, and the great intellectual migration. Part I: Rudolf Carnap. *Journal for the History of Analytical Philosophy*, 8(11), 1–23.
- Verhaegh, S. (2023). Carnap and Quine: First encounters (1932–1936). In S. Morris (Ed.), *The philosophical project of Carnap and Quine* (pp. 11–31). Cambridge University Press.
- White, M. (1999). *A philosophers' story*. Pennsylvania State University Press.
- Whitehead, A. N. and Russell, B. (1910–2). *Principia Mathematica*. Vols. I–III. Cambridge University Press.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.