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Teacher Leaders

Elementary Mathematics Specialists: Influencing Student Achievement

A three-year study found that those responsible for coaching math teachers positively affected student academic progress in grades 3, 4, and 5. Read why this effect took time to emerge.

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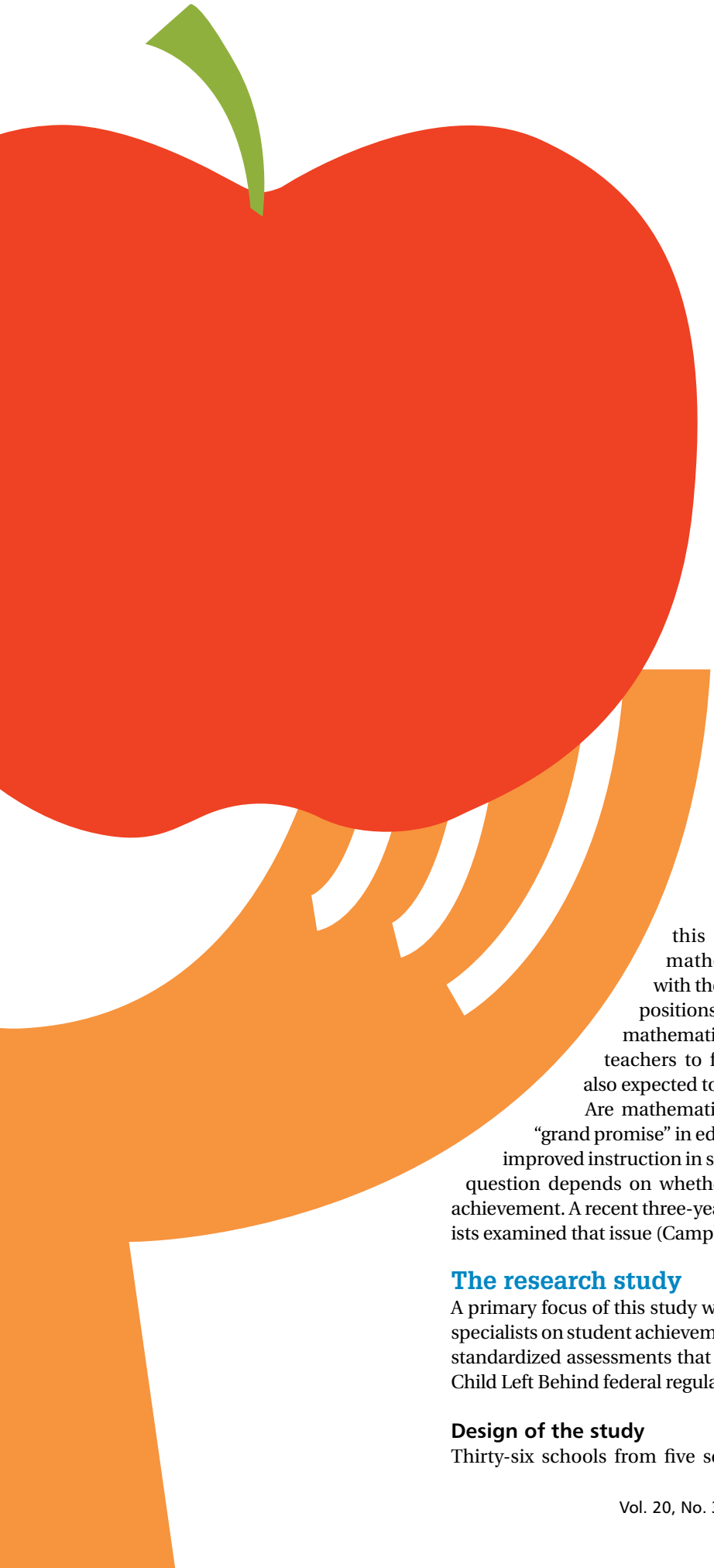
"To whom do you turn in this school for advice or information about mathematics instruction?" (Spillane, Healey, and Parise 2009, p. 413). When teachers in forty-four schools were asked this question, they were more likely to indicate a teacher leader in their school, rather than the school's principal or any other administrator. But, who are these teacher leaders for mathematics, and what do they do?

In many schools, such leaders are knowledgeable, on-site teachers who support their colleagues' efforts to interact about all facets of mathematics teaching—curriculum, lesson planning, student work, assessments, and school improvement. Because these teachers are facilitating on-site, job-embedded, professional learning, many school districts are formalizing



this practice and creating either elementary mathematics specialist or coaching positions with the hopes of developing these leaders. The two positions are somewhat different. Elementary school mathematics coaches focus on working with individual teachers to foster instructional change; specialists are also expected to advance a school's mathematics program.

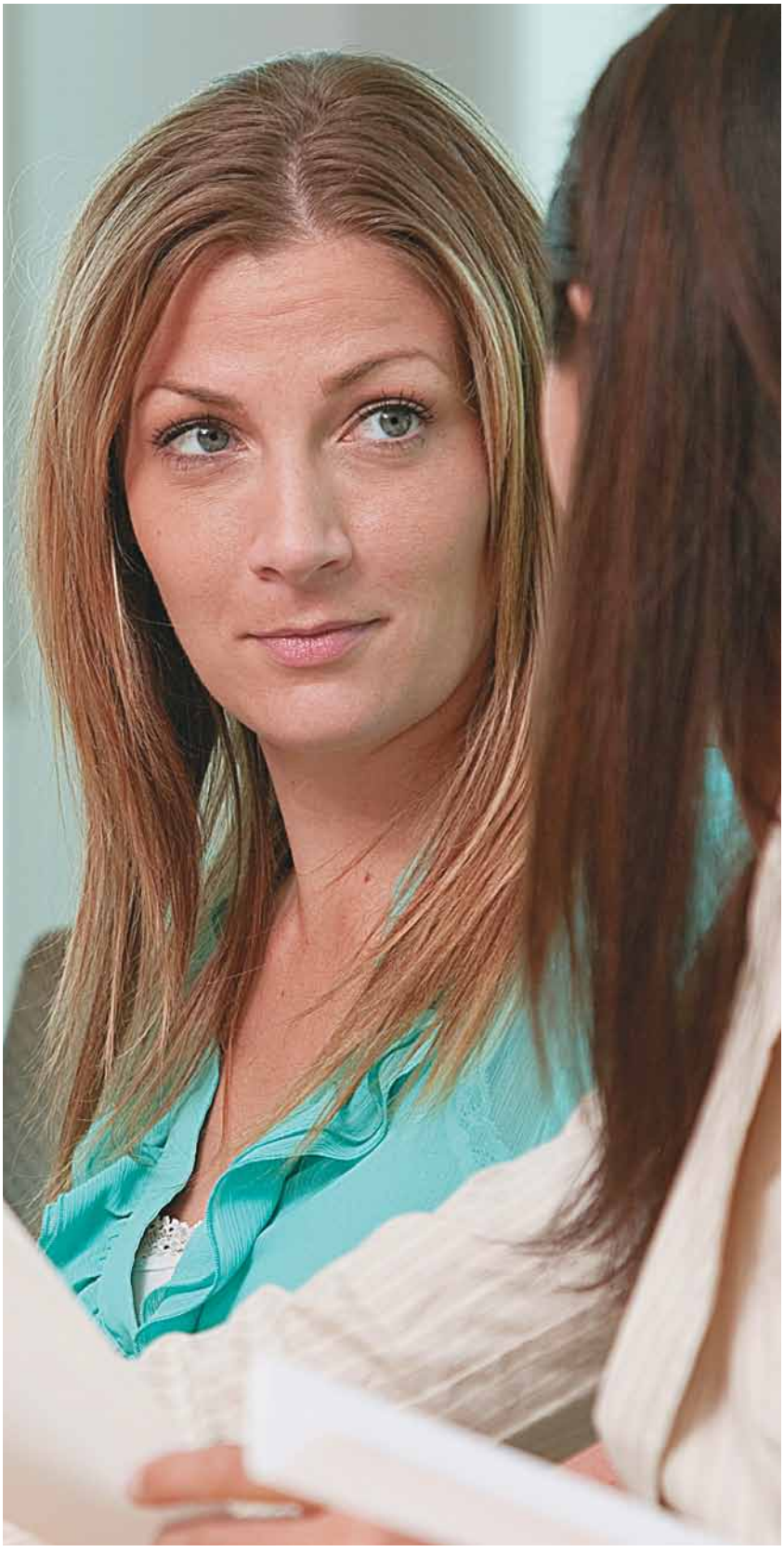
Are mathematics specialists or coaches merely the latest "grand promise" in education, or do they really offer a path toward improved instruction in schools? For many readers, the answer to that question depends on whether these teacher leaders influence student achievement. A recent three-year study of elementary mathematics specialists examined that issue (Campbell and Malkus 2011).

The research study

A primary focus of this study was to determine the impact of mathematics specialists on student achievement (in grades 3, 4, and 5) as measured by the standardized assessments that were administered by one state to meet No Child Left Behind federal regulations.

Design of the study

Thirty-six schools from five school districts were in the study; districts



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selected sets of three schools each. Each triplet of schools was comparable in terms of student demographics and past performance on the state's mathematics achievement tests. The schools represented a range of demographic and economic settings in urban and suburban schools; none of the schools had a mathematics specialist or coach.

Two groups of elementary mathematics specialists were in the study. All the specialists were experienced classroom teachers who had each completed mathematics content and leadership/coaching courses before being placed in schools as full-time mathematics specialists. One school in each triplet was randomly selected to have a mathematics specialist from the first group for three years; a randomly identified second school in each triplet was assigned a specialist from the other group for one year; the third school in each triplet was a control site, receiving no specialist. To determine whether these elementary mathematics specialists influenced student achievement, two analyses of student mathematics achievement scores were completed. The treatment-versus-control analysis looked at all three years of data from the thirty-six schools, comparing the mathematics achievement scores of students in the schools with an elementary mathematics specialist for either one or three years to the student achievement scores in those same years in the schools with no specialists. A second year-by-year analysis examined the same three years of mathematics achievement scores of students in the treatment and control schools, keeping track of whether the scores from treatment schools were from the first, second, or third year of a specialist being placed in a school.

Findings

The treatment-versus-control analysis determined that in all three grades, on average, the mathematics achievement scores of those students in the schools where an elementary mathematics specialist was placed for three years were significantly higher than the achievement scores of students in the control schools. However, this was not the case in the schools that had a specialist for only one year. Elementary mathematics specialists who were in a school for only one year did not significantly affect the mathematics achievement

scores of the students in their schools at any grade 3–5, as compared to the scores of the students in the control schools.

This was an interesting finding. Was this because the two groups of specialists differed in how effective they were? Or was it because the specialists who were in their schools for three years had more time to learn on the job and to work with teachers? The year-by-year analysis supplied the answer to these questions.

This analysis found no statistically significant difference in student achievement between the control schools and the schools with specialists when the specialists were in their first year of placement. This was the case for both groups of specialists and for each of grades 3–5. But the year-by-year analysis found that the mathematics specialists who were in their schools for three years had a statistically significant effect on student achievement at all three grade levels in year 2 and year 3 of their placement. This analysis provided evidence that the group of specialists who were in the schools for three years had more of an impact on student achievement than the other group of specialists because they were in their schools longer, not because of a difference in effectiveness between the two groups of specialists during a first year of placement.

Factors potentially influencing these positive impacts

In this study, the positive effect of elementary mathematics specialists on student achievement did not occur simply by creating a position and naming an individual to serve as a school's specialist. It developed over time as a knowledgeable elementary mathematics specialist and a school's instructional and administrative staff learned and worked together. But how did these experienced teachers learn to be specialists? And what kind of work did they do in the schools?

Preparation

These math specialists were accomplished classroom teachers who enjoyed teaching mathematics to children; but to be a specialist and a coach, they had to draw on other skills and proficiencies. To support that transition, as prospective specialists, they completed five mathematics content courses and two leadership/coaching courses.

Mathematics content courses

Three of the courses addressed number and algebra. One course focused on whole numbers and operations; another addressed rational numbers and proportional reasoning; and the third examined patterns, functions, and algebra. These courses not only deepened the prospective specialists' understanding of mathematics but also furnished examples of student work that prompted discussion of mathematical meaning and student reasoning. This was important because it provided a foundation that the specialist would draw on later in their work with teachers, both when planning lessons with individual teachers and when examining student work with grade-level teams. A fourth course presented a number of hands-on activities in geometry and measurement, whereas the remaining mathematics course emphasized data analysis with an introduction to probability. This course was a starting point for the challenge of organizing and interpreting school mathematics achievement data, a task that many of these specialists were assigned by their principals after being placed in schools.

Leadership/coaching courses

These two courses addressed the role of a mathematics specialist in a school. The first course focused on the design, delivery, and evaluation of mathematics instruction. This course expected the participants to conduct and analyze student interviews; develop mathematics lessons reflecting best practices; observe another teacher with pre-observation and debriefing sessions and prepare a written reflection on the observation; and analyze student work samples, describing how student work could serve as a tool for professional development. As such, this course engaged prospective specialists in the kinds of tasks they would perform while working with grade-level teams of teachers, when coaching or preparing to coach teachers, or when observing instruction.

For example, consider the assignment of conducting and analyzing student interviews, which required the prospective specialists to identify those components of mathematical understanding they would address in a student interview, as well as critical prerequisite ideas. For each of these components, the prospective specialists had to reflect on how students might

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Researchers found that student achievement did not automatically improve when a math specialist was hired. Positive change takes time.

use symbols, drawings, or concrete materials to represent a mathematical situation or to solve a mathematical task. They also had to consider connections and distinctions between mathematical representations or ideas. This approach is similar to preparing to work with teachers in co-planning sessions where attendees unpack the meaning of the mathematical standards in a curriculum and discuss how students might learn and interpret mathematical concepts. To prepare for the interview assignment, prospective specialists had to consider which problems they might challenge a student to solve, as this would help them infer the depth of a student's conceptual understandings. These are the kinds of tasks that a specialist might work with teachers to co-create when co-planning a lesson or assessment. The interview assignment typically included items that could be solved by a mathematical procedure and that expected a student to explain why and how to use that procedure. A specialist might take this approach during a grade-level team meeting when asking teachers to solve a problem in multiple ways and then discussing what understandings were accessed within those solution methods, as well as what difficulties students might encounter. Finally, the interview assignment required prospective specialists to analyze a student's mathematical strengths and reasoning. This relates to teacher-specialist review of student work in order to identify strengths and incomplete, immature, or unique perceptions of mathematics to be addressed in future instruction.

The second leadership/coaching course emphasized those abilities needed when working with adult learners, focusing on techniques for serving as leader and coach in a school. These included learning how to plan for and facilitate learning in small-group settings, in coaching sessions, and in schoolwide professional development sessions.

An important feature of the second leadership/coaching course was its emphasis on understanding and implementing a coaching model (West and Staub 2003). The coaching model includes planning a lesson with an individual teacher, either observing or co-teaching that lesson with the teacher, and then debriefing with the teacher following the lesson. This model offered the prospective specialists a common framework within which to consider how as a coach they could intersect the demands of (1) enhancing teachers' understanding of the mathematical concepts underlying the content in their curriculum, (2) challenging and championing teachers' perspectives on teaching, (3) supporting teachers' efforts to design lessons that could foster student understanding, and (4) engaging with teachers to interpret their students' thinking.

The role of elementary mathematics specialist

The mathematics specialists in this study worked with individual teachers so that a teacher might better understand how students learn and consequently make changes in his or

her teaching while strengthening and expanding instructional repertoire. This meant that these specialists might demonstrate a lesson in a teacher's classroom as well as implement the coaching model with teachers. The specialists also offered programmatic leadership, assuming the role of "community organizer" for mathematics in their schools (Neufeld and Roper 2003). As such, they might collaborate with grade-level teams, resource teachers, and the principal, to do the following:

- Assist administrative and instructional staff in interpreting data and designing school improvement plans
- Facilitate teachers' use of research-based instructional strategies, including differentiated instruction
- Work with parent/guardians and community leaders to foster partnerships supporting students' learning of mathematics
- Collaborate with administrators to provide leadership for a school-wide mathematics program (Virginia Mathematics and Science Coalition 2008, p. 1)

Initial activity in schools

Although these specialists were knowledgeable, they could not be mathematics leaders until they earned the respect of the teachers in the school. And they could not be effective coaches until they were viewed as approachable. This required them to develop and demonstrate interpersonal skills that ultimately would allow them to influence teachers' instructional practice.

Some principals introduced specialists at their first faculty meeting. When the principal conveyed enthusiasm about the specialist position and a sense of how the specialist would be working with and supporting teachers, acceptance seemed to be fostered. In some cases, when this introduction did not occur, specialists drafted a letter to introduce themselves to teachers. These letters conveyed the specialists' eagerness to work with the teachers and listed possible collaborations.

During the first few weeks of school, the specialists were encouraged to set up short visits to all mathematics classes. These visits always occurred at a time convenient to the teacher and helped specialists get a sense of how teachers and students at each grade were engaging in mathematics. The observations prompted conversations about instructional routines and were particularly useful when a new specialist had always taught mathematics to either primary or upper-elementary students, with no experience in the other grades.

The specialists were encouraged to try determining who was respected as a model of mathematics instruction in their school and then to seek that person out and collaborate regularly in his or her classroom. This not only built future capacity for the school but also discredited the assumption that the specialist was there to "fix" struggling teachers.

Gaining influence, fostering growth

When the teachers and administrators saw the specialists in their schools as knowledgeable individuals who were continuing to learn, the specialists were able to set up willing, patient partnerships determined by teachers' needs. Programmatic change was not accomplished by dispensing advice, but by partnering with and coaching teachers. This in turn led to improved student achievement.

The specialists in the study spent more time coaching individual teachers than working with grade-level or vertical teams of teachers. This important work with individual teachers was more personal and focused. But, in principle, as specialists gain their footing, engaging with teams of teachers is important because it lays a foundation for addressing what is a major challenge: a shared vision for the mathematics program in the school.

When teachers met with the specialist in grade-level, mathematics planning teams, it was an opportunity for all to learn. The team discussed the meaning of mathematical concepts, ways to address the expectations of the mathematics curriculum's objectives, as well as shared planning to meet the needs of students. Some principals expected their specialists to work more closely with one grade, co-planning and co-teaching in a classroom in that grade on a daily basis. This allowed the specialist a better sense of how students were reacting to lessons and what they were or were not learning. Ideally this permitted a cycle of sharing and discussion at grade-level mathematics meetings as the team co-planned lessons and examined and interpreted student work.

Lessons learned

An unexpected outcome was the study's documentation of re-assignment of some specialists by their principals to attend to state-assessment demands in the spring. This is one of many reasons why a newly placed specialist and her principal should have proactive conversations before the start of school, discussing and negotiating a vision for the school's mathematics program. These discussions should address the role and responsibilities of the specialist; negotiate how the specialist will support the teachers, clarify priorities, establish the specialist's schedule for approximately the first six weeks of school with the principal's support for subsequent scheduling autonomy; and establish how the specialist and the principal will work together. Through such discussions, a specialist and her principal create a partnership of trust that will facilitate the specialist's success.

The specialists in this study noted that their background in assessment was not as strong as in other areas. As a result, a third leadership/coaching course has been launched. This course addresses formative and summative assessments, organizing and analyzing school achievement data, and leading "next-step" discussions addressing a school's or a grade-level's student achievement data.

Crucial characteristics

The impact of these specialists on student achievement did not occur simply because some individuals were appointed to fill positions. Rather, three crucial features characterize their assignments: knowledge, time, and nonevaluative collaboration. They were highly knowledgeable, having completed mathematics content and leadership/coaching courses that allowed them to learn coaching practices, to deepen their knowledge of mathematics and effective teaching practices so they had defensible ideas to share, and to develop their identity as a coaching specialist. Such courses gave the specialists opportunities to consider why and how to build relationships and interact respectfully with both teachers and administrators.

The specialists were based full-time in their schools without a classroom of students. Even so, no significant change in student achievement took place after a one-year placement of specialists. The specialists' impact on student achievement emerged over time. It is important to recognize that the eventual increased student achievement scores did not occur because a specialist was prompting teachers to adopt the surface features of an instructional model or to deliver scripted lessons unquestionably. Rather, achievement increased as the specialists developed into on-site leaders who could encourage teachers to reflect on instructional practices and to learn over time, as the specialists supported professional interaction, appreciated efforts, served as mentoring coaches, and addressed concerns.

These specialists were to establish and maintain collaborative relationships with teachers, connecting to and supporting their schools' professional culture. Yet, the purpose of these collaborations was not simply to provide support for teachers or to offer "another pair of hands" in teachers' classrooms. The specialists worked with and coached teachers to enhance teachers' instructional knowledge and practice. Only then could the specialists serve as leaders who were agents for instructional change and teachers' professional growth (Frank, Zhao, and Borman 2004). Finally, these teacher leaders collaborated with others to advance the mathematics program in their schools, ideally serving as a resource that teachers and the principal alike could turn to. Yet they were not administrators, and they were not responsible for evaluating teachers.

Each of these features likely influenced the effectiveness of the specialists, who worked as knowledgeable mathematics coaches and had the time to develop relationships with teachers, to build and carry out a vision for a schoolwide mathematics program with teachers and administrators, and to support their schools' professional culture. However, they did not have to navigate the relational impediments that come with the administrative responsibility of evaluating the teachers with whom they worked. The positive impacts that these elementary mathematics specialists had on mathematics achievement should not be presumed in other settings where these characteristics are not met.

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