RESEARCH ARTICLES

Pharmacy Students' Approaches to Learning in an Australian University

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Objectives. To investigate how pharmacy students' approaches to learning change over the duration of a bachelor of pharmacy degree program.

Methods. Data were obtained from a cross-sectional, repeated measures design, using a validated self-report survey instrument. Areas examined included processing and regulation strategies, motivational preferences for learning, and the relationship between approaches to learning and academic performance.

Results. Pharmacy students were strongly vocationally oriented in their studies across all year groups. This approach had a significant relationship to academic performance. Overall, students indicated a preference for external regulation strategies. There was little evidence of maturation in approaches to learning as students progressed through the curriculum.

Conclusions. Students' preference for vocationally related strategies can be harnessed to increase both adoption of self-regulation behaviors and motivation for mastery of material. Comparison of our results with other studies indicates that approaches to learning may be influenced more by the learning environment than the discipline of study.

Keywords: learning, bachelor of pharmacy degree, Vermunt's Inventory of Learning Styles

INTRODUCTION

The bachelor of pharmacy degree, a 4-year undergraduate program that can lead to registration as a pharmacist, has been offered at the University of Sydney for more than 40 years. Expected attributes of graduates include the specialized knowledge and skills necessary to meet the standards for entry-level pharmacists in Australia, and broader skills such as critical judgment, rigorous and independent thinking, self-evaluation, and problem-solving skills.[1] The latter skills underpin a commitment to lifelong learning, which is critical if pharmacists are to meet future professional challenges, in particular the emerging field of professional cognitive services.[2]

In order to provide opportunities for developing independent learning skills, pharmacy educators at the University of Sydney have modified their teaching approaches over the past decade to include problem-based, self-directed learning. However, in recent years, concerns have been expressed by both academic and clinical educators in the Faculty regarding pharmacy stu-

dents' reluctance to engage in appropriate self-directed and reflective learning practices. Concerns have also been expressed by some pharmacy graduates through the University-wide Student Course Experience Questionnaire (SCEQ)[3-5] about a perceived high workload, inappropriate assessment, and the quality of the teaching they received. Students may be adopting approaches which do not match the learning expected by academics, causing dissatisfaction among both groups. Therefore, this study was designed to investigate the learning approaches preferred by students.

Two methods of student learning which are commonly used in higher education are the Approaches to Learning and Learning Styles models. A review of these models[6] suggests that they are both attempts to represent aspects of student learning but that they have been derived from different underlying assumptions. Briefly, the Learning Styles model, based on Kolb's model of experiential learning[7], is based on the assumption that individuals possess relatively stable strategies for learning that are constituent aspects of their psychological profile and personality. In contrast, the Approaches to Learning model, based on the work of Marton and Säljö,[8] suggests that learning strategies are also dependent on context, and that the features of the learning environment

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can be manipulated to encourage the use of productive strategies. We have used the latter model in this study. Some confusion remains in the use of terminology, however, since the instrument employed in this study is titled the Inventory of Learning Styles. Despite its name, the instrument actually measures approaches to learning, as described in a later section.

Entwistle and Ramsden[9] described the concepts of deep and surface approaches in order to explain the different ways in which students approach learning activities and tasks. The deep approach is characterized by 3 primary intentions on the part of the student: to understand, integrate, and apply. The surface approach is characterized by an intention to memorize for reproduction. Importantly, the authors point out that it is not appropriate to classify a student as either deep or surface, since the approach and associated strategies adopted in any given situation will be influenced by circumstances. Similarly, Biggs[10] postulated that student approaches to learning are influenced both by personal characteristics and the teaching context. Regulation of learning, particularly self-regulation,[11] has also been identified as a significant influence on student learning outcomes.

On the basis of these theoretical underpinnings, the Inventory of Learning Styles (ILS)[12] was chosen for this study. As stated previously, the name is somewhat misleading as the tool does not actually measure learning styles in the sense this term is usually understood. The ILS is a validated diagnostic instrument[12,13] that measures students' approaches to their learning, their motivation, and their conceptions about learning. The inventory was constructed using phenomenographic analyses of interviews with higher education students, resulting in 4 learning dimensions: meaning directed, reproduction directed, undirected, and application directed.

Theoretically, models of achievement motivation predict that adoption of approaches involving deep learning strategies and self-regulation will enhance both the learning experience and academic performance, and that surface learning strategies and dependence upon external sources of regulation are likely to be counterproductive to achieving these outcomes.[14] However, in the higher education sector it is hypothesized that students will mature in their learning as they progress through their course, with the result that more productive approaches to learning will increase at the expense of less productive ones.[15] In other words, with increasing experience and age, and upon exposure to facilitating teaching and assessment practices, students are expected to employ deeper learning strategies and a greater self-regulation, with decreased reliance on external sources of regulation. It is further hypothesized that adoption of these productive approaches will also be reflected in student academic performance.

These hypotheses have not been confirmed. A longitudinal study of 244 first-year social sciences students[16] found improvements over time in deep processing and self-regulation strategies and a decrease in external regulation. A similar pattern of results was found in a first- and second-year sample of 276 students from law, economics, social sciences, and languages disciplines.[17] However, conflicting results were found by Busato et al[18] among a group of 477 first- to fifth-year psychology students. Students did not score higher on productive approaches to learning and did not have increased vocational orientation as they progressed through the curriculum. Similarly, an increase in surface learning approaches over time was found by Vermunt and Minneart.[16]

With respect to academic performance, research findings have also been mixed. While one study[13] found a significant relationship between productive approaches to learning and academic performance in a group of 273 second- and fourth-year social sciences students, other studies have found no such relationship.[18,19]

Recent Australian research has shown that the process of undertaking final-year high school examinations can be counterproductive to fostering deep learning strategies or intrinsic interest and mastery of subject areas.[20-22] This body of work also found clear differences in these processes according to gender and subject area.[22,23] Given that the majority of Australian pharmacy courses are for undergraduate degrees and most students who begin their pharmacy education have recently completed their high school education, this research suggests that many are beginning their program of pharmacy study with unproductive learning strategies, and that early experiences at university may be critical in shaping their approaches to tertiary and postgraduate learning.

Little specific research has been published about pharmacy students' learning preferences, and where data have been collected, the focus has been on learning styles rather than learning approaches, level of self-regulation, or level of vocational orientation. These results indicate that individuals with different learning styles have strong preferences for different teaching modalities.[24] Further research indicates an influence of personal learning styles on academic performance as well as performance in clinical practice.[24,25] A single study of pharmacy students' approaches to learning[26] found no relationship between achievement orientation or learning strategies and academic performance.

Currently, there are no objective baseline data regarding Australian pharmacy students' approaches to learning. With 11 schools of pharmacy in Australia offering

undergraduate and postgraduate degrees and graduating approximately 1800 students each year, there is clearly a need to establish data such as these. This study was undertaken to provide data that would allow development of curricula and learning environments that address the need for pharmacy students to graduate with the skills and motivation necessary for ongoing professional practice, and that also address academics' and clinicians' concerns regarding their students' ability to meet these criteria, and graduates' dissatisfaction with some aspects of the pharmacy degree.

The specific objectives of this study were to:
(1) Measure and evaluate the approaches to learning that students adopt to carry out their academic tasks.
(2) Examine the relationships between students' approaches to learning and academic performance outcomes.
(3) Examine differences in students' approaches to learning between year groups and within the same year group over time.
(4) Evaluate the influence of gender and subject on students' approaches to learning.

METHODS

The project utilized a cross-sectional, repeated-measures design and was carried out between March and November 2005. Ethics approval from the University of Sydney Human Ethics Committee was obtained prior to commencement of this study. All students from each of the 4 years comprising the undergraduate bachelor of pharmacy course were invited to participate in the study.

A self-report survey instrument comprising sociodemographic items and Vermunt's Inventory of Learning Styles (ILS)[12] was administered. Sociodemographic indicators included in the survey were: gender, entry pathway to university, language spoken at home, ethnic/cultural identification, and hours worked. Scores for 120 ILS items were collated to create a cumulative score for the 4 scales: (1) *meaning directed*: deep processing strategies and self-regulation, and a belief that learning is the construction of knowledge; (2) *reproduction directed*: surface learning strategies and external sources of regulation, and a belief that learning is the intake of knowledge; (3) *undirected*: poor self-regulation, ambivalence, and dependence on external sources of help; (4) *application directed*: strong vocational orientation and a belief that learning is the use of knowledge.

The survey instrument was administered at the beginning (early March 2005) and end of the University calendar year (late October 2005). Students were provided with an information sheet outlining the rationale for the study and inviting their participation. Non-completion of the survey instrument indicated that the student did not wish to volunteer, while completion of the survey implied consent. The procedure was undertaken either during lecture or tutorial time. The time taken to complete the questionnaire was approximately 20 minutes.

To measure any differences in learning approaches with respect to subject area, students in each of the 4 years were assigned to 1 of 2 groups (group A and group B) based on their student identification number. All students in group A were asked to complete the questionnaires with regards to the physical sciences courses (eg, medicinal chemistry) they were enrolled in, while all students in group B were asked to complete the questionnaires with regards to the social and clinical sciences courses (eg, clinical pharmacy) they were enrolled in. To facilitate this process, they were asked to write down the particular subject they were thinking of while completing the survey. Our hypothesis was that pharmacy students would adopt a different approach to their studies depending on the type of material they were studying.

Students participating in the study were also asked to consent to an analysis of group data regarding their academic performance. Raw scores were obtained from results of an end of semester individual examination for each student. These data were used to assess the relationship between learning approach and academic performance.

SPSS 11.5 (SPSS Inc, Chigago, Illinois) was used for all statistical analyses. Descriptive statistics of baseline data regarding age, gender, and pathway of entry to the undergraduate course are reported. Repeated measures analysis of variance were performed to determine changes over time and between groups (including interactions). All pairwise comparisons were corrected for familywise error using the Bonferroni adjustment. A Multiple Regression procedure was performed to determine the extent to which learning approach contributed to academic performance.

RESULTS

Five hundred ninety-one students were included in the survey (Table 1). Sixty-nine percent were female. Most students gained entry to the bachelor of pharmacy program via final year high school examinations (75% of the sample). The remaining modes of entry consisted of entry via University foundation programs, an overseas qualification, previous degree, and degree transfer. These modes of entry are reflected in the age distribution of the students (Table 1). Figure 1 indicates a high level of linguistic diversity, with the majority of students speaking a language other than English at home.

Table 1. Demographics of Bachelor of Pharmacy Students and Percentage Who Participated in a Survey of Approaches to Learning

	Bachelor of Pharmacy Students				
Variable	**Year 1** **n = 245***	**Year 2** **n = 201***	**Year 3** **n = 187***	**Year 4** **n = 160***	**Total** **N = 793**
Age range, y	17-38	17-24	18-51	19-42	17-51
Female, %	68	64	71	77	69
Completed first survey instrument (beginning of academic year), No.	221	129	143	98	591
Completed both first and second survey instrument (end of academic year), No. (%)[†]	214 (87)	121 (60)	122 (65)	64 (40)	521 (66)

*Total number of students in that year of the program
[†]Percentage calculated using the total n for each year as the denominator rather than the total number of students who participated in the survey

As the maximum score for each of the 4 learning approaches varied (due to unequal number of items for each subscale), scores were standardized so that comparisons could be made. Matching of students' first and second survey instruments resulted in a reduced sample size as not all students were present at both data collections and participation in the study was voluntary (Table 1).

A general linear model procedure was performed, using learning approaches as the within-subjects factors, and year group as the between-subjects factor. Based on the Pillai criterion, there were no significant gender differences on any of the learning approaches scales for any year group ($p > 0.05$). There were also no significant group differences ($p > 0.05$) with respect to differences in students' scores on learning approaches as a function of subject area.

A significant multivariate main effect for all within- and between- subjects factors, except for test occasion by year group interaction ($p > 0.05$), was obtained. There were significant changes (1) over time between the beginning and end of the academic year, for the entire sample ($F_{1,517} = 16.30$; $p < 0.01$; (2) between learning approaches for the entire sample ($F_{3,517} = 1018.96$; $p < 0.01$); (3) between learning approaches as a function of year group ($F_{9,1551} = 11.41$; $p < 0.01$); (4) over time, as a function of learning approach for the entire sample ($F_{3,515} = 5.14$; $p < 0.01$), and (5) over time, as a function of learning approach and year group ($F_{9,1551} = 5.84$; $p < 0.01$). Of most interest are the third and fifth changes.

Results for these data are based on an average of test occasion (beginning and end of academic year) scores. Pairwise comparisons between the learning approaches for each year group showed significant differences ($p < 0.05$) for all pairs except year 2, meaning directed versus reproduction directed; year 3, meaning directed versus reproduction directed; and year 4, meaning directed versus reproduction directed or undirected and reproduction directed versus undirected. Mean scores indicated that the application directed approach to learning is overwhelmingly favored by all undergraduate pharmacy students in all years (Table 2). For all year groups except year 1, there was no significant difference between meaning directed and reproduction directed learning. For years 1-3, students' scores on these 2 learning approaches were significantly lower than for undirected, which in turn was significantly lower than application directed.

Pairwise comparisons between year groups for each learning approach were also conducted. Results indicated significant differences ($p < 0.05$) for meaning directed (year 1 vs. year 2; year 1 vs. year 3; year 2 vs. year 4; year 3 vs. year 4) and reproduction directed (year 1 vs. years 2-4 inclusive) approaches to learning, but not for undirected or application directed. Meaning directed scores were lower in the year 2 and 3 groups compared to year 1 (Table 2), but year 4 group scores for this learning approach were higher than those of their more junior cohorts. For
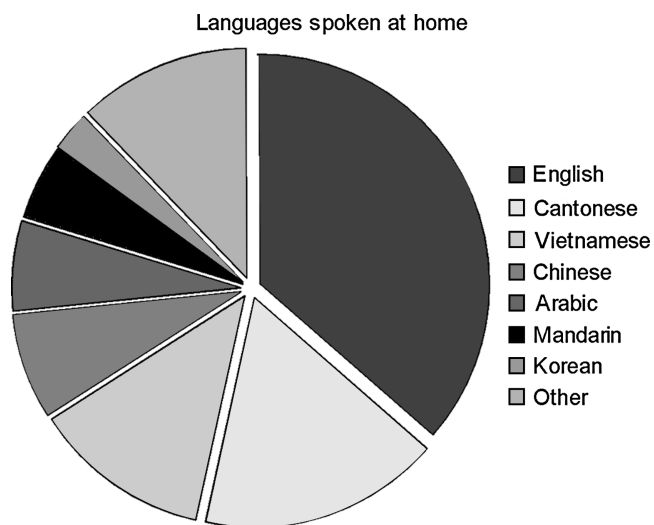

Figure 1. Language spoken in student's home.

Languages spoken at home

- English
- Cantonese
- Vietnamese
- Chinese
- Arabic
- Mandarin
- Korean
- Other

Table 2. Students' Learning Approaches Scores by Year in the BPharm Program

Learning Approach	Students' Scores, Mean (95% CI)			
	Year 1	Year 2	Year 3	Year 4
Meaning Directed	62.8 (61.8-63.8)	58.9 (57.6-60.2)	58.4 (57.0-59.7)	64.8 (62.9-66.6)
Reproduction Directed	65.9 (64.9-66.9)	60.4 (59.2-61.7)	58.9 (57.7-60.2)	62.1 (60.3-63.8)
Undirected	64.7 (63.9-65.5)	65.1 (64.0-66.2)	64.8 (63.8-65.9)	65.4 (64.0-66.9)
Application Directed	80.1 (79.0-81.1)	81.0 (79.6-82.4)	81.3 (80.0-82.7)	82.1 (80.2-84.0)

reproduction directed, year 1 group scores were significantly higher compared to those of the other year groups. Years 2, 3 and 4 group scores were all similar for this learning approach. For the remaining learning approaches, undirected and application directed, year group scores were not significantly different.

Mean differences between scores on survey instruments administered at the beginning and end of the year, and 95% confidence intervals for each year group as a function of time and learning approach are presented in Table 3. In year 1, meaning directed and reproduction directed scores declined significantly. There were no significant changes in year 2 students' scores on any of the learning approaches from the beginning to the end of the academic year. For students in years 3 and 4, scores on application directed declined significantly over time. While these results suggest an undesirable decline in application directed scores, this remains the most preferred approach to learning for all student groups across all time points.

When the relationship between students' scores on the learning approaches and academic performance outcomes were examined, only a modest amount of variance in the data was explained ($F_{4,519} = 26.15$; $p = 0.01$; R squared = 0.168). A multiple regression of the total group (years 1-4 combined) indicated a significant negative relationship between meaning directed ($t = -5.60$; $p = 0.01$) and reproduction directed ($t = -5.32$; $p = 0.01$), and academic performance; and a significant positive relationship between undirected ($t = 2.17$; $p = 0.03$) and application directed ($t = 3.46$; $p = 0.01$), and academic performance.

A multiple regression with backward elimination of variables was also conducted for separate year groups to examine the extent to which the variance within year group students' academic performance scores may be explained by learning approaches. The only year group to show any significant relationship with the outcome variable was year 2 ($F_{4,116} = 3.38$; $p=0.05$; $R^2 = 0.39$). The final model excluded meaning directed, reproduction directed and undirected variables and retained the application directed variable ($t = 2.49$; $p = 0.01$).

DISCUSSION

Overall, the sample studied was a strongly vocationally focused group of students, independent of where each student was in their progression through the degree. Adoption of an application directed approach reflects a strong vocational orientation to learning and a belief that learning comprises the use of knowledge, rather than intake of knowledge or constructing knowledge. Given that the purpose of a pharmacy degree is to equip students with the requisite knowledge and skills to become registered pharmacists, this finding is pleasing. Hopefully, these results will be of help in finetuning current teaching methods for the Faculty's students, for example, using application-directed attributes as a conduit for developing students' deep-learning strategies and self-regulatory processes.

However, the extent to which this approach to learning also equips the student with a desire for lifelong learning, problem solving, critical thinking, reflection, and constructing meaningful connections between

Table 3. Changes in Pharmacy Students' Scores Over Time

Learning Approach	Difference Between Scores, Mean (95% CI)*			
	Year 1	Year 2	Year 3	Year 4
Meaning Directed	4.2[†] (2.3-6.1)	−1.2 (−3.7-1.4)	−1.3 (−3.8-1.2)	0.1 (−3.5-3.5)
Reproduction Directed	3.8[†] (1.9-5.6)	0.6 (−1.9-3.1)	0.9 (−1.6-3.4)	−3.1 (−6.6-0.4)
Undirected	−0.6 (−2.1-1.0)	1.7 (−0.3-3.8)	1.1 (−0.9-3.1)	0.8 (−2.0-3.6)
Application Directed	1.8 (−0.1-3.8)	1.5 (−1.1-4.0)	4.6[†] (2.0-7.2)	8.3[†] (4.8-11.9)

*Positive numbers reflect a decline in scores between the first and second administration of the survey instrument
[†]$p < 0.01$

information is questionable. The results of this study indicate significantly lower preferences for meaning-directed approaches, and this was true of all year groups. This finding supports the concerns previously expressed by pharmacy academics and clinicians. Year 1 students appear to begin their pharmacy degree with unproductive approaches to learning and those do not change substantively over time. The meaning-directed approach to learning was the least used approach to learning among all year groups, followed closely by reproduction-directed and then undirected approaches to learning. Thus, students are indicating higher levels of poor self-regulation, ambivalence regarding their learning orientations, and dependence upon external sources of help. Concomitantly, lower preferences are expressed for deep processing strategies and self-regulation, attributes which are necessary for mastery of learning material and independent learning.

These outcomes have implications for the teaching methods adopted by faculty members and instructors. Based on the results of this study, there would be merit in building on the application-directed approach indicated by pharmacy students, then channeling students' efforts into meaning-directed modes of learning. This can be achieved through aligning learning outcomes, learning activities, and assessments, and adding structured activities that focus on developing required skills, such as deep processing strategies. Sufficient time must be provided to complete tasks, and tasks must be engaging even if they are time consuming. Assessment is a key factor in this process, and teaching staff are required to have a good understanding of the relationship between assessment type and student learning, as well as skills in test construction.

There is some evidence in the research literature, however, to suggest that adopting a reproduction-directed approach, for example, is not necessarily unproductive, and that consistency between approaches may benefit learning. Research by Beishuizen, Stoutjesdijk & Van Putten[27] showed that university students who combined external regulation strategies with stepwise processing achieved good results in an experimental task. Those students who combined incompatible strategies, such as self-regulation strategies with stepwise processing, performed poorly on the task. Adoption of a reproduction style approach to learning by the pharmacy students in the current study would probably be more productive than their preference for an undirected approach.

In contrast to previous research,[16,17] the results of this study do not appear to provide evidence of any maturation in learning style as students progressed through the curriculum. While these data are consistent with Busato et al's[18] findings, which indicated no improvements in productive approaches to learning as students progressed through the curriculum, they in fact showed that year 2 and 3 students' scores on meaning directed learning were significantly lower than year 1 students' scores. However year 4 scores on this learning approach were comparable with year 1, suggesting a recovery over time but no clear indication of overall improvement. Similarly, while the repeated measures analysis showed that there were some changes in students' learning styles from the beginning to the end of the academic year, there was not a clear pattern of change, and when these results are compared to previous research using student groups from other discipline areas, no consistent pattern can be ascribed to any discipline. This suggests that the learning approaches that higher education students adopt may be influenced more by the particular learning environment within which they are studying, as well as individual preferences for learning, rather than by the subject matter within a particular discipline.

Determining the relationship between these students' approaches to learning and their academic performance was hampered by the small percentage of variance explained in the data. Previous studies examining this type of relationship using Vermunt's ILS[12] have shown conflicting results. For example, Veenman et al[19] found a nonsignificant relationship between learning styles and grade point average (GPA), while Boyle et al[13] found a significant relationship between the 2 factors. A more detailed analysis which excludes the scores of those (few) pharmacy students who have a prior degree and utilizes a standardized form of performance outcome (such as multiple-choice examination or essay style) for all year groups would perhaps be a more valid approach to this analysis. Nevertheless, the negative relationship between meaning directed and performance directed is interesting. This may suggest an approach to teaching and/or assessment that does not foster deep approaches to learning and independent thought. For example, a heavy emphasis on assessment modalities, which measure the intake of knowledge rather than its use or construction, will encourage students to adopt external, reproductive approaches to their learning. The significant decline in scores on meaning-directed learning among year 2 and year 3 students seems to support this conclusion.

Finding no significant subject-specific group differences in students' scores was surprising and indicates that this group of pharmacy students preferred the same approach whether they were studying subjects in the physical or social sciences. Given the strong vocational approach of these students, it could be argued that they may be more comfortable with, and interested in, the

physical sciences and therefore more likely to adopt a deeper approach to learning. However, this was not borne out by the results. In addition, there were no significant differences between scores of male and female students, which is contrary to findings in previous studies of senior high school students,[22] as well as previous research on students in higher education.[28,29]

Consideration should be given to the limitations of this study. First, students from only one Australian school of pharmacy participated in this study. While The University of Sydney Faculty of Pharmacy has the largest enrollment in Australia, it is possible there may be variations between cohorts from other pharmacy schools. Second, given the length of the survey instrument (120 items), test fatigue may have had an impact on the reliability of students' responses. Third, while the instrument was validated for use with higher education students, its application to a pharmacy student cohort had not been tested; confirmatory factor analysis would enable refinement of the instrument for use in a pharmacy-specific setting. These findings would also be enhanced through triangulating these data with data obtained via student focus group discussions, or observational methods of the learning processes students undertake in classroom activities.

Currently, our research emphasis is on following the 2005 cohort of pharmacy students through to the completion of the program. Also, in 2006, testing of master of pharmacy students commenced. Future research will involve evaluation of the new curriculum as it is rolled out and comparisons between degree courses, as well as study of any new long-term patterns identified. Mapping of the new curriculum to future graduates' ratings of their degree course will also help to determine the extent to which changes to learning and teaching have influenced students' perceptions of their university experience. Comparative research utilizing other discipline groups both nationally and internationally would also be of benefit, particularly with respect to application-directed approaches, subject, and gender.

CONCLUSION

This study of a group of Australian undergraduate pharmacy students revealed a strong vocational focus, indicating a desire for the use of knowledge rather than the intake or construction of knowledge. There is little evidence of a preference for deep learning strategies or self-regulation, and no developmental trend in students' learning approaches between the first and fourth years of pharmacy school was found. These results will be utilized in a substantial curriculum revision to be introduced in 2008: learning activities and assessments will specifically include experiences that prepare students for independent, reflective learning, and a better alignment will be sought between staff and student perceptions of the course material, assessment, and workload, as well as student motivation for learning.

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