

# PREDICTORS OF STUDENT SUCCESS IN THE US ARMY GRADUATE PROGRAM IN ANESTHESIA NURSING

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*The primary objective of this research was to identify cognitive and noncognitive factors that may predict student success in the US Army Graduate Program in Anesthesia Nursing. Second, the results of this study will help identify students possibly at risk for failure so that interventional measures can be developed and implemented to promote success and reduce attrition.*

*Participants in this 3-year longitudinal, nonexperimental, prospective, descriptive study were 42 students. Cognitive and noncognitive assessment tools were used to identify predictors of success. The measure of success was defined as graduation from the program and withdrawal or relief as nonsuccess.*

*All data were analyzed using logistic regression. Results*

*were considered statistically significant at a P value of .05 or less. Only 2 noncognitive factors, locus of control and trait anxiety, were statistically significant such that students with a more external locus of control and lower trait anxiety were more likely to succeed (-2 log likelihood of 33.83; overall P = .012).*

*The findings suggest that locus of control and trait anxiety may be the most predictive indicators of success in the program. Furthermore, our findings support that noncognitive factors may be as vital as cognitive factors in predicting academic success.*

**Key words:** Academic performance, anesthesia nursing, graduate nursing education.

There is a nationwide shortage of Certified Registered Nurse Anesthetists (CRNAs) that is expected to further deteriorate during the next 10 years.<sup>1</sup> Currently, the army is experiencing a shortage of CRNAs. Nurse anesthetists are essential to the mission of the army in wartime and in peacetime operations because CRNAs provide approximately 80% of the anesthesia in medical treatment facilities and are the only anesthesia providers in forward deployed units. Because the US Army Graduate Program in Anesthesia Nursing (USAGPAN) is virtually the sole source of CRNAs for the US Army, it is essential that the officers who begin the USAGPAN successfully complete it.

Researchers have attempted to find ways to predict success in academic programs, including medical, allied health, and nursing.<sup>2-4</sup> Cognitive and noncognitive factors have been examined with varying degrees of success. Cognitive factors such as grade point averages (GPAs), course grades, critical thinking tests, and

graduate record examination (GRE) scores have been studied for predictive value. Furthermore, various noncognitive factors such as personality and psychological tests, essays, and interviews have been devised and administered in attempts to predict success in academic programs.

Cognitive factors may have a slight advantage as predictors of success over noncognitive factors, although cognitive and noncognitive factors have been suggested to have some predictive value. Therefore, this study included cognitive and noncognitive factors to examine potential predictors of student success in the USAGPAN.

## Methods and materials

This was a 3-year longitudinal, nonexperimental, prospective, descriptive study. The study was approved through the Brooke Army Medical Center Institutional Review Board, San Antonio, Texas, and the University of Texas Health Science Center at

Houston Review Board. Students were invited to participate in the study via email. The invitation outlined the study's purpose, risks, benefits, procedures, confidentiality and data storage, and subjects' right not to participate. Directions to the web-based cognitive and noncognitive assessment tools and instructions for completing the assessment tools were included in the invitation. Completion of the assessment tools indicated consent.

Cognitive and noncognitive assessment tools were used to identify predictors of success in the USAGPAN. The following 2 noncognitive assessment tools were administered (1) the Rotter Locus of Control Scale (<http://www.ballarat.edu.au/ard/bssh/psych/rot.htm>) and (2) the trait portion of the State-Trait Anxiety Inventory (Mind Garden Inc., Menlo Park, California). Age and gender were also considered noncognitive factors. The cognitive indicators were the following: (1) the Watson-Glaser Critical Thinking Appraisal (Harcourt Assessment, San Antonio, Texas) and (2) the GRE verbal score and GRE quantitative score.<sup>5-8</sup> The measure of success was defined as graduation from the program; withdrawal or relief from the program was considered nonsuccess.

## Instruments

The trait portion of the State-Trait Anxiety Inventory measures trait anxiety—the relative stability of individual differences in anxiety-proneness; that is, differences between the tendency to perceive stressful situations as dangerous or threatening or to perceive them as innocuous (Figure 1). This perception, in turn, may manifest in the response of an individual to varying degrees.<sup>6</sup>

Reliability of the Trait Anxiety Inventory has been established with test-retest stability coefficients with a median score of 0.765. Given the transitory nature of anxiety states, measures of internal consistency such as the  $\alpha$  coefficient provide a more meaningful index of reliability scales than the test-retest correlations. The  $\alpha$  coefficients for the Trait Anxiety scale were uniformly high, with a median coefficient of 0.90.<sup>6</sup>

Evidence for construct validity was obtained by comparing the mean scores of healthy subjects with those of various neuropsychiatric patients. The scores for the neuropsychiatric patient groups were consistently higher (mean, 46.62 vs 34.57) than the scores of healthy subjects. The difference provides evidence that the trait anxiety score discriminates between healthy subjects and neuropsychiatric patients with whom anxiety is a major symptom.<sup>6</sup>

The Rotter Locus of Control Scale is an instrument that places the individual on a continuum from an

**Figure 1. Five sample questions from the State-Trait Anxiety Inventory**

A number of statements which people have used to describe themselves are given below. Read each statement and then select the appropriate value that indicates how you generally feel. There are no right or wrong answers.

Please type the last five numbers of your social security number.

1. I feel pleasant.

- Almost Never
- Sometimes
- Often
- Almost Always

2. I feel nervous and restless.

- Almost Never
- Sometimes
- Often
- Almost Always

3. I feel satisfied with myself.

- Almost Never
- Sometimes
- Often
- Almost Always

4. I wish I could be as happy as others seem to be.

- Almost Never
- Sometimes
- Often
- Almost Always

5. I feel like a failure.

- Almost Never
- Sometimes
- Often
- Almost Always

Students were invited to complete the instrument via a secure web-based platform.

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internal to external locus of control (Figure 2). People with a high internal locus of control believe that their success is dependent on their own behavior, whereas people with a high external locus of control believe that their success is controlled by external forces.<sup>5</sup> Internal consistency was established by calculating a split-half reliability coefficient of 0.73. Test-retest reliability was established with a correlation coefficient of 0.72.

Evidence of the construct validity of the Rotter Locus of Control Scale comes from predicted differ-

**Figure 2. Five sample questions from the Rotter Locus of Control Scale**

Please select the answer that most closely reflects your belief.

Please type the last five numbers of your social security number.

1.

- a. Children get into trouble because their parents punish them too much.
- b. The trouble with most children nowadays is that their parents are too easy with them.

2.

- a. Many of the unhappy things in people's lives are partly due to bad luck.
- b. People's misfortunes result from the mistakes they make.

3.

- a. One of the major reasons why we have wars is because people don't take enough interest in politics.
- b. There will always be wars, no matter how hard people try to prevent them.

4.

- a. In the long run people get the respect they deserve in this world.
- b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

5.

- a. The idea that teachers are unfair to students is nonsense.
- b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

Students were invited to complete the instrument via a secure web-based platform.

Available at: <http://www.ballarat.edu.au/ard/bssh/psych/rot.htm>, from the following public domain website: <http://www.ballarat.edu.au/ard/bssh/psych/rot.htm>.

ences in behavior for people who score above and below the median of the scale or from correlations with behavioral criteria. Rotter<sup>5</sup> found strong support for the hypothesis that the individual who has a strong belief that he or she can control his or her own destiny is likely to (1) be more alert to the aspects of the environment that can provide useful information for his or her future behavior, (2) take steps to improve his or her environmental condition, (3) place greater value on skill or achievement reinforcements and be generally more concerned with his or her ability, and (4) be resistive to subtle attempts to influence him or her.<sup>5</sup>

The Watson-Glaser Critical Thinking Appraisal (WGCTA), a cognitive test, determines aspects of

inference, recognition of assumptions, deductions, interpretation, and evaluation of arguments (Figure 3). The reliability of the WGCTA has been established in 3 ways: internal consistency, stability of scores over time, and the correlation of scores on different forms.<sup>7</sup>

Internal consistency of the WGCTA was established by calculating split-half reliability coefficients, which ranged from 0.69 to 0.85. Test-retest reliability was established with a correlation coefficient of 0.73, reflecting reasonable stability of the measure over time.<sup>7</sup>

Content validity of the WGCTA was established by comparing scores of upper level college students with entry-level students. The upper level students generally scored higher (mean, 59.5) than entry-level students (mean, 55.8).<sup>7</sup>

### Statistical analysis

The study used a convenience sample of 46 students enrolled in the USAGPAN. Because the dependent variable (success vs nonsuccess) was categorical and logistic regression has less restrictive assumptions than multiple regression or discriminant analysis, logistic regression was used to analyze the relationship between the multiple cognitive and noncognitive factors and success in the USAGPAN. Results were considered statistically significant at a *P* value of .05 or less.

### Results

There were 42 students who enrolled in the study. Table 1 provides the descriptive statistics of the participants. Whereas 38 of the 42 students in the study completed the locus of control and/or the trait portion of the State-Trait anxiety inventories, only 26 (62%) of 42 completed the WGCTA. Because the intent of the study was to examine critical thinking as a predictor of success and because literature suggests that the predictive value of cognitive factors is superior to that of noncognitive factors, the first iteration of logistics regression analysis included scores from the WGCTA as a predictive factor, thus limiting the analyzable sample size to 26.

Analysis of the model, with WGCTA included, revealed an overall *P* value of .054, indicating that the predictors did not reliably distinguish between success and failure ( $-2 \log$  likelihood, 20.82). The overall predictive value of the model was 84.62%. Whereas specificity was 93%, sensitivity was 70%. Only locus of control contributed significantly to the model such that students with a more external locus of control were 2 times more likely to succeed (Table 2).

Because WGCTA scores did not contribute signifi-

Figure 3. Representative sample questions from the Watson-Glaser Critical Thinking Appraisal

**EXAMPLE**  
Two hundred students in their early teens voluntarily attended a recent weekend student conference in a Midwestern city. At this conference, the topic of race relations and means of achieving lasting world peace were discussed, since these were the problems the students selected as being most vital in today's world.

	T	PT	ID	PF	F
1	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
5	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- As a group, the students who attended this conference showed a keener interest in broad social problems than do most other students in their early teens.
- The majority of the students had not previously discussed the conference topics in their schools.
- The students came from all sections of the country.
- The students discussed mainly labor relations problems.
- Some teenage students felt it worthwhile to discuss problems of race relations and ways of achieving world peace.

**EXAMPLE**  
Statement: "We need to save time in getting there so we'd better go by plane."

	Test 2 Assumption	
	Made	Not Made
1	<input checked="" type="radio"/>	<input type="radio"/>
2	<input checked="" type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input checked="" type="radio"/>

**Proposed Assumptions:**

- Going by plane will take less time than going by some other means of transportation. (It is assumed in the statement that the greater speed of a plane over the speeds of other means of transportation will enable the group to reach its destination in less time.)
- There is plane service available to us for at least part of the distance to the destination. (This is necessarily assumed in the statement since, in order to save time by plane, it must be possible to go by plane.)
- Travel by plane is more convenient than travel by train. (This assumption is not made in the statement—the statement has to do with saving time, and says nothing about convenience or about any other specific mode of travel.)

**EXAMPLE**  
Some holidays are rainy. All rainy days are boring. Therefore—

	Test 3 Conclusion	
	Follows	Does Not Follow
1	<input type="radio"/>	<input checked="" type="radio"/>
2	<input checked="" type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input checked="" type="radio"/>

- No clear days are boring. (The conclusion does not follow. You cannot tell from the statements whether or not clear days are boring. Some may be.)
- Some holidays are boring. (The conclusion necessarily follows from the statements since, according to them, the rainy holidays must be boring.)
- Some holidays are not boring. (The conclusion does not follow, even though you may know that some holidays are very pleasant.)

**EXAMPLE**  
A study of vocabulary growth in children from eight months to six years old shows that the size of spoken vocabulary increases from zero words at age eight months to 2562 words at age six years.

	Test 4 Conclusion	
	Follows	Does Not Follow
1	<input checked="" type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input checked="" type="radio"/>

- None of the children in this study had learned to talk by the age of six months. (The conclusion follows beyond a reasonable doubt since, according to the statement, the size of the spoken vocabulary at eight months was zero words.)
- Vocabulary growth is slowest during the period when children are learning to walk. (The conclusion does not follow since there is no information given that relates growth of vocabulary to walking.)

**EXAMPLE**  
Should all young men in the United States go to college?

	Test 5 Argument	
	Strong	Weak
1	<input type="radio"/>	<input checked="" type="radio"/>
2	<input checked="" type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input checked="" type="radio"/>

- Yes; college provides an opportunity for them to learn school songs and cheers. (This would be a silly reason for spending years in college.)
- No; a large percent of young men do not have enough ability or interest to derive any benefit from college training. (If this is true, as the directions require us to assume, it is a weighty argument against all young men going to college.)
- No; excessive studying permanently warps an individual's personality. (This argument, although of great general importance when accepted as true, is not directly related to the question, because attendance at college does not necessarily require excessive studying.)



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Students were invited to complete the instrument via a secure web-based platform.

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cantly to the model but significantly limited the analyzable data from the sample, the WGCTA scores were omitted in a second regression analysis. Analyzable data increased from 26 to 38 for this analysis. Of the 42 students enrolled in the study, 4 completed only 1 of 2 noncognitive tools; therefore, those data were not analyzed.

The logistic regression for this model demonstrated an overall *P* value of 0.012 (-2 log likelihood, 33.83), suggesting that these predictors reliably distinguished between students who succeeded and students who did not. The overall predictive value of the model was 84.21%, sensitivity was 91%, and specificity was 71%, suggesting good predictive value. Only locus of control and trait anxiety scores contributed significantly to this second model such that students with a more external locus of control and lower trait anxiety were more likely to succeed (Table 3).

Figure 4 illustrates the direction in which locus of

control and anxiety predictors influence nonsuccess vs success in the USAGPAN. A higher locus of control score represents a more external locus of control. A higher anxiety score represents increased anxiety.

**Table 1. Descriptive statistics of the sample (n = 42).**

Interval data	
Mean ± SD (range) age, y	34.6 ± 5.24 (26-45)
Ordinal/nominal data	
Rank	Frequency (%)
First lieutenant	5 (12)
Captain	32 (76)
Major	5 (12)
Gender	
Male	24 (57)
Female	18 (43)

**Table 2. Contribution of each variable to the logistic regression equation**

Factor	Logits	SE	Wald statistic	Degrees of freedom	Significance	R	Odds ratio
Graduate record examination							
Verbal	-0.0008	0.0093	0.0074	1	.93	0.00	1.00
Quantitative	-0.0099	0.0094	1.1226	1	.28	0.00	0.99
Age	-0.1248	0.1256	0.9877	1	.32	0.00	0.88
Gender	1.1519	1.2621	1.4495	1	.22	0.00	4.57
Critical thinking	-0.0419	0.1022	0.1682	1	.68	0.00	0.95
Anxiety	-0.3574	0.2358	2.2972	1	.12	-0.09	0.70
Locus of control	0.7357	0.3675	4.0075	1	.04*	0.24	2.08

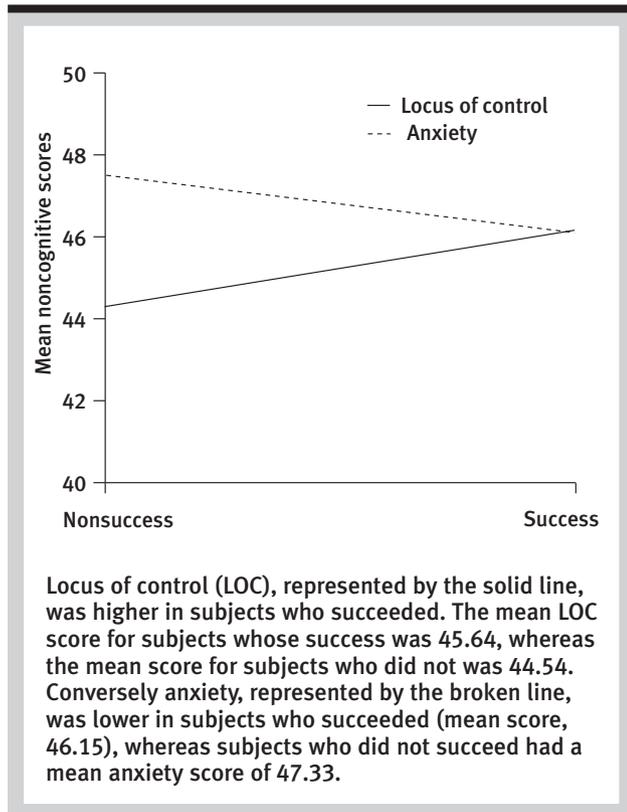
\* Only locus of control significantly contributed to the model.

**Table 3. Contribution of each variable, except the Watson-Glaser Critical Thinking Appraisal scores, to the logistic regression equation**

Factor	Logits	SE	Wald statistic	Degrees of freedom	Significance	R	Odds ratio
Graduate record examination							
Verbal	-0.0016	0.0071	0.0489	1	.82	0.00	0.99
Quantitative	-0.0051	0.0059	0.7427	1	.38	0.00	0.99
Age	-0.1341	0.0900	2.2193	1	.13	-0.06	0.87
Gender	1.727	1.0785	2.5663	1	.11	0.01	5.62
Anxiety	-0.4016	0.1788	5.0473	1	.02*	-0.24	0.68
Locus of control	0.7357	0.3003	4.9395	1	.02*	0.24	1.94

\* Locus of control and trait anxiety significantly contributed to the model.

**Figure 4. Direction in which locus of control and anxiety predictors influence nonsuccess vs success**



## Discussion

The overall purpose of this research was to identify cognitive and noncognitive factors that may predict success in the USAGPAN. By examining the causes of attrition, program directors may be able to identify students who may be at risk. Thus, interventional measures may be developed and implemented to promote success and reduce attrition.

Researchers have attempted to discover ways to predict student success in academic programs, including medical, allied health, and nursing. Cognitive and noncognitive factors have been studied with varying degrees of success within these educational milieus; however, research examining cognitive predictors is most abundant. For example, the GRE, a cognitive tool, has been used as the standard in predicting success in graduate programs. Historically, graduate nursing programs have required the GRE, assuming that it would predict students who would be successful in completing the program. Yet, there are still questions as to whether this test is the best tool for predicting success. Willingham<sup>4</sup> criticized the GRE, suggesting that the GRE focused on narrow aspects of competency and had a possible cultural bias.

Based on the assumption that GRE scores predicted success, Stein and Green<sup>8</sup> studied the undergraduate GPA and the GREs with regard to student performance. The researchers found a small, but positive correlation between the quantitative GRE scores and the total GPA among 35 graduate students (0.33) and a stronger correlation for students who entered the field of medical-surgical nursing (0.50). Furthermore, the GRE verbal and quantitative scores (0.56 and 0.56, respectively) were better predictors of total graduate GPA than non-nursing-related GPA or nursing GPA (0.01 and 0.27, respectively). The GRE qualitative score predicted the total GPA the most effectively for medical-surgical students (0.70). These findings suggested that the baccalaureate GPA and the GRE predicted success with about the same accuracy, thus suggesting these 2 factors are valid and reliable tools for admission into the graduate nursing program.<sup>8</sup>

However, in subsequent research, Stein<sup>9</sup> found no correlations between GRE scores and graduate nursing grades. The only strong correlation was found between graduate nursing GPA and total graduate GPA (0.86). This variation from the previous study may have been due to the larger sample in the second study.<sup>9</sup>

More recently and more pertinent to anesthesia nursing success, Zaglaniczny<sup>10</sup> studied cognitive factors as predictors of success in anesthesia school. The study included 1,690 anesthesia nursing school graduates who took the National Certification Examination (NCE) from December 1987 to December 1989. Of 13 academic, demographic, and preadmission variables, science and overall GPAs were suggested as important predictors of performance on the NCE. However, graduates that failed the NCE still had a mean science GPA and a mean overall GPA greater than 3.0 (3.14 and 3.37, respectively).

Unlike the results from the study by Zaglaniczny,<sup>10</sup> the present study suggested that the cognitive factors, quantitative and verbal GRE scores, and WGCTA scores, were not predictors of success in the USAGPAN. These findings may be explained by the smaller sample ( $n = 38$ ) of our study and by the academic homogeneity of graduate anesthesia nursing students. Students entering the USAGPAN are fairly homogeneous regarding educational preparation and GRE scores, as are all graduate anesthesia nursing students, which may further emphasize the importance of noncognitive factors as potential predictors of success in anesthesia nursing programs. Various noncognitive assessment tools such as personality tests and psychological tests, essays, and interviews have been developed and administered in attempts to predict

success in academic programs but have been studied less comprehensively than cognitive predictors.

For example, the Rotter Locus of Control and anxiety measurements have been used in conjunction with cognitive factors in an attempt to predict success in medical schools. Grover and Smith<sup>11</sup> examined cognitive factors, such as Medical College Admission Test scores and GPA, and noncognitive factors, including locus of control and Academic Anxiety Test scores to predict success. Although anxiety scores were not predictive, their findings suggested that whereas students who demonstrated a greater change in locus of control, whether internal or external, were likely to be moderate to high achievers, students with a stable locus of control were likely to be low achievers. This finding may be significant in that the direction of the shift may not be as important as the demonstration of flexibility, an important trait for success in a program of rigorous study.<sup>11</sup>

Two similar studies by Markert<sup>12</sup> and Linn and Zeppa<sup>13</sup> used the Rotter Locus of Control and anxiety measurements to predict success in medical school. The findings of these studies were the reverse of the previously described study. Although locus of control in these studies did not correlate significantly with performance, perception of stress (favorable vs unfavorable) showed promise (weak correlations).<sup>12,13</sup>

The findings from our study suggest that students with higher trait-anxiety scores are half as likely to be successful compared with students with lower trait-anxiety scores (odds ratio, 0.68). Moreover, students with a more internal locus of control are 2 times more likely to succeed. Whereas the findings regarding anxiety are congruent with findings that suggest academic performance during medical school is negatively related to reported stress levels,<sup>14</sup> the findings regarding locus of control are unusual.

Unlike most findings that suggest internal locus of control is positively correlated with academic success,<sup>15-17</sup> the findings from this study suggest that students with a more external locus of control are 2 times more likely to succeed in the USAGPAN. We speculate that because the USAGPAN is a military graduate program, a more external locus of control may be associated with better adaptation to the military educational milieu. Although the USAGPAN is fully accredited and modeled after the University of Texas Health Science Center at Houston's graduate anesthesia program, there are aspects of the program that are military, such as physical training requirements and mandatory assemblies and parades. Students with a more internal locus of control may find these military requirements distracting.

## Conclusion

The findings from this study suggest that locus of control and trait anxiety may be the most predictive indicators of success in the USAGPAN. Unlike most studies that suggest a more internal locus of control is correlated with academic success,<sup>16</sup> this study suggested that a more external locus of control was associated with academic success. We speculate that because the USAGPAN is a military graduate program, a more external locus of control may be associated with better adaptation to the military educational milieu. Second, a lower trait anxiety score was associated with academic success in the USAGPAN. This finding is supported by educational studies suggesting that anxiety is negatively correlated with academic success.<sup>18</sup> If anxiety is negatively correlated with success in the USAGPAN, anxiety-relieving interventions might be developed to promote success. Finally, our findings support that noncognitive assessment tools such as locus of control and anxiety and stress tests may be more predictive of academic success than cognitive tools for this military graduate anesthesia program.

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