Chi-square Critique of Vaticanus Distigme-obelos Denials

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This study supplements my article submitted to *New Testament Studies*, 'Critique of Vaticanus Distigme-obelos Denials.' In response to my 'Vaticanus Distigme-obelos Symbols Marking Added Text, Including 1 Corinthians 14.34–5' *NTS* 63 (2017) 604–24 study,[1] the April 2019 issue of *NTS* published two articles that deny the existence of distigme-obelos symbols. Page numbers in parentheses hereafter cite those two articles.

Richard Fellows' article[2] makes two central assertions denying the correlation of three or more words of added text with bar length measurements. First, Fellows denies a strong correlation between these eight characteristic bars' extension into the margin and three-or-more word additions. Second, he denies a strong correlation between these eight characteristic bars' total length and three-or-more word additions. I had identified long measurements of these two features as two of the five characteristic features (listed on p. 13 below) of the bars in distigme-obelos symbols. The standard chi-square probability test is the proper procedure to evaluate the probability that Fellows' two central assertions are correct.

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[1] Available for free download from https://www.cambridge.org/core/services/aop-cambridge-core/content/view/A5FC01A6E14A2A1CF1F514A9BF93C581.

[2] Richard G. Fellows, 'Are There Distigme-Obelos Symbols in Vaticanus?', *NTS* 65 (2019) 246–51.

These specific chi-square tests contrast the frequency of widely acknowledged, three-or-more-word-adding, NA[28]-listed variants occurring on distigme lines with characteristic bars to their frequency on distigme lines with undisputed paragraphoi. Both chi-square tests focus on the correlation of such multi-word adding variants and one of the characteristic graphic features of characteristic bars. The first focuses on their bars' extension into the margin, the second on their bars' length. Both use Fellows' own measurement of the characteristic bar that he designates as the shortest either in extension into the margin (2.24 mm) or overall length (3.88 mm). Both chi-square tests compare the eight-out-of-eight, 100% frequency of such multi-word additions following characteristic bars to their zero-out-of-twenty, 0% frequency of such multi-word additions when the bar has this characteristic graphic feature in distigme lines with undisputed paragraphoi. These and two other chi-square test described later also exclude as incorrect Jan Krans's denial that distigme-obelos symbols exist.

Fellows' first central assertion regarding bars 'adjacent to distigmai'[3] (247) is: 'there is no strong correlation between extension into the margin and the number of words of omitted[4] text in textual variants. Any trend is explicable by chance' (249). This is the opposite of my research hypothesis that characteristic bars by distigme lines mark the location of multi-word additions. In particular, it denies a correlation between the

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[3] This is required by 'black diamonds' in Fellow's sentence quoted next (249).

[4] It is puzzling in light of scholarly consensus that obeloi mark where text was *added* and the consistent description of obeloi throughout my article marking where text was *added* that Fellows refers to their correlation with '*omitted* text'. Vaticanus's asterisks, not obeloi, mark omitted text.

characteristic bars' second and fourth characteristic features listed on p. 13 below: each extends measurably farther into the margin than most bars adjacent to distigmai, and each occurs at the location of a widely recognised, multi-word addition. The chi-square test determines the probability that the null hypothesis, namely the opposite of the research hypothesis, is correct. In this case, Fellows' first central assertion is the null hypothesis: 'There is no strong correlation between extension into the margin [of bars by distigme lines] and the number of words of [added] text in textual variants' (249).

A strong correlation between multi-word additions and these bars' extension into the margin is obvious, however, in Fellows' own Figure 3.[5] By Fellows' own measurements and the word counts he provides, all eight characteristic bars extend into the margin at least 2.24 mm, which is Fellows' own measurement of the characteristic bar he identifies as having the least extension into the margin,[6] and coincide with widely acknowledged, NA[28]-cited, three-or-more-word additions. These include the five longest additions to distigme lines with a bar that Fellows lists. Furthermore, by Fellows' own measurements and the word counts he lists, not even one of 'the twenty undisputed

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[5] On 5 Oct. 2017 Fellows kindly emailed to me the measurements he uses in his *NTS* article of extension into the margin and overall length of these twenty-eight bars.

[6] Fellows' measurement of Matt 18.10/12's bar's extension into the margin excluding the separated dot, causing it to be the shortest characteristic bar extension into the margin he lists. See my 'Critique of Vaticanus Distigme-Obelos Denials', pp. 5–6 and n. 10, for evidence that the dot is part of this bar. Consequently, Fellows' measurement of this bar's extension into the margin is 1 mm too short. Fellows' next lowest characteristic-bar extension-into-the-margin measurement is 2.39 mm.

paragraphoi' (249) extends into the margin at least 2.24 mm and also coincides with a NA[28]-cited, three-or-more-word addition.

Obviously, if my research hypothesis is correct that these are distigme-obelos symbols marking the locations of multi-word additions to the text, this explains why all characteristic bars coincide with multi-word additions. Fellows, however, denies any valid distinction between bars by distigme lines that share the characteristic features identified in my 2017 *NTS* article and undisputed paragraphoi by distigme lines. Indeed, he asserts that they are 'indistinguishable' (246, 251). The standard chi-square test calculates the probability if Fellows' null hypothesis were correct that this sharp contrast would occur between characteristic bars and undisputed paragraphoi by distigme lines regarding correlation between extension into the margin and multi-word additions.

The first chi-square test determines whether there is a statistically significant correlation in the occurrence by distigme lines of widely acknowledged, NA[28]-listed, three-or-more-word additions and the extension of that line's bar into the margin being at least 2.24 mm. This test compares the eight-out-of-eight, 100% frequency of such three-or-more-word additions following a distigme adjacent to a characteristic bar that extends into the margin at least 2.24 mm to the 0% frequency of such three-or-more-word additions occurring with a bar that extends into the margin at least 2.24 mm in the twenty distigme lines with an undisputed paragraphos bar.

To prevent overestimation of statistical significance when the number of occurrences is small, this chi-square test includes Yates's correction. The chi-square result including Yates's correction is $\chi^2 = 23.311$, d.f. (degrees of freedom) = 1. The chi-

square calculator at http://courses.atlas.illinois.edu/fall2017/STAT/STAT200/pchisq.html calculates the probability of this happening as p (probability) = 0.000001378.

This, the standard probability test, shows the probability that Fellows' first main null hypothesis is correct is 1.378 in 1,000,000. A chi-square result showing the probability of something happening randomly as one in twenty is regarded as statistically significant, namely strong enough to exclude the null hypothesis as invalid. This test's chi-square value rejects Fellows' null hypothesis at a statistical probability 36,284 times greater than the generally-accepted threshold to reject his null hypothesis.[7] This test overwhelmingly excludes as invalid Fellow's null hypothesis assertion that 'there is no strong correlation between extension into the margin and the number of words of [added] text in textual variants' (249). This test gives strong confirmation that the research hypothesis is correct, namely that characteristic bars following distigmai mark the location of multi-word-adding textual variants. Consequently, this test result justifies distinguishing characteristic bars from undisputed paragraphoi.

Making the case even stronger, a gap follows all seven of these apparently original distigme-obelos symbols at the exact point where multi-word additions begin. This identifies their location over sixteen times more precisely than simply somewhere in the line.[8]

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[7] 1.378 in 1,000,000 = 1 in 725,689.404935. 725,689.404935 ÷ 20 = 36,284.4702467.

[8] There are 694 letters in the 42 lines of Vaticanus 1236 column A, Matthew's first column of narrative text, an average of 16.5 letters per line. 694 ÷ 42 = 16.523809.

Fellows' second central assertion, namely his second null hypothesis, regarding bars 'adjacent to distigmai'[9] (247) is: 'there is no strong correlation between bar length and number of added words in textual variants' (251). This is the opposite of my research hypothesis that characteristic bars by distigme lines mark the location of multi-word additions. In particular, it denies a correlation between characteristic bars' third and fourth characteristics listed on p. 13 below: each is measurably longer than most bars adjacent to distigmai, and each occurs at the location of a widely recognised, multi-word addition.

Contrary to Fellows' second central assertion, a strong correlation between multi-word additions and bar length by distigme lines is obvious in Fellows' Figure 2. By his own measurements and word count, all eight characteristic bars are at least 3.88 mm long[10] and coincide with widely acknowledged, NA[28]-cited, three-or-more-word additions, including the five longest additions. Not even one of the other twenty bars by distigme lines[11] (undisputed paragraphoi) is that long and also coincides with a NA[28]-cited, three-or-more-word addition.

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[9] This is required by 'these… results' and 'see Fig. 3' in this and the prior sentence (251).

[10] Fellows' measurement of Matt 18.10/12's bar's length excluding the separated dot, hence his shortest characteristic bar length measurement. See my critique, pp. 5–6 and n. 10, for evidence the dot is part of this bar. Consequently, this bar's length should be listed as 1 mm longer. Fellows emailed to me the length measurements he used in his *NTS* article of these twenty-eight bars on 5 Oct. 2017. Fellows' second shortest characteristic bar measurement is 4.01 mm long.

[11] To which Fellows is referring ('these measurements' 251).

The second chi-square test determines whether there is a statistically significant correlation in the occurrence by distigme lines of widely acknowledged, NA[28]-listed, three-or-more-word-adding variants and bars that are at least 3.88 mm long. This test compares the eight-out-of-eight, 100% frequency of such three-or-more-word additions following a distigme adjacent to a characteristic bar that is at least 3.88 mm long to the 0% frequency of such three-or-more-word additions occurring with a bar that is at least 3.88 mm long in the twenty distigme lines with an undisputed paragraphos bar.

To prevent overestimation of statistical significance when the number of occurrences is small, this chi-square test includes Yates's correction. The chi-square result is $\chi^2 = 23.311$, d.f. (degrees of freedom) = 1. The chi-square calculator at http://courses.atlas.illinois.edu/fall2017/STAT/STAT200/pchisq.html calculates the probability of this happening as p = 0.000001378.

This, the standard probability test, shows the probability that Fellows' second main null hypothesis is correct is 1.378 in 1,000,000. A chi-square result showing the probability of something happening randomly as one in twenty is regarded as statistically significant, namely strong enough to exclude the null hypothesis as invalid. This test's chi-square value rejects the null hypothesis at a statistical probability 36,284 times greater than the generally-accepted threshold to reject his null hypothesis.[12] This test overwhelmingly excludes as invalid Fellow's null hypothesis assertion that 'there is no strong correlation between bar length and number of added words in textual variants' (251). This test gives strong confirmation that the research hypothesis is correct, namely that characteristic bars following distigmai mark the location of multi-word-adding

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[12] 1.378 in 1,000,000 = 1 in 725,689.404935. 725,689.404935 ÷ 20 = 36,284.4702467.

textual variants. Consequently, this test result justifies distinguishing characteristic bars from undisputed paragraphoi.

Making the case even stronger, a gap follows all seven apparently original distigme-obelos symbols at the exact point where a multi-word addition begins. This identifies their location over sixteen times more precisely than simply somewhere in the line.[13]

By Fellows' own measurements, bars by distigme lines exhibiting either length characteristic have extraordinarily strong correlation with multi-word additions. Both together overwhelmingly refute Fellows' denial of a strong correlation between characteristic bars and the number of added words.

Fellows contends, however, that 'these are not two independent observations: the bar is longer than average precisely because it extends further into the margin' (251). Yet Fellows' own lists of examples of these two observations in 1 Corinthians (249 n. 9, 251, n. 10) demonstrate that these observations are largely independent. Eighteen of the references he cites for these two observations apply to only one of them. Only seven apply to both.

Fellows made an important contribution in identifying a ninth characteristic bar at 1285B (Mark 6.11) with a large mid-line gap at the exact point where some manuscripts add 15–18 words (249). As a result of his sharing this discovery with me in 2017, I reexamined *Vaticanus* five more times and identified nine more (for a new total of seventeen) distigme-obelos symbols and enough more undisputed paragraphoi by

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[13] There are 694 letters in the 42 lines of Vaticanus 1236 column A, Matthew's first column of narrative text, an average of 16.5 letters per line.

distigme lines to bring that total to thirty. All nine newly discovered distigme-obelos symbols have a gap on their line at the exact point NA[28] and/or Reuben-Swanson-noted[14] variants cumulatively add four or more words that were not in the original text. All thirty undisputed paragraphoi by distigme lines lack at least two of the five characteristic bar features listed on p. 13 below. I submitted a new article, 'Seventeen Vaticanus Distigme-obelos Symbols Marking where Text was Added, including 1 Corinthians 14.34–5', with the details of these new discoveries to *NTS* along with my 'Chi-square Data Critique of Vaticanus Distigme-obelos Denials.' *NTS* has a policy of not accepting more than one article at a time submitted by the same author. If *NTS* does not publish it as well as my 'Critique of Vaticanus Distigme-obelos Denials', I plan to make it available elsewhere.

The ideal confirmation of a thesis identifying what rarely-occurring symbols mean is if it accurately describes what occurs in all cases not originally considered. My thesis accurately describes what in fact occurs by all nine newly discovered distigme lines with a bar that both extends measurably farther into the margin than most undisputed paragraphoi by a distigme line and is also measurably longer than most undisputed paragraphoi by a distigme line.

NA[28] and/or Reuben-Swanson listed variants that cumulatively add four or more words that were not in the original text occur on average only about once in eighty lines of Vaticanus text.[15] Nevertheless, one of these rare variants occurs by every one of these

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[14] R. Swanson's separate volumes, *Matthew, Mark, Luke, John*, are all Sheffield/Pasadena, CA: Sheffield Academic/William Carey, 1995; *Acts* is 1998; *1 Corinthians* (Wheaton, IL: Tyndale House/William Carey) 2003.

[15] This is calculated conservatively from Matthew, the synoptic Gospel (since synoptics

nine newly discovered characteristic bars. Furthermore, all nine begin precisely at a gap in the following line, just as do all but one (with distinctive downward dipping ink from both dots and the bar, indicating a different hand and explaining why there is no gap) of the eight characteristic bars my 2017 *NTS* article identified. If Fellows' and Krans's distigme-obelos denials were correct, the precise correlations of all these gaps with where all these rare variants begin would have to be mere coincidence.

This expanded group of distigme-obelos cases adds to the evidence that Fellows was incorrect in asserting that 'these are not two independent observations: the bar is longer than average precisely because it extends further into the margin' (251). Of the (now) forty-seven bars by a distigme line, 1237C is the shortest, but only three of the other thirty undisputed paragraphoi by distigme lines clearly exceed its extension into the margin: 1268A, 1469C, and 1504B. Similarly, 1429C and 1361A appear to have the least extension into the margin of these forty-seven bars but are longer than most of the thirty

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have more harmonisations adding multiple words) represented by the most papyri (since more papyri reveal more variants). NA[28] cites fifty-six four-word-or-more additions in Matthew. Matthew has 5343 lines in *Vaticanus*. 5343 ÷ 56 = one per 95.410714 lines. Of the seventeen distigme-obelos cases, Reuben Swanson notes variants cumulatively adding four or more words that NA[28] lacks at Mark 3.5; 5.40; and Acts 9.31. Taking this 17:14 ratio as roughly typical of how much more frequently Swanson lists multi-word additions compared to NA[28], this raises the odds of hitting such variants by 17/14. 1/95 x 17/14 = .0127269, namely one in 78.5737. This is rounded up to eighty because Matthew has the highest likelihood of multi-word additions.

undisputed paragraphoi. As height and weight are different characteristics, so are extension into the margin and bar length.

Jan Krans's article denying the existence of distigme-obelos symbols[16] on p. 256 confirms an important finding I had made late in 2017, namely that the only distigme-obelos symbol my 2017 *NTS* article identified as adding only three words (Mark 5.40), in fact, like all seventeen distigme-obelos lines, marks where NA[28] and/or Reuben-Swanson-noted variants cumulatively add four or more words. As note 15 explains, such variants occur only about once in eighty *Vaticanus* lines.

Nevertheless, Krans asserts that distigme-obelos symbols are just 'the coincidental combination of distigme and paragraphos' (252, 257), that 'there is no clue for concluding that a paragraphos doubles as an obelos' (255), that the distigme-obelos symbol 'does not exist but is only the fruit of Payne's imagination' (255, 256) and are 'markings created by him' (254), and that the differences between distigme-obelos symbols and paragraphoi that randomly occur by distigme 'turn out to be insignificant' (255). If these are 'marking created by' me, why can anyone confirm their existence and their characteristic features by looking at any facsimile of *Vaticanus*? Furthermore, why can anyone confirm that multi-word additions occur on each of their lines? If Krans's denials of the characteristic features distinguishing distigme-obelos symbols and paragraphoi were valid, why do these characteristic features accurately predict what in fact occurs in all nine subsequently discovered characteristic bars, namely that they all occur by a line where variants cumulatively add at least four words. Furthermore, why do the variants by all nine begin precisely at a gap in that line? The odds of seventeen

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[16] Jan Krans, 'Paragraphos, Not Obelos, in Codex Vaticanus', *NTS* 65 (2019) 252–7.

random *Vaticanus* lines all coinciding with such a variant anywhere on these lines, let alone at a gap, is approximately one in $80^{17} = 2.25$ in 10^{32}.

Since distigmai mark the location of textual variants, however, multi-word additions are more likely to occur by distigme lines than by random *Vaticanus* lines. Consequently, limiting probabilities to distigme lines is essential to avoid an overstatement of the statistical case. This focus on distigme lines, therefore, is not, as Krans alleges, a 'basic error' (255). All seventeen distigme lines with characteristic bars coincide with variants that cumulatively add four or more words compared to only three[17] of thirty distigme lines with undisputed paragraphoi. The chi-square value of these figures for Krans's null hypothesis denying these characteristic bars mark the location of multi-word additions, even with Yates's correction, is $\chi^2 = 32.369$ d.f. 1. The chi-square calculator at http://courses.atlas.illinois.edu/fall2017/STAT/STAT200/pchisq.html calculates the probability of this happening as $p = .00000001275$. This is just 1.275 in 100,000,000. This is 3,921,569 times greater than the one-in-twenty threshold statistically sufficient to exclude Krans's distigme-obelos denial as an incorrect hypothesis.[18]

This does not even take into consideration that in every case but one by a later hand, who could not insert a gap into the already written text, these variants on distigme-obelos marked lines begin not just anywhere on that line but precisely at its gap. Variants

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[17] The words added to Mark 14.70 (1301B) and Acts 14.18 (1403B) are at a gap. The words added to 1 Cor 10.17 (1469C) are not at a gap. Note that because distigmai mark the locations of textual variants, it is nothing exceptional, but rather to be expected, that out of thirty such variants three would be variants adding four or more words.

[18] 1.275 in 100,000,000 = 1 in 78,431,372.549. 78,431,372.549 ÷ 20 = 3,921,568.62745.

that cumulatively add four or more words begin precisely at a gap in all sixteen distigme lines with a characteristic bar and a gap compared to only two[19] of thirty distigme lines with undisputed paragraphoi. The chi-square value for Krans's null hypothesis using these figures, even with Yates's correction, is $\chi^2 = 34.343$ d.f. 1. The chi-square calculator at http://courses.atlas.illinois.edu/fall2017/STAT/STAT200/pchisq.html calculates the probability of this happening as p = .000000004621. This is just 4.621 in 1,000,000,000. The probability of Krans's null hypothesis being correct by this chi-square test is one in 216,403,376. This 10,820,169 times greater than the one-in-twenty threshold statistically sufficient to exclude Krans's distigme-obelos denial as an incorrect hypothesis.[20]

All this shows to an exceptionally high degree of probability that the seventeen characteristic bars are not merely paragraphoi that by chance share the following five characteristic traits:

1. Each occurs immediately after a distigme.

2. Each extends measurably farther into the margin than most bars adjacent to distigmai.

3. Each is measurably longer than most bars adjacent to distigmai.

4. Each occurs at the location of a widely recognised, multi-word addition.

5. A gap at the precise location of this addition follows all sixteen apparently original characteristic bars.

All sixteen times there is a combination of distigme + characteristic bar + gap, the gap marks the precise point of the beginning of widely-acknowledged, NA[28] and/or Reuben-

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[19] The words added to Mark 14.70 (1301B) and Acts 14.18 (1403B) are at a gap

[20] 4.621 in 1,000,000,000 = 1 in 216,403,375.893 ÷ 20 = 10,820,168.7946.

Swanson-noted variants that cumulatively add four or more words that were not in the original text. Mere coincidence cannot adequately explain this.

All seventeen characteristic bars occur at the location of the same kinds of additions that scribe B marked with similarly shaped obeloi where the LXX added text to the MT. Furthermore, scribe B explained that obeloi signify added text.[21] Since these seventeen characteristic horizontal bars are distinguishable in both form and function from paragraphoi, since their primary function of identifying the location of multiple words of added text is the standard function of obeloi, and since this is not a function of paragraphoi, they should be recognised as obeloi. Since a distigme identifies a textual variant, and since an obelos identifies a specific category of textual variant, text that was added after the original composition, 'distigme-obelos' is the most appropriate name for this symbol.

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[21] Payne, 'Distigme-obelos', 608–9.