

OLD SYRIAC GRAPHOTACTICS

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Abstract¹

This paper examines the graphotactic development of the Old Syriac script. It provides a graphotactically-motivated edition of the oldest Syriac inscription from 6 CE, indicating graph joining and the spacing between graphs. The main claim of the paper is that Old Syriac writing was less cursive in the first century than the second, and the second century was less cursive than the third. Indeed, a number of graphemes, which are dual-joining in Classical Syriac, were right-joining in Old Syriac. The resulting data also help in confirming the dating of the earliest inscription and in settling at least one disputed reading.

The purpose of the present inquiry is to investigate the graphotactic properties of Old Syriac (sometimes called proto-Syriac),² viz., its cursive and spacing features. Broadly speaking, *graphotactics* is the study of the arrangement of graphemes, analogous with *phonotactics* in phonology and *morphotactics* in morphology. Graphotactics has been the domain of the study of a wide variety of grapheme arrangement problems, ranging from the spacings between graphemes in Old English³ to the automatic substitution of graph forms, especially those of Syriac and Arabic, in computer systems.⁴ This inquiry is confined to two

¹ I am indebted to the following: John Healey and Aaron M. Butts read an earlier draft and provided comments and suggestions. J. Healey provided me with a photograph of Bs2, and A. Butts two high-resolution images of P. Dura 28. Hoda Mitwally helped me to obtain publications not available at the Beth Mardutho Research Library.

² The term 'Old Syriac' is preferred here but should not be confused with the term 'Old Syriac Gospels' which applies to the early Gospels written in *Classical Syriac*.

³ Robert D. Stevick, *Old English Graphotactics* (<http://faculty.washington.edu/stevickr/graphotactics>, Oct. 17, 2010).

⁴ Nizar Y.A. Habash, 'Nuun: A System for Developing Platform and Browser independent Arabic Web Applications', in *Proceedings of the Arabic Translation and Localization Conference* (Tunis 1999), 59–65 [<http://www.nizarhabash.com/publications/atlas-99.pdf>, Oct. 17, 2010]; G.A. Kiraz, 'Ordering Malayalam Strings using a Two-Level System', lecture handout at Mahatma Gandhi University (Kottayam, November 1994).

aspects of graphotactics: 1) the degree of cursive writing, or rather the joining properties of graphs, in Old Syriac, and 2) the spacing between graphs (both intra-word and inter-word spacing).

Old Syriac appears in three media types: inscriptions carved on stone (first to third centuries), inscriptions set in mosaic (second to third centuries), and writing on parchments (third century, more precisely 240–3 CE). (Shorter texts appear on papyri, coins and pottery but are excluded from this study).⁵ The Old Syriac script has been generally described as similar to Palmyrene *cursive* writing.⁶ Drijvers and Healey⁷ (hereinafter D&H) already noted that the three media types gave rise to three degrees of cursive writing, carvings on stone being the least cursive and writing on parchment the most, with setting in mosaic in between. By the time of the first dated codex from 411 CE (MS BL Add. 12,150),⁸ written in *Classical* Syriac, the Syriac script has become fully-cursive (at least in the case of dual-joining graphemes). This paper attempts to establish the development of cursive writing during the centuries prior to the 411 codex. During the course of the investigation, it will be shown that some graphemes may have been only right-joining at some point, and progressively became dual-joining by 411.

To set the stage for this inquiry, a graphotactically-motivated edition of the oldest of the inscriptions, As55 dated 6 CE, indicating the joining of its graphs, or lack thereof, and the spacings between disjointed graphs, is given. An analysis of the graphotactic properties of the text is then attempted. The results of this analysis become the departure point for further investigation into the joining properties of the rest of the inscriptions.

The presentation to follow requires some definitions. Borrowing from the terminology of phonology and morphology, linguists of writing systems define a GRAPH (cf. *phone* in phonology and *morph* in morphology)

⁵ For an overview of Old Syriac, see A. Butts, ‘Old Syriac’ and ‘Papyri’ in Brock, Butts, Kiraz and Van Rompay (eds), *Gorgias Encyclopedic Dictionary of the Syriac Heritage* (Piscataway 2011).

⁶ S. Brock, *An Introduction to Syriac Studies* (Gorgias Handbooks 4, Piscataway 2006), 23.

⁷ H. Drijvers and J.F. Healey, *The Old Syriac Inscriptions of Edessa and Osrhoene. Texts, Translations, and Commentary* (Leiden 1999), 16–17.

⁸ An image is found in W. Hatch, *An Album of Dated Syriac Manuscripts* (Boston, 1946; 2nd ed. with an introduction by L. Van Rompay, Piscataway 2002), Pl. I. A description of the codex is given by W. Wright, *Catalogue of the Syriac Manuscripts in the British Museum* (London 1870–2; reprint Piscataway 2002), Part II, 631 ff. (No. DCCXXVI).

as the most basic unit of written language; it usually corresponds to a letter or shape such as ܢ or ܢ. A GRAPHEME (cf. *phoneme* in phonology and *morpheme* in morphology) is defined as the minimally significant unit in a writing system at a more abstract level. For instance, the difference between initial ܢ and final ܢ is merely contextual, and, hence, both are said to represent the same grapheme <n> (graphemes are shown in angle brackets). Indeed, both graphs, ܢ and ܢ, are ALLOGRAPHS (cf. *allophone* in phonology and *allomorph* in morphology) of the same grapheme.

In Syriac (and Arabic) cursive writing, the graphs are mostly connected with a JOINER LINE at the baseline (with the exception of Syriac <t> and <ṭ> which require an additional stroke from the baseline to the top of the graph); e.g., the joining of <byrḥ> in ܒܝܪܗܝܢ ‘in the month’. Graphemes that join on both sides, such as <y> in ܕܝܢܐ, are said to be DUAL-JOINING (hereinafter DJ), while those that join only on the right, such as <r>, are said to be RIGHT-JOINING (hereinafter RJ). (These terms are recent, probably an innovation of Unicode.)⁹ It must be stressed that *right* in *right-joining* is used with the right-to-left script in mind, not the left-to-right Roman transcription; hence, we say that <y> is on the *right* of <r> in <byrḥ>.

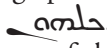
In formal and standardized writing, the sets of DJ and RJ graphemes are usually mutually exclusive. In Classical Syriac, for example, the two sets are as follows:

DJ = <b g ḥ ṭ y k l m n s ‘ p q š>
 RJ = <’ d h w z ṣ r t>

In a less formal setting, the hypothesis of mutual exclusivity needs to be examined further. It has already been noted by Hatch¹⁰ that the grapheme <s>, in Classical Syriac, switches from being RJ to DJ around the first quarter of the seventh century, but switching from one class to another does not betray mutual exclusivity per se. Since such changes take some time to become the new ‘standard’, there will be of course a period of time when <s> appeared as both DJ and RJ. In fact, as late as the eleventh century <s> appears both ways, sometimes on the same page. It is in interim periods like this that mutual exclusivity does not hold. In the case of Old Syriac, it will be shown shortly that this mutual exclusivity of the two sets does not hold, which may be an indication that the script was in a state of development.

⁹ The Unicode Consortium, *The Unicode 5.0 Standard* (Boston, MA 2006), 288–90.

¹⁰ See discussion in Hatch, *An Album*, 34.

One final term needs to be introduced. When indicating spacing in the inscription, the term KERNING, borrowed from typography, is used to indicate that a part of a graph overhangs the edge of an adjacent graph; e.g., the hanging of the right part of <n> under <h> and <w> in .

The rest of the paper shall present a graphotactic edition of As55 (§1) with an analysis (§2). This is followed by a discussion of the rest of the inscriptions (§3). Finally, concluding remarks are given (§4).

1. The Text of As55

The choice of As55 as the departure point for our inquiry was made for several reasons: Firstly, it is the earliest example of Syriac writing on any medium. Secondly, amongst the inscriptions, it is one of the few texts that is available both in photographic and drawing forms, allowing a comparison of the text as it appears in the photograph against the drawing (sometimes with conflicting results). Thirdly, it is one of the more legible inscriptions. Fourthly, and very importantly, it is one of the longest inscriptions consisting of *c.* 38 legible words. It is only shorter than As37, dated 165 CE, which totals 46 words, and Bs2, dated 73 CE, which totals 49 words.

Inscription As55 was discovered by Cumont¹¹ who made a drawing from which Kugener¹² deciphered the text. An edition was prepared by Maricq¹³ which became more or less the standard text. This text was reproduced by Drijvers.¹⁴ Degen¹⁵ challenged a few readings. The latest and most accessible edition of the text, incorporating Degen's findings, appears in D&H¹⁶ and Healey.¹⁷ (Starcky¹⁸ had suggested <wlḥwy>

¹¹ Cumont, *Études syriennes* (Paris, 1917), 144–50.

¹² M.A. Kugener, 'Une inscription syriaque de Biredjik', *Rivista degli studi orientali* 1 (1907), 587–94.

¹³ A. Maricq, 'La plus ancienne inscription syriaque: celle de Birecik', *Syria* 39 (1962), 88–100.

¹⁴ H.J.W. Drijvers, *Old-Syriac (Edesean) Inscriptions* (Leiden 1972), 1–2.

¹⁵ R. Degen, 'Zur syrischen Inschrift von Birecik', in R. Degen, W.W. Müller, and W. Röllig (eds), *Neue Ephemeris für Semitische Epigraphik*, vol. 3 (Wiesbaden 1974), 67–111.

¹⁶ Pp. 140–4, Pl. 40.

¹⁷ J.F. Healey, *Aramaic Inscriptions & Documents of the Roman Period* (TSSI IV, Oxford 2009), 223–6 and pl. 4.

¹⁸ J. Starcky, 'Les premières inscriptions syriaques', *Bible et Terre Sainte* 119 (1970), 4–7, 24.

instead of <włhlwy'> [line 4], which was adopted by Drijvers, but discarded later on.) The graphotactic edition below sheds some light on at least one disputed reading.

The graphotactic edition has two main characteristics: Firstly, it maintains the joining and disjoining of graphs based on a study of a photograph of a squeeze (*estampage* in Maricq's words). (A more recent photograph is not available.) Secondly, it provides measurements of spacings between disjoined graphs. The measurements are relative, not absolute, taken as the percentage of horizontal space with respect to the width of the entire image. For instance, a measure of 1.0 means 1.0% of the width of the entire inscription image; i.e., the entire width of the image is 100%.

The inscription image, depicted in Fig. 1 below, was scanned into TIFF¹⁹ format directly from D&H (Pl. 40). The photograph of the squeeze lacked the necessary resolution for our purposes. To improvise, two algorithms were applied on the image using the software Photoshop:²⁰ The first is Gaussian blur which applies to the image the Gaussian function²¹

$$G(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{x^2}{2\sigma^2}}$$

where x is the distance of a point from the origin, and σ is the standard deviation. Less formally, the application of the function results in an image where noise is reduced making it easier to see the peripherals of graphs in the inscription. The second algorithm, or rather modification, was to adjust the brightness levels of the image histogram resulting in an image in which the graphs appear clearer against the background. The details of the histogram adjustments are shown in Fig. 1 as well.

Determining the joining properties of graphs is not without challenges. The available image, while enhanced by the transformations described above, remains in low resolution. In this case, a drawing is also available which is used to confirm readings. However, one cannot

¹⁹ For the benefit of future generations, TIFF stands for Tagged Image File Format. It was created by Aldus which was acquired by Adobe Systems, the current copyright holder of the format. It has the ability to store image data in a lossless manner which is necessary for the current study.

²⁰ Thomas Knoll et al., *Adobe Photoshop CS2*, Version 9.0.2 (Adobe Systems Incorporated, 2005).

²¹ L.G. Shapiro and G.C. Stockman, *Computer Vision* (Upper Saddle River, NJ 2001), 137, 150.

entirely rely on the drawing as it was not made with this sort of study in mind. In fact, there are not a few instances where the observation from the photograph contradicts what the drawing gives. Such contradictions are noted in the comments after the text.

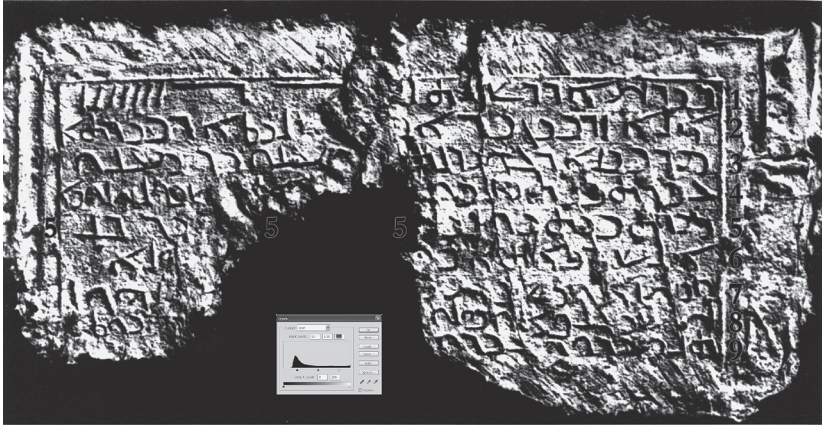


Fig 1. An enhanced photograph of As55.

The following guidelines were observed for taking space measurements. The distance measured was taken at the baseline, or when no joiner line is available, at an imaginary baseline taking into consideration the adjacent graphs. In cases in which parts of a graph kerns above or below the adjacent one, the kerning was ignored; e.g. in measuring the distance in Ⲛ ⲁ , the distance from the left-most point of <n> to the right-most point of the right leg of <'> is given, regardless of whether the top-right point of <'> extends well above <n> or not. In some cases, kerning results in a negative measurement; e.g., the right-most tip of <š> in line 1 is extended well below the preceding ⲛ . In measuring spacing for right-joining graphs, such as ⲛ , the measurement begins from the left-most point of the graph. In cases in which two measurements are given, sometimes one positive and one negative (e.g., Ⲛ ⲁ at the end of line 2), the positive measurement is taken from the baseline, while the negative measurement indicates the degree of kerning. Approximate measurements, because of lack of clarity in the photograph, are indicated with \approx .

Keeping this in mind, the text of As55 follows. Graphs whose joining property is not clear at all are shaded, even if their main body is clear in the photograph, and are excluded from this study. Both <d> and <r> appear as dotless ⲛ in the inscription, but the disambiguating

point is given below for clarity; the point obviously has no bearing on spacing or joining. Notes are given after the text and are indicated by line number.

[]	0.4, 0.3	-0.1	0.5, 0.8	1.2	0.6, 0.7	1		
[]	0.3, 0.2	0.4	1.9/0.4	1.0	0.2, 0.3, -0.2, 0.4, 1.8	0.7, 0.9	2	
					-0.9/0.6	-1.4, 0.3, 0.2, -0.1, 1.4		
[]	-0.5, 0.4, 0.5	-0.3	0.8	0.5	0.4	0.3	3	
						0.2		
[]	0.1, 0.2	0.4	-0.1	0.2	-0.3	0.4	0.3	4
						-0.5, 0.6, 0.5		
	1.4	0.4		0.4	0.4	0.3	0.8	5
						-0.5, 0.1		
[]	0.8, 0.4	0.8	1.0	0.2	-0.1	2.0	-0.3, 0.7	6
							0.9	7
		0.5	1.1	0.4	0.5	1.1	0.9, 0.3, 0.5, 0.2	
							1.1	8
[]	0.2, 0.1	0.0	0.1	0.3	0.2	0.5	-0.2	9
							0.3, 0.4	

(M = Maricq's drawing).

Line 1

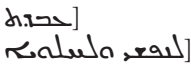





[]	<y> is RJ.
[]	<š> is RJ; distance between <šn> is either 0.3% or 1.5%, but probably the former.

Line 2

[]	distance from the top right tip of <'> to <r> is 0.4%.
[]	while <š> is not legible, it is clearly not connected to <l>; <y> is RJ; <t> is RJ and sits on the baseline; 0.3% between <t,> is from the top right tip of <'> to the top tip of <t>.
[]	<y> is RJ; the leg of <t> is kerned under <r>.

Line 3

[]	the bottom right tip of the right leg of <'> is broken and the measurement is approximate.
[]	<lt> are clearly joined in the image, but are disjoined in M.
[]	the bottom-right corner and the entire foot of is not legible, making it difficult to measure spacing accurately on both sides of the graph.
[]	it is more likely that <nw> are disjoined, though the spacing seems minimal (but joined in M).

- Line 4

<bd> disjoined in M; the leg of <t> is kerned under <d>.
 <yw> are joined *without* inter-word spacing; in <wl> the bottom-right tip of <l> is kerned under <w>; <lh> are joined; in <hl> the bottom-right tip of <l> reaches the left-most point of <h> but the disjoining is clear; <lw> are joined.
- Line 5

<rt> the leg of <t> is kerned under <r>.
 <yt> are joined; <ty> the approximation in distance is due to the fact that the right-most part of the arch of <y> is erased in the photograph (though intact in M).
 <lb> seem to be joined, but not in M.
 <kl> are joined.
- Line 6

<'> the left-leg is not legible in the image, but appears in M; <nš> the top-right tip of <š> kerns over <n>.
 <y> kerns under <d>.
- Line 7

The width of <h> is at most 4.1%; the top-right tip of <'> kerns on top of <z>.
- Line 8

The <h> is partly legible. The distance from the beginning of the line to the beginning of <š> is 6.3% (for which see below); the right-most point of <y> kerns under <š>.
 <gl> are joined; <p'> are joined.
 The bottom-right tip of <l> almost kerns under the left-most point of <s>; <lw> are joined.
 <y> is clear in the image, but marked with a supralinear line in D&H; while <'> is not entirely legible, its right leg is legible which permits the measurement between <t'>.
- Line 9

The joining of <'b> is not clear on the image, but M has them joined; <bd> are joined.

2. Graphotactic Analysis of As55

2.1 Joining Properties

In terms of joining properties, graphemes in (Classical) Syriac are divided into two groups: right-joining and dual-joining. To the former class belong <' d, h, w, z, š, r, t> with the rest of the graphemes

belonging to the latter class. The grapheme <s> is a special case as it seems to have been right-joining until the first quarter of the seventh century and then became dual-joining.

In Old Syriac, more specifically in As55, the set of dual-joining classes is larger. This is not merely because of the lack of cursive writing; rather, there are graphs whose ductus does not seem to permit them to join with the following graph. The following table gives the set of DJ graphemes (in Classical Syriac), indicating the number of times they are joined or disjoined to the following graph in As55:

	Joined	Disjoined
ܣ	3	9
ܥ	1	
ܦ		2
ܩ		2
ܪ	3	11
ܫ	1	
ܬ	5	2
ܭ	2	2
ܬ	1	7
ܨ		1
ܩ	4	2
ܪ	1	
ܫ		5

The grapheme <q> does not appear legibly in the text making it impossible to determine its joining property. Apart from <h, t, s, š>, all of the remaining graphemes join at least once with the following graph making them plausibly DJ. Based on manuscript evidence in the Classical Syriac period, we can safely assume that <s> was mostly RJ. What of the joining properties of <h>, <t> and <š>?

The case for <h> as a right-joining grapheme is difficult to make. Its ductus permits it to join, though in both instances in As55, it is disjoined. (A third instance in line 8 is difficult to read, but the distance between <h> and <š> is long. In fact, the distance from the beginning of <h> to the end of <š> is so long, *c.* 3%, that one questions whether there is indeed another graph in between.)


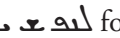
If <ṭ> was written in the same manner as in Classical Syriac (as far as we know from the received calligraphic tradition), first drawing the shaft from top to bottom, then curving to the right to create the circular part, then it can plausibly join with the next graph. However, it seems that in As55, the entire graph sits on the baseline, as opposed to Classical Syriac where the circular part hangs from the base line. This makes it implausible for <ṭ> to connect to the next grapheme rendering it a RJ grapheme.

The case for <š> as a right-joining grapheme is easier to make. It occurs five times in the As55, and not a single time is it connected to the next grapheme. Indeed, its ductus makes it difficult to argue for a DJ <š>.



In summary, it is proposed here that the earliest evidence of Old Syriac writing, As55, points to the following graphemes as being RJ: <’ d, h, w, z, ḥ, ṭ, š, r, š, ṭ>. The jury is still out on <q>.

2.2 Spacing

There are two types of spacing to consider: intra-word and inter-word. Intra-word spacing is the distance from a RJ graph, or a disjointed DJ graph, to the next graph. For intra-word spacing, the minimum spacing that occurs in As55 is 0.1%, while the maximum spacing is 1.1%, the average spacing being 0.42%.

As for inter-word spacing, the minimum spacing is 0.3%, while the maximum spacing is 2.0%, the average spacing being 1.0%. It is clear that the writing system by 6 CE did exhibit word spacing. Having said that, there is one instance in As55 where word spacing is ignored; viz.,  for  ‘for myself and Laḥluyā’ (line 4). That word spacing was not fully developed in Old Syriac will become more apparent as we see more examples in later inscriptions.

2.3 Allographs

While Classical Syriac is rich in allographic variations (DJ graphemes have four allographs each, and RJ graphemes have two allographs each), the text of As55 hardly exhibits allographic variations. In fact, if one is to restrict allographs to exclude shapes that differ from each other by the mere joiner line, then the only allographic variation in As55 is that of <n>:  throughout, but  in final form (line 7). In contrast, Classical Syriac Estrangelā has the following allographic variations:

<y>: ܝ and ܝ
 <k>: ܟ and ܟ
 <m>: ܡ and ܡ
 <n>: ܢ and ܢ

While <y> appears in As55 in all positions (e.g., final in ܝܢܝܢ line 1, initial and stand-alone in ܝܢܝܢ), its shape does not exhibit any allo-graphic variations at all. It always looks more or less like Estrangelā , of Classical Syriac. The graphemes <k> and <m> do not appear in final form making it impossible for us to know if by 6 CE these did exhibit allographic variations or not.

Another allographic variation of <n> in Classical Syriac is the connected final form ܢ as opposed to the final stand-alone form ܢ. The former occurs post RJ graphemes, while the latter post DJ graphemes. The only occurrence of final <n> in As55 is in line 7 after a RJ grapheme. Hence, As55 does not have sufficient data to tell us if ܢ was even a possibility (but see section 3 for post As55 data).

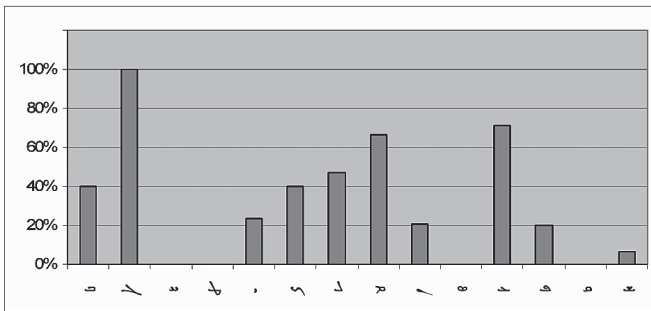
3. Joining Properties in Later Inscriptions

The appendices give the texts of later inscriptions in a manner similar to the As55 text above, but without giving measurements of space. Only inscriptions that have available photographs or drawings in D&H are considered. As before, graphs whose joining properties are not clear are shaded and are excluded from the analysis. A database was created to account for the joining properties of the corpus. Each graph was counted as being joined or disjoined. Its inscription number (from D&H) and date were also given. In the case of dated inscriptions, the exact date was given. In the case of undated inscriptions, an approximate date to the nearest 25 years was given; hence, ‘early third century’ translates into 225, ‘mid second century’ translates into 150, etc.

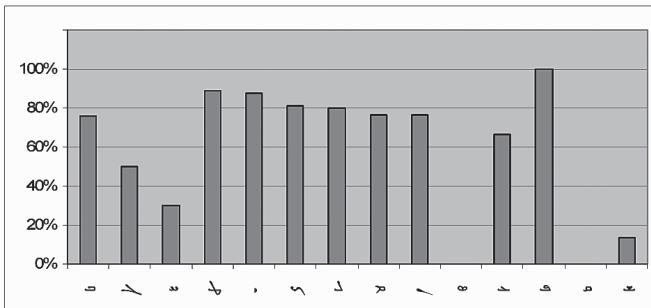
Graphemes that are DJ in Classical Syriac are listed in the table below. For each grapheme, the table gives the number of occurrences of the grapheme in the corpus grouped by century and joining property (J for joined, and D for disjoined). For instance, during the first century, occurs 25 times where its joining property is legible in a photograph, 10 out of which are joined and 15 disjoined. The table is followed by charts which give the rate of cursive writing in percentage terms. The data of the first and second centuries reflect monumental writing, while that of the third century represents a mixture of monumental and mosaic writing, the latter being more cursive in general.

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	1 st century		2 nd century		3 rd century		Totals	
	J	D	J	D	J	D	J	D
Ⲁ	10	15	51	16	97	9	158	40
Ⲁ	1	0	1	1	13	0	15	1
Ⲁ	0	7	6	14	13	3	19	24
Ⲁ	0	3	8	1	5	0	13	4
Ⲁ	7	23	43	6	49	5	99	34
Ⲁ	2	3	13	3	7	2	22	8
Ⲁ	8	9	36	9	54	9	98	27
Ⲁ	8	4	23	7	53	12	84	23
Ⲁ	5	19	33	10	49	7	87	36
Ⲁ	0	1	0	9	1	8	1	18
Ⲁ	10	4	16	8	33	5	59	17
Ⲁ	1	4	6	0	9	0	16	4
Ⲁ	0	2	0	6	13	7	13	15
Ⲁ	1	15	3	19	8	24	12	58

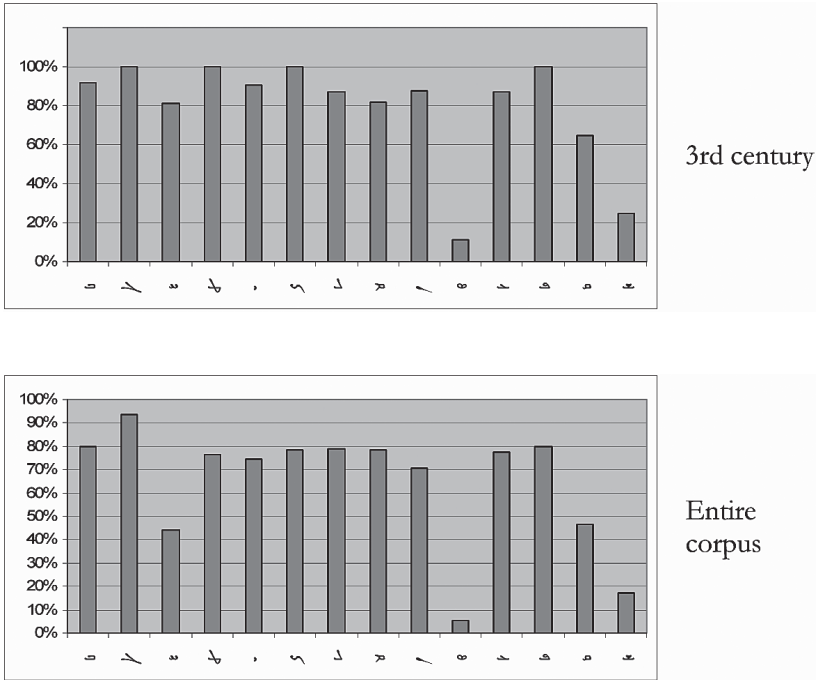


1st century



2nd century

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The following grapheme classification is used in the discussion to follow:

- A. Totally-cursive graphemes. These are the graphemes that occur cursively all the time; i.e., full fledged DJ graphemes.
- B. Semi-cursive graphemes. These are graphemes with a cursive rate over 50%; i.e., they occur cursively more than half the time.
- C. Slightly-cursive graphemes. These are graphemes with a cursive rate under 50%.
- D. Non-cursive graphemes. These are the graphemes that never occur cursively; i.e., full fledged RJ graphemes.

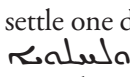
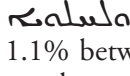
The data gives a clear indication of a progressive process by which the script becomes more and more cursive in time. Considering the data from the first century, ignoring <g> as it occurs only once, one finds that there are no graphemes that are totally cursive. Only two graphemes, <m> and <ʿ>, are semi-cursive. Seven graphemes, <b y k l n p š>, are slightly cursive. Four graphemes, <ḥ ṭ s q>, are non-cursive. It is worth noting that <ṣ̄> is cursive one out of fifteen times only, a rate that will be maintained throughout the next two centuries. Recall that <s> is mostly a RJ grapheme in Classical Syriac. We were unable earlier to determine the joining property of <q> in As55 as it did not occur there. The data from the first century point to <q> being RJ.

The script becomes more cursive during the second century. While only <m> and <‘> were semi-cursive during the first century, now <b ṭ y k l m n ‘ p> are semi-cursive (<ṭ> jumps from being non-cursive to semi-cursive). Only <š> remains in the slightly-cursive club, but will maintain its status going forward. The graphemes <s q> remain non-cursive. (The grapheme <g> occurs twice, once cursive and once non-cursive.)

The script becomes increasingly cursive by the end of the third century. For the first time, the totally-cursive class acquires new members: <g ṭ p> (now <g> occurs 13 times). Semi-cursive graphemes exhibit a higher rate of cursive writing, now all are over 80% cursive, while before they mostly were under 80% cursive (still over 50%). The grapheme <q> moves from being non-cursive to semi-cursive. Even <s> abandons the non-cursive club, and becomes slightly-cursive, albeit only once (but the joining is clear).

Conclusion

This paper has provided an analysis of the historical development of graph joining in Old Syriac. It put forward the hypothesis that Old Syriac did not begin as fully cursive as in Classical Syriac. It was partially cursive and became increasingly cursive in time. In fact, during the first century there are graphemes, which we know as dual-joining from Classical Syriac, that were right-joining. Indeed, in some cases the ductus of these graphemes, such as <ṭ> and <š>, did not permit them to be dual-joining.

Parenthetically, the graphotactic edition of As55 above may help settle one disputed reading. Starcky reads  in place of Maricq's  in line 4. Starcky's reading would require a spacing of 1.1% between <h> and <w> which is more than the average inter-word spacing in the text (let alone the intra-word spacing which should be the base for reference here). In addition, the width of <h> in this case cannot be more than 3.1%. This makes Maricq's reading more plausible.

The paper has thus far been silent about the Old Syriac texts written on parchments. I was only able to examine a high-resolution image of P. Dura 28 (P1 in D&H). It has already been stated that the writings in the parchments is by far more cursive than those in the inscriptions. This is entirely true. In fact, P. Dura 28 is more cursive than the Classical Syriac script of 411 CE. As far as joining properties are concerned, the writing in P. Dura 28 seems to be very similar to

- 6 6
- 7 7
- 8 8
- 9 9

4 <y> touch but it is difficult to discern if it is due to kerning or an actual join. 5 <m> are clearly joined, but it could be due to kerning. In 4 and 5 <n> has the shape rather than .

Grapheme	Joint Count	Disjoint Count
	7	6
<h>		5
<t>		1
<y>	4	12
<k>	1	3
<l>	3	7
<m>	6	2
<n>	4	12
<‘>	6	2
<p>		4
<q>		2
<š>	1	10

165 CE (As 29, image and drawing)

- 1 1
- 2 2
- 3 3

1 <lm> seems to be joined in the image, but not in the drawing. 2 <n> joined in image, but not in drawing. 3 <nt> joined in image, but not in drawing.

Grapheme	Joint Count	Disjoint Count
	2	
<y>	1	
<l>	1	2
<m>		2
<n>		3
<‘>	1	
<p>	1	
<q>		1

165 CE (As 36, drawing)

- 1 כַּוְּנָה עֲבַדְתָּ אֱלֹהִים וְיָדָה לְיְהוָה
- 2 אֵל אֱלֹהֵינוּ יְהוָה אֱלֹהֵינוּ אֱלֹהֵינוּ
- 3 כַּוְּנָה עֲבַדְתָּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 4 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 5 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ

1 [כַּוְּנָה עֲבַדְתָּ אֱלֹהֵינוּ] words joined (no word spacing). 4 [אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ] words joined; 5 [אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ] words joined.

Grapheme	Joint Count	Disjoint Count
	4	
<ḥ>	3	
<ṭ>	1	
<y>	8	
<l>	6	
<m>	2	
<n>	6	
<'>	3	
<š>		3

165 CE (As37, image and drawing)

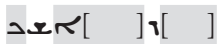

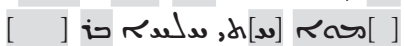
- 1 כַּוְּנָה עֲבַדְתָּ אֱלֹהִים וְיָדָה לְיְהוָה
- 2 אֵל אֱלֹהֵינוּ יְהוָה אֱלֹהֵינוּ אֱלֹהֵינוּ
- 3 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 4 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 5 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 6 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 7 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 8 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ
- 9 אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ

1 [כַּוְּנָה עֲבַדְתָּ אֱלֹהֵינוּ] words joined. 8 [אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ] <'n> is joined, but the join could be a scratch. 9 [אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ אֱלֹהֵינוּ] words joined.

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	11	2
<ḥ>	1	1
<ṭ>	4	
<y>	13	
<k>	7	
<l>	10	2
<m>	10	
<n>	9	1
<s>		5
<‘>	2	
<p>	1	
<q>		1
<š>	1	4



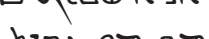
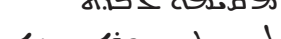
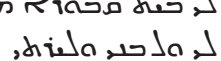
188 CE (As41, image)

	1
	2
	3

The image is not clear enough to determine most of the joining properties. It is clear, however, that both <ḥ> and <š> are RJ.

Grapheme	Joint Count	Disjoint Count
<ḥ>		2
<l>	1	
<n>	1	
<š>		2

201/2 CE (As16, photograph (not clear) & drawing)

	1
	2
	3
	4
	5

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	6	
<h>		1
<y>	3	
<l>	5	1
<m>	3	1
<n>	2	
<s>		1
<‘>	1	1
<q>		2
<š>		2

209 CE (As9, drawing by Segal)

כַּוְנֵה אַרְזֵי זַעֲבֵי צִוְיָה אֲנֵה חַבְצָה כִּי כִּי חַלְהָה חַבְצֵה לְהַבְצֵה
 חַלְהָה מֵהָה לְהַלְבֵה

Grapheme	Joint Count	Disjoint Count
	3	1
<y>	1	
<n>	2	
<‘>	4	
<š>		3

218 CE (Am8, photograph)

חַ[] אֲנֵה[] חַבְצֵה 1
 חַבְצֵה
 אֲנֵה וְנֵה כִּי חַבְצֵה 2
 חַבְצֵה לְהַבְצֵה מֵהָה לְהַלְבֵה 3
 אֲנֵה 4
 חַבְצֵה 5
 חַבְצֵה 6
 אֲנֵה 7
 חַבְצֵה 8
 וְנֵה 9
 חַבְצֵה כִּי 10
 חַבְצֵה 11

- 12 כּוּלַּכֵּס
- 13 כּוּ וּגְלֵלָה
- 14 כּחַבְּ
- 15 כּוּ וּגְלֵלָה
- 16 כּוּא
- 17 וּגְלֵלָה
- 18 כּ חַ
- 19 כּוּ וּגְלֵלָה
- 20 כּוּכַחְבְּ
- 21 כּוּ וּגְלֵלָה

1 [כּ חַ עַל] words joined. 3 [לַ חַבְּ] words joined.

Grapheme	Joint Count	Disjoint Count
	15	2
<y>	9	1
<l>	8	1
<m>	4	3
<n>	5	
<’>	3	1
<q>		2
<š>		5

224 CE (Am9, photograph by Drijvers)

- 1 כּוּזַעַלֵּס
- 2 עַלַּעַשְׂכֵּס
- 3 חַלְלֵלָה חַבְּ
- 4 חַחַ כּוּ חַבְּכֵס
- 5 כּוּ חַחַ חַבְּכֵס
- 6 כּחַ חַבְּכֵס חַחַ

Grapheme	Joint Count	Disjoint Count
	5	
<y>	2	
<n>	1	
<q>		1
<š>	1	

OLD SYRIAC GRAPHOTACTICS

227/8 CE (*Bm1*, photograph by *Parlasca*)

- ܩܘܐ 1
- ܩܘܐ 2

Grapheme	Joint Count	Disjoint Count
<p>	1	

228 CE (*Am7*, photograph by *Segal*)

- ܩܘܐ 1
- ܩܘܐ ܩܘܐ ܩܘܐ ܩܘܐ 2
- ܩܘܐ ܩܘܐ ܩܘܐ ܩܘܐ 3
- ܩܘܐ ܩܘܐ ܩܘܐ ܩܘܐ 4
- ܩܘܐ ܩܘܐ ܩܘܐ ܩܘܐ 5

5, ܩܘܐ ܩܘܐ] words joined.

Grapheme	Joint Count	Disjoint Count
	4	2
<ɸ>	1	
<y>	4	
<l>	6	2
<m>	2	2
<n>	5	
<ʿ>	2	1
<p>	2	
<š>		2

235/6 CE (*Am6*, photograph by *Segal*)








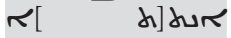

- ܩܘܐ 1
- ܩܘܐ ܩܘܐ 2
- ܩܘܐ ܩܘܐ 3
- ܩܘܐ ܩܘܐ ܩܘܐ 4
- ܩܘܐ ܩܘܐ ܩܘܐ 5
- ܩܘܐ ܩܘܐ ܩܘܐ 6
- ܩܘܐ 7

Grapheme	Joint Count	Disjoint Count
	9	
<g>		
<h>	1	
<y>	4	
<k>	1	
<l>	5	
<m>	5	
<n>	4	
<'>	6	
<q>	1	
<š>	4	

II. Undated Inscriptions

The following inscriptions are not considered as neither photographs nor drawings are of sufficient quality for a graphotactic analysis: As 28, As43, and As45.

As1 (c. first half of 3rd century)





	1
	2
	3
	4
	5
	6
	7
	8
	9

5  words joined.

Grapheme	Joint Count	Disjoint Count
	2	3
<t>	1	
<y>	1	
<k>	1	
<l>	2	
<m>	3	
<n>	4	1
<s>		1
<'>	1	
<p>	1	






OLD SYRIAC GRAPHOTACTICS

As2 (c. 2nd/3rd century)

- 1  [
- 2  [
- 3  [
- 4  [



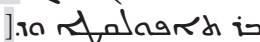
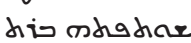


Grapheme	Joint Count	Disjoint Count
<g>	1	
<y>	1	
<m>	1	
<s>		1

As6 (c. 2nd/3rd century)

- 1  [
- 2  [
- 3  [
- 4  [
- 5  [

Grapheme	Joint Count	Disjoint Count
	2	
<h>	1	
<y>	1	
<k>	2	
<l>	2	
<m>	2	
<‘>	1	
<q>		1

As10 (c. 3rd century, Segal photograph & drawing)

- 1  1
- 2  2
- 3  3
- 4  4
- 5  5
- 6  6

As20 (undated, Segal photograph, Pognon drawing)

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

1 *כיה* disjoint in Pognon; *ככח* disjoint in P. 3 *כנח* <m> joint in P. 4 *כנח* <h> no word spacing. 5 *כנח* <m> joint in P.

Grapheme	Joint Count	Disjoint Count
	4	
<g>	1	
<h>	1	1
<y>	1	1
<k>	1	
<l>		2
<m>	1	2
<n>	2	3
<’>		1
<q>		1
<š>		2

A26 (c. mid 2nd century, Drijvers photograph, Segal drawing)

- 1
- 2
- 3

2 *וכה* <k> disjoint in Segal’s drawing.

Grapheme	Joint Count	Disjoint Count
	1	1
<y>		1
<k>	2	1
<l>	1	
<n>	1	
<q>		1

As27 (c. mid 2nd century, Segal photograph & drawing)

We rely mostly here on the drawing.

- 1 **כ[ו], ע[ל] א**
- 2 **בבז עמלח י לר א**
- 3 **לשח אלתח אל ענ**
- 4 **אזנודח כו אדומח חבל ענ**
- 5 **אעמח,**

Grapheme	Joint Count	Disjoint Count
	2	
<h>	1	2
<y>	5	
<l>	3	
<m>		1
<n>	1	
<s>		1
<‘>	3	
<š>		1

As30 (c. mid 2nd century, Drijvers photograph, Segal drawing)

- 1 **זבז אדומח א**
- 2 **חזנודח אדמח**
- 3 **חמחח חמחח א**
- 4 **אחל בבז כו**
- 5 **אדומח א אכמח,**

Grapheme	Joint Count	Disjoint Count
	1	1
<y>	2	
<k>	2	
<l>		1
<m>	2	
<n>	2	2
<‘>	2	

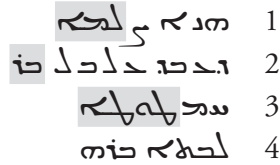
As32 (c. mid 2nd century, Healey photograph, Segal drawing)

- 1 **כזכא,**
- 2 **זבז אככח,**
- 3 **זבז כזכ**

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	2	2
<y>	1	
<k>	1	
<n>	1	

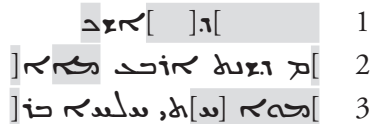
As40 (c. mid 2nd century, Drijvers photograph)



 1
 2
 3
 4

Grapheme	Joint Count	Disjoint Count
	3	1
<ḥ>		1
<l>	1	1
<m>		1
<n>		1
<š>		2

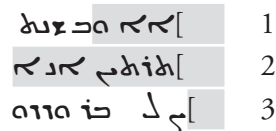
As41 (before 188, Drijvers photograph)



 1
 2
 3

Grapheme	Joint Count	Disjoint Count
	2	
<ḥ>		2
<l>	1	
<n>	1	
<š>		2

As42 (c. mid 2nd century, Drijvers photograph)



 1
 2
 3

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	1	1
<n>	1	
<š>		1

As47 (c. mid 2nd century, Healey photograph, Pognon drawing)

ܡܠܟ ܝܠܝܫܘܥ ܘܥܒܘ	1
ܕܩܝܡܘܢܐ ܕܡܪܝܢܐ ܕܩܝܡܘܢܐ	2
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	3
ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ	4
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	5
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	6
ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ	7
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	8

3 [ܩܝܡܘܢܐ ܕܩܝܡܘܢܐ] no word spacing.

Grapheme	Joint Count	Disjoint Count
	7	
<g>	1	
<ʔ>	2	
<y>	3	
<l>	6	
<m>	3	
<n>	1	
<‘>	3	
<p>	1	
<š>		3

As49 (c. mid 2nd century, Healey photograph, Pognon drawing)

ܘܥܒܘ ܕܩܝܡܘܢܐ	1
ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ	2
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ	3
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ	4
ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܕܩܝܡܘܢܐ	5
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	6
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	7
ܘܩܝܡܘܢܐ ܕܩܝܡܘܢܐ ܘܩܝܡܘܢܐ	8

3 [ܐܠܗܐ ܥܠܝܗ] no word spacing.

Grapheme	Joint Count	Disjoint Count
	6	
<h>	1	
<t>	1	–
<y>	3	
<l>	3	1
<m>	1	
<n>	4	
<s>		1
<‘>	2	1
<p>	2	
<š>		1

As50 (c. mid 2nd century, Healey photograph, Pognon drawing)

- ܐܠܗܐ 1
- ܐܠܗܐ 2
- ܐܠܗܐ [ܐܠܗܐ] 3
- ܐܠܗܐ [ܐܠܗܐ] 4
- ܐܠܗܐ [ܐܠܗܐ] 5

Grapheme	Joint Count	Disjoint Count
	2	
<y>	1	
<k>	1	
<l>	1	
<n>	1	
<s>		1
<‘>		1
<p>	1	

As56 (unknown date, Segal photograph & drawing)

- ܐܠܗܐ ܐܠܗܐ 1
- ܐܠܗܐ ܐܠܗܐ 2
- ܐܠܗܐ [ܐܠܗܐ] 3
- ܐܠܗܐ ܐܠܗܐ 4

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	3	5
<ḥ>		2
<y>	3	
<m>	1	1
<n>	1	
<‘>		2
<q>		2
<š>		1

As57 (unknown date, Segal photograph)

ܟܘܒܘܢܐ ܟܘܒܘܢܐ 1

Grapheme	Joint Count	Disjoint Count
	2	
<k>		1
<m>	1	

As60 (c. mid 2nd century, Güler photograph)

ܟܘܒܘܢܐ ܟܘܒܘܢܐ 1
 ܟܘܒܘܢܐ ܟܘܒܘܢܐ 2
 ܟܘܒܘܢܐ ܟܘܒܘܢܐ 3
 ܟܘܒܘܢܐ ܟܘܒܘܢܐ 4

Grapheme	Joint Count	Disjoint Count
	2	2
<ḥ>		2
<y>	2	3
<l>	2	1
<m>	3	1
<n>		2
<s>		1
<‘>		2
<š>	2	1

OLD SYRIAC GRAPHOTACTICS

As61 (c. mid 2nd century, Güler photograph)

- 1
- 2
- 3
- 4
- 5

Grapheme	Joint Count	Disjoint Count
		1
<g>		1
<h>		2
<y>	1	2
<k>		1
<l>		1
<m>		1
<n>	3	1
<q>		1

Am2 (c. early 3rd century, Segal photograph)

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15

7 no word spacing.

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	5	
<g>	2	
<ḥ>		1
<y>	3	1
<l>	7	2
<m>	6	1
<n>	1	2
<ʿ>	2	1
<p>	1	
<š>	2	

Am3 (c. early 3rd century, Euling photograph)

1	ܐܢܢܐ ܕܢܘܨܐ ܕܥܘܠܐ ܕܥܘܠܐ ܕܥܘܠܐ ܕܥܘܠܐ ܕܥܘܠܐ
2	ܐܢܢܐ ܕܢܘܨܐ
3	ܐܢܢܐ ܕܥܘܠܐ
4	ܐܢܢܐ ܕܥܘܠܐ
5	ܐܢܢܐ
6	ܐܢܢܐ
7	ܐܢܢܐ ܕܥܘܠܐ
8	ܐܢܢܐ
9	ܐܢܢܐ ܕܥܘܠܐ
10	ܐܢܢܐ
11	ܐܢܢܐ
12	ܐܢܢܐ
13	ܐܢܢܐ []
14	ܐܢܢܐ ܕܥܘܠܐ
15	ܐܢܢܐ ܕܥܘܠܐ
16	ܐܢܢܐ
17	ܐܢܢܐ []
18	ܐܢܢܐ []
19	ܐܢܢܐ
20	ܐܢܢܐ
21	ܐܢܢܐ

OLD SYRIAC GRAPHOTACTICS

Grapheme	Joint Count	Disjoint Count
	18	
<g>	3	
<h>	1	
<y>	2	
<k>	1	
<l>	11	
<m>	6	1
<n>	5	1
<s>	1	4
<ʿ>	5	
<q>	1	
<š>		6







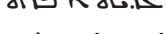
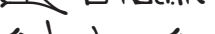







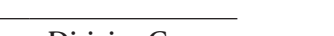
Am4 (c. early 3rd century, Segal photograph & drawing)

ܘܠܗ ܕܢܘܨܐ	1
ܘܠܗ ܕܢܘܨܐ	2
ܘܠܗ ܕܢܘܨܐ	3
ܘܠܗ	4
ܘܠܗ ܕܢܘܨܐ	5
ܘܠܗ [] ܕܢܘܨܐ	6
ܘܠܗ	7
ܘܠܗ ܕܢܘܨܐ	8
ܘܠܗ	9
ܘܠܗ ܕܢܘܨܐ	10
ܘܠܗ	11
ܘܠܗ ܕܢܘܨܐ	12
ܘܠܗ ܕܢܘܨܐ	13

Grapheme	Joint Count	Disjoint Count
	7	1
<g>	1	
<h>	2	
<y>	6	
<l>	1	
<m>	15	2
<n>	4	
<ʿ>	4	
<q>	6	
<š>		2

OLD SYRIAC GRAPHOTACTICS

Am5 (c. early 3rd century, Segall/Parlasca photographs)

- 1  1
- 2  2
- 3  3
- 4  4
- 5  5
- 6  6
- 7  7
- 8  8
- 9  9
- 10  10
- 11  11
- 12  12
- 13  13
- 14  14
- 15  15
- 16  16

Grapheme	Joint Count	Disjoint Count
	12	
<g>	4	
<h>	4	
<ṭ>	1	
<y>	4	
<l>	3	
<m>	4	
<n>	8	
<s>		1
<š>	4	
<p>	1	
<q>	2	
<š̄>		2

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