# IT'S ABOUT TIME? TESTING THE DAWSON CERAMIC SERIATION USING LUMINESCENCE DATING, SOUTHERN NASCA REGION, PERU

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*The Dawson seriation of Nasca ceramics has long been assumed to be an accurate marker of temporal changes in the prehispanic south coast of Peru. We test this assumption by directly dating a sample of sherds using Optically Stimulated Luminescence (OSL). Our results suggest that while some phases of the seriation are valid chronological markers, others appear to be the result of other factors aside from time. We discuss the implications of these results and call for additional studies of ceramics using luminescence dating.*

*Los arqueólogos han asumido que la seriación de Dawson sobre la cerámica Nasca es un marcador preciso que registra cambios temporales en la costa sur del Perú prehispánico. Comprobamos esta asunción usando Luminiscencia Ópticamente Estimulada que fechó una muestra de 50 tiestos de cerámica provenientes de sitios ubicados en la región sur de Nasca. Nuestros resultados indican que algunas fases de la seriación Dawson son marcadores válidos de cronología, pero otros parecen ser el resultado de otros factores además del tiempo. En este trabajo discutimos las implicancias de estos resultados y sugerimos que son necesarios más estudios de cerámica usando fechados de luminiscencia.*

Precise and accurate chronologies are central to archaeological studies in order to evaluate social, political, and economic transformations in the past. In the Central Andes, where high-precision techniques such as dendrochronology are not yet applicable, archaeologists have frequently turned to stylistic seriation for dating and chronology building (Rowe 1961). While such seriations may work at a general level, it is often difficult to test them using absolute dating methods such as radiocarbon dating due to problems of association between dates and the materials on which seriations are constructed (e.g., charcoal vs. pottery). Moreover, while a seriation may be supported through stratigraphic means and through radiocarbon dating within a particular site, it is not always clear that a particular style ranges across the exact same temporal window over larger geographic areas or that different styles appear in the same temporal order in different valleys or subregions.

This limitation of seriation requires independent testing of chronologies, as has been recently noted elsewhere in the world (see, for example, Peeples and Schachner 2012; Pestle et al. 2013; Shennan and Wilkinson 2001; Smith et al. 2013). In this paper, we independently assess the temporal veracity of the most commonly used seriation on the south coast of Peru, the so-called Dawson Seriation. Specifically, we pose the question, "Is the Dawson Seriation about time?" To address this question, we employ optically stimulated luminescence (OSL) analysis to date individual sherds collected from surface survey across a broad area in the Southern Nasca Region (SNR). In the end, we compare our independent luminescence dates against the stylistic assignments to evaluate ceramic chronology in the SNR. We

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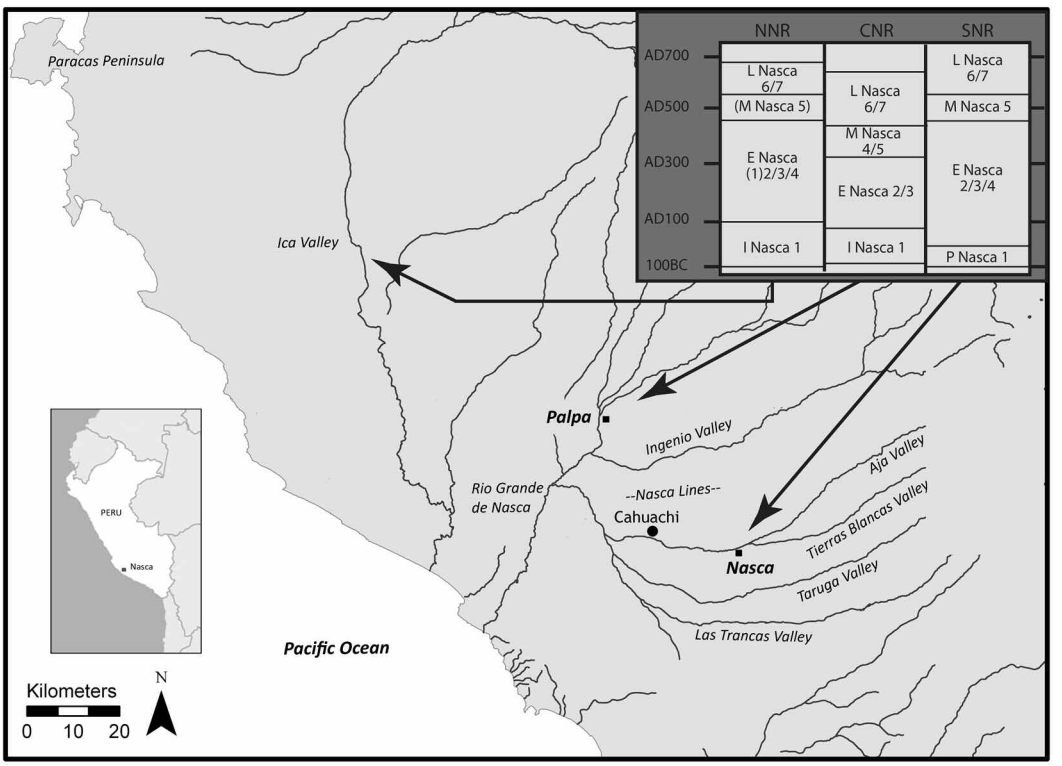


**Figure 1. Map of the Nasca region with the subregions highlighted. Also noted are the chronologies as currently understood by field archaeologists. The NNR chronology is derived from Beresford-Jones et al. (2011), Cook (1993), and DeLeonardis (2001) and is something of a compromise of the three published chronologies; the CNR chronology is based on the work of Hecht (2009), Reindel (2009), and Unkel et al. (2012); and the SNR chronology has previously been published by Schreiber and Lancho (2003) and Vaughn (2009). Map is redrawn from an illustration by Stefanie Bautista.**

conclude that the Dawson Seriation includes a significant non-temporal component, and we caution against the uncritical assumption that style equals time in south coast prehistory.

## Nasca Style and Time

The Nasca region of the south coast of Peru witnessed the development of the indigenous Paracas, Nasca, and Tiza civilizations and was also the site of imperial expansion by the Wari and Inca empires. As a focal point of indigenous civilization, the region has drawn the attention of archaeologists and art historians alike for over a century, especially those interested in the vibrant polychrome pottery of Nasca that flourished during the first millennium A.D. (Table 1; Vaughn 2009). The heartland of the Nasca region is made up of two major drainages, the Ica and Río Grande de Nasca. It is divided into three subregions: the Northern Nasca Region (NNR), Central Nasca Region (CNR), and the SNR (Figure 1).

Despite the fact that it was never fully published, the most frequently used chronology in Nasca since the 1950s has been the seriation developed by Lawrence Dawson (Rowe 1956:146, 1960:29). This seriation has come to be known informally as the Dawson Seriation (Carmichael 2013; Proulx 2006:29). It falls into the Early Intermediate period and Middle Horizon of the "Master Sequence," the Central Andean chronology developed by John Rowe and his students (Rowe 1967), which is still widely used by Andean archaeologists (Table 1). The Dawson Seriation—made on a sample of 660 vessels from the SNR purchased by Max Uhle in 1905 (Proulx 2006:25)—divides Nasca pottery into nine styles (Nasca 1–9) and has been refined stylistically over the years by various specialists (see Proulx 2006). Both the Dawson Seriation and the Master

Table 1. Chronology for the Nasca Region, Including the SNR (Conlee 2003; Schreiber and Lancho 2003; Vaughn 2009) and CNR (Unkel et al. 2012).

| Horizons / Periods | Local Period | Culture/Phase | Approx. Date in the SNR (Vaughn 2009) | Culture/Phase | Approx. Date in the CNR (Unkel et al. 2012) |
|---|---|---|---|---|---|
| Late Horizon | *–Inca–* | Inca | A.D. 1476–1532 | LIP/LH | A.D. 1180–1560 |
| Late Int. Period (LIP) | *–Tiza–* | Tiza | A.D. 1000–1476 | (gap)* | A.D. 790–1180 |
| Middle Horizon | *–Loro–* | Chakipampa ("N9"); Loro ("N8") | A.D. 750–1000 | Chakipampa ("N9"); Loro ("N8") | A.D. 640–790 |
| Early Int. Period (EIP) | *–Nasca–* | Late Nasca (Nasca 6, 7) | A.D. 550–750 | Late Nasca (Nasca 6, 7) | A.D. 440–640 |
| | | Middle Nasca (Nasca 5) | A.D. 450–550 | Middle Nasca (Nasca 4, 5) | A.D. 300–440 |
| | | Early Nasca (Nasca 2, 3, 4) | A.D. 1–450 | Early Nasca (Nasca 2, 3) | A.D. 80–300 |
| | | Proto Nasca (Nasca 1) | 100 B.C.–A.D. 1 | Initial Nasca (Nasca 1) | 260 B.C.–A.D. 80 |
| Early Horizon | *–Paracas–* | Paracas | 800–100 B.C. | Paracas | 840–260 B.C. |

* Unkel et al. report no radiocarbon dates during this time period and attribute this to a lack of archaeological remains in the region during this time, hence the "gap." Conlee (2013) has also documented this gap in radiocarbon dates in the SNR.

Sequence have performed fairly well and portions of the chronologies have been tested and supported through stratigraphic excavations in the Nasca region (e.g., Beresford-Jones 2011; Beresford-Jones et al. 2009; Conlee 2003; DeLeonardis 2000; Edwards 2010; Hecht 2009, 2013; Reindel 2009; Van Gijseghem 2006; Vaughn 2009).

The seriation was developed using complete museum specimens with a full suite of decorative attributes to define different phases. In the field, archaeologists rarely recover entire specimens and, as a result, lump some of the nine phases into larger periods of development: Proto-Nasca, equivalent to Phase 1; Early Nasca (Phases 2–4); Middle Nasca (Phase 5); and Late Nasca, comprising Phases 6–7. It was later recognized that Nasca 8 and 9 were part of the Middle Horizon. Phase 8 was renamed Loro (Schreiber and Lancho 2003:18) and represented a local style pertaining largely to the Middle Horizon, while Phase 9 was recognized as a variant of the Chakipampa style pottery of the Wari Empire. This grouping of phases was based on stylistic similarities of the pottery and, more importantly, on evidence from settlement survey in the SNR suggesting that the grouped phases frequently co-occur at settlements (Schreiber and Lancho 2003; see also Carmichael 1998a:notes 4, 27). For example, excavations at the habitation site of Marcaya revealed Nasca 3 and Nasca 4 pottery to the virtual exclusion of all other phases; the first author has referred to this site as an Early Nasca village both out of semantic convenience and because these phases co-occur in the site's vessel assemblage (Vaughn 2009).

Parallel and extensive survey and excavations in the CNR by Reindel (2009) and colleagues have resulted in a similar scheme with slightly different groupings: Initial Nasca (Phase 1); Early Nasca (Phases 2 and 3); Middle Nasca (Phases 4 and 5); and Late Nasca (Phases 6 and 7; see Table 1 and Figure 1). The grouping of phases in this subregion of Nasca is based similarly on the co-occurrence of phases at sites in survey and excavations (Hecht 2013; Reindel 2009). Cultural groupings in the NNR are still being refined, with Beresford-Jones (2011) proposing a scheme grouping Ocucaje 10 and Nasca 1 into Initial Nasca, Nasca 2–5 into Early Nasca, and Nasca 6 and 7 into Late Nasca. Cook (1999), on the other hand, has suggested that Early Nasca includes Nasca 1, while DeLeonardis (2000) essentially follows the chronological groupings of the SNR for the Ica Valley, although she also states that the "absolute chronology of Phases 2–4 of the Nasca stylistic sequence is poorly documented" (DeLeonardis 2000:365).

Although archaeologists and art historians alike have used the Dawson Seriation for almost half a century, the question remains: does it reflect temporal changes only, or do phases of the seriation also reflect other phenomena, such as regional variability, substyles, or something else entirely? Independent tests of the Dawson Seriation have been somewhat limited. One exception is the work undertaken in the CNR in Palpa by Markus Reindel and colleagues (Hecht 2013; Reindel 2009; Unkel et al. 2012). This work has shown that some assumptions of the Dawson Se-

riation can be questioned (for example, whether Nasca 6 is a temporal phase or whether it is actually a regional substyle; see Hecht 2013). Furthermore, systematic radiocarbon dating by phase in Palpa has shown that the timing of some of the phases in the CNR differs substantially from dates obtained in the SNR (Table 1). Other efforts to independently test the Dawson Seriation include an obsidian hydration study (Eerkens et al. 2008) and a very limited analysis of ceramic sherds ($n = 5$) from the Ica Valley using thermoluminescence (Massey 1986:33). Limited studies have been undertaken using Optically Stimulated Luminescence (OSL) of sediment associated with geoglyphs (Eitel et al. 2005; Greilich and Wagner 2009; Rink and Bartoll 2005) and non-archaeological contexts (Kadereit et al. 2009). Nonetheless, as far as we are aware, there have been no other attempts to date diagnostic sherds directly using OSL. With many lingering questions, we believe it necessary to assess the temporal accuracy of the Dawson seriation. Below, we describe our methods, sample, and results.

## Luminescence Dating and Sample

Luminescence refers to light emission from crystalline structures after the absorption of naturally occurring energy in the form of ionizing radioactivity (alpha, beta, and gamma particles; Feathers 2003). Luminescence requires an external stimulus, either heat (thermally stimulated luminescence, or thermoluminescence), or light (optically stimulated luminescence, or OSL). In archaeological applications, both approaches measure the last time a particular object was heated to a certain temperature (approximately 500 degrees centigrade) or was exposed to sunlight (Feathers 2003). Thus, luminescence dating has certain advantages over other absolute dating methods because the "target" event and dating event are the same (e.g., when a pot was fired). Other dating methods for ceramics rely on association of the ceramic with the material that is dated, so the target event (e.g., when a pot was fired) and the dating event (e.g., when a tree stopped absorbing $CO_2$, in the case of radiocarbon dating) are not the same.

With the advantages of luminescence dating in mind, we determined that employing the method would provide a good opportunity to test the validity of the Dawson Seriation and the Master Sequence in the Nasca region. Our sample consisted of 50 sherd fragments collected from the surface of 32 sites located in the SNR (Table 2). Most sites were recorded as part of a settlement study of the SNR undertaken by Schreiber (Schreiber and Lancho 2003), while seven of these sites have been the focus of excavations (Edwards 2010; Eerkens et al. 2009; Van Gijseghem 2006; Vaughn 2009; Vaughn and Linares 2006). Of those sites, five have associated radiocarbon dates (Table 3). Sherd fragments and sediment samples to measure the equivalent dose were collected in the field by Vaughn and Eerkens in 2007. To augment phases underrepresented in our field collection, Vaughn and Eerkens sampled additional sherds at the Museo Regional de Ica, Peru, where surface collections from Schreiber's survey were curated. In all cases, samples were selected based on diagnostic features of the seriation or, when these were not present, on site context and artifact association.

The 50 dated sherd samples include fragments from the Early through Late Horizons (Figure 2). Initial phasing of the sherds was undertaken based on the diagnostic features present on the sample, as well as by using site context and artifact association. To ensure that phasing was done accurately and consistently, we asked seven additional specialists in south coast archaeology to phase the samples from photos without any additional identifying information (i.e., site context or our initial phasing). These two phasing assessments overlap to a significant degree, and our final phase assignment is based on their independent assessment of the sherds, as well as on our previous determinations.

The methodological details of optically stimulated luminescence, as practiced in our study, are described in Supplemental Text 1.

## Results and Discussion

Table 2 lists our age estimates for all 50 sherds. This table also reports the range of dates based on overall estimates of b-value for all samples. It should be noted that, because luminescence ages are calculated based on estimates of equivalent dose and dose-rate and because each of these de-

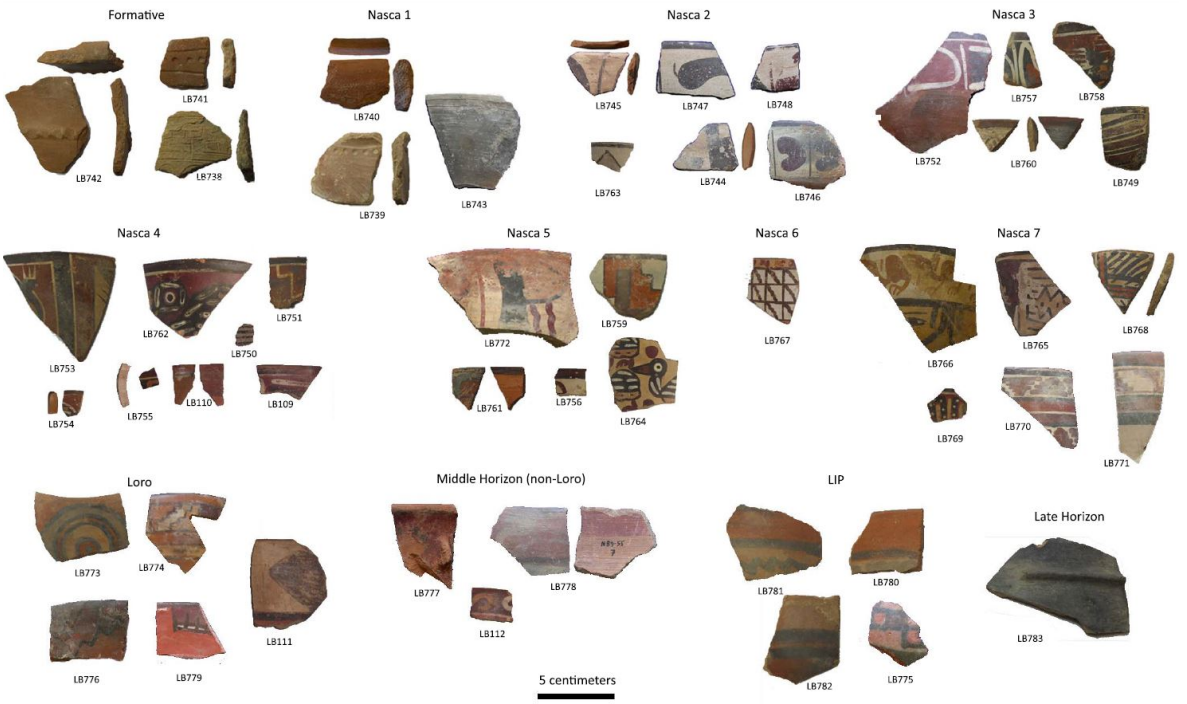


**Figure 2. All samples included in the analysis organized by identified phase. A phase consensus could not be reached on two of our samples (LB0750 and LB0775).**

terminations has random and systematic errors, it is possible that our reported 1-sigma error terms underestimate the overall error. Nevertheless, given that we processed and measured all samples in the same way, we can eliminate systematic errors. Although associating our absolute ages with ages for samples outside of our study will require additional consideration, for our purposes of assessing the Dawson Seriation, the precision is quite sufficient. Several of our samples fall well outside the expected range, and we discuss each of these below. On a general level, these samples notwithstanding, the results replicate much of the Dawson Seriation and Master Sequence: the Early Horizon sherds are earlier, while the Late Intermediate period and Late Horizon sherds are later (see Figure 3). Despite this general trend, however, there are major discrepancies and some unexpected results from our analysis, warranting discussion. We summarize this discussion in terms of the major deviations from the Dawson Seriation in our analysis.

*Nasca 2*

The first major deviation of our results from the Dawson Seriation is in Nasca 2. As a group, our Nasca 2 sample exhibits great variability in age estimates. One sherd (LB0745) did not have enough aliquots remaining to make alpha efficiency measurements. Consequently, it was deemed unreliable and not included in the analysis. Two other samples (LB0744 and LB0746), dating to the sixth and seventh centuries A.D., respectively, are far outside the expected range for Nasca 2. These two anomalous dates appear to have been caused by fading in the samples. Nevertheless, the remaining three samples are consistent and date from approximately 250 B.C. to A.D. 50. This is a century and a half earlier than predicted by the Dawson Seriation and previous work in the SNR. Perhaps more surprising is that the three dates for Nasca 2 are essentially contemporaneous with Nasca 1 sherds in the analysis. Furthermore, there is at least a century of overlap between Nasca 1 and 2 and the beginning of Nasca 3. This unexpected result contradicts the general consensus that Nasca 2 is a clear chronological phase between Phases 1 and 3 (Hecht 2013; Proulx 2006:33; Schreiber and Lancho 2003).

Table 2. Samples in the Analysis with OSL Results.

| ID# | Site | SNR Valley[a] | Phase | Equivalent Dose Best Fit ED (Gy) | ED (Gy) error | b-value | b-value (err.) | non b-value corrected OSL date (BP)[b] Min | non b-value corrected OSL date (BP)[b] Max | OSL Date (BP)[b] | OSL range (±) | Calendar date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LB0742 | Uchuchuma | Aja | EH | 8.57 | .28 | .47232 | .02524 | 2699 | 2961 | 2830 | 131 | 817 B.C. |
| LB0741 | Uchuchuma | Aja | EH | 7.59 | .1 | .76811 | .1034 | 2392 | 2594 | 2493 | 101 | 480 B.C. |
| LB0738 | La Puntilla | Aja | Oc7-8 | 9.83 | .25 | .60747 | .07997 | 2300 | 2522 | 2411 | 111 | 398 B.C. |
| LB0739 | La Puntilla | Aja | N1 | 8.01 | .34 | .69812 | .03823 | 2160 | 2402 | 2281 | 121 | 268 B.C. |
| LB0740 | Uchuchuma | Aja | N1 | 8.04 | .24 | 1.38243 | .03754 | 2032 | 2216 | 2124 | 92 | 111 B.C. |
| LB0743 | 89-25 | Aja | N1 | 8.43 | .23 | .60419 | .06095 | 1849 | 2025 | 1937 | 88 | A.D. 76 |
| LB0745 | 90-20 | Nasca | N2 | 6.64 | .18 | - | - | 2349 | 2665 | 2507 | 158 | 494 B.C.[c] |
| LB0748 | 90-20 | Nasca | N2 | 5.75 | .04 |  | .00994 | 2188 | 2360 | 2274 | 86 | 261 B.C. |
| LB0747 | 90-23 | Nasca | N2 | 6.10 | .2 | .85977 | .05683 | 1941 | 2141 | 2041 | 100 | 28 B.C. |
| LB0763 | Upanca | Tierras Blancas | N2 | 6.34 | .27 | .63549 | .03687 | 1848 | 2068 | 1958 | 110 | A.D. 55 |
| LB0744 | 89-11 | Aja | N2 | 5.64 | .24 | .88421 | .05265 | 1415 | 1583 | 1499 | 84 | A.D. 514 |
| LB0746 | 86-6 | Aja | N2 | 4.71 | .17 | .70387 | .05439 | 1286 | 1424 | 1355 | 69 | A.D. 658 |
| LB0752 | 96-267 | Las Trancas | N3 | 6.26 | .31 | 1.02928 | .10765 | 1931 | 2191 | 2061 | 130 | 48 B.C. |
| LB0749 | Upanca | Tierras Blancas | N3 | 5.64 | .18 | .45967 | .06933 | 1853 | 2053 | 1953 | 100 | A.D. 60 |
| LB0757 | Uchuchuma | Aja | N3 | 5.51 | .17 | .708 | .081 | 1794 | 1990 | 1892 | 98 | A.D. 121 |
| LB0109 | Marcaya | Tierras Blancas | N3 | 4.41 | .3 | .90056 | .20601 | 1071 | 1255 | 1781 | 121 | A.D. 232 |
| LB0760 | Uchuchuma | Aja | N3 | 5.22 | .19 | 1.07599 | .0885 | 1662 | 1842 | 1752 | 90 | A.D. 261 |
| LB0755 | 96-174 | Aja | N4 | 24.56 | 1.5 | - | - | 6281 | 7393 | 6837 | 556 | 4824 B.C.[c] |
| LB0753 | 86-12 | Nasca | N4 | 4.92 | .23 | .8908 | .11183 | 1578 | 1786 | 1682 | 104 | A.D. 331 |
| LB0754 | 94-6 | Taruga | N4 | 4.93 | .18 | - | - | 1548 | 1800 | 1674 | 126 | A.D. 339[c] |
| LB0750 | 96-272 | Las Trancas | N4 | 5.71 | .18 | .66534 | .10873 | 1545 | 1707 | 1626 | 81 | A.D. 387 |
| LB0762 | 86-12 | Nasca | N4 | 4.75 | .19 | .63314 | .03569 | 1484 | 1646 | 1565 | 81 | A.D. 448 |
| LB0758 | Upanca | Tierras Blancas | N4 | 5.85 | .14 | 1.46861 | .08872 | 1498 | 1630 | 1564 | 66 | A.D. 449 |
| LB0751 | Uchuchuma | Aja | N4 | 4.60 | .24 | .57635 | .1055 | 1435 | 1641 | 1538 | 103 | A.D. 475 |
| LB0110 | Marcaya | Tierras Blancas | N4 | 4.96 | .6 | .72884 | .14208 | 1235 | 1595 | 1532 | 180 | A.D. 481 |
| LB0772 | 90-54 | Las Trancas | N5 | 5.36 | .29 | .67458 | .09167 | 1500 | 1720 | 1610 | 110 | A.D. 403 |
| LB0761 | 86-12 | Nasca | N5 | 4.60 | .23 | .64785 | .04645 | 1501 | 1701 | 1601 | 100 | A.D. 412 |
| LB0764 | 86-14 | Tierras Blancas | N5 | 5.16 | .25 | .58875 | .06729 | 1420 | 1604 | 1512 | 92 | A.D. 501 |
| LB0759 | 90-10 | Taruga | N5 | 5.08 | .21 | 1.2945 | .18147 | 1273 | 1439 | 1356 | 83 | A.D. 657 |
| LB0767 | 90-12 | Taruga | N6 | 5.32 | .2 | 1.07583 | .18651 | 1417 | 1599 | 1508 | 91 | A.D. 505 |
| LB0765 | 90-10 | Taruga | N7 | 5.68 | .13 | .56847 | .03523 | 1653 | 1801 | 1727 | 74 | A.D. 286 |
| LB0766 | 86-15 | Tierras Blancas | N7 | 5.00 | .26 | .59375 | .05951 | 1542 | 1750 | 1646 | 104 | A.D. 367 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LB0768 | 86-16 | Tierras Blancas | N7 | 4.61 | .18 | .51962 | .10508 | 1454 | 1626 | 1540 | 86 | A.D. 473 |
| LB0769 | 86-16 | Tierras Blancas | N7 | 4.25 | .15 | .55699 | .11625 | 1439 | 1609 | 1524 | 85 | A.D. 489 |
| LB0771 | 90-48 | Las Trancas | N7 | 5.32 | .19 | .56745 | .07784 | 1341 | 1487 | 1414 | 73 | A.D. 599 |
| LB0770 | 96-258 | Las Trancas | N7 | 4.66 | .33 | .581 | .19789 | 1257 | 1493 | 1375 | 118 | A.D. 638 |
| LB0774 | 90-48 | Las Trancas | Loro | 5.74 | .23 | .88491 | .06872 | 2094 | 2334 | 2214 | 120 | 201 B.C.[d] |
| LB0779 | 90-38 | Las Trancas | Loro | 5.28 | .13 | .83322 | .04295 | 1956 | 2132 | 2044 | 88 | 31 B.C.[d] |
| LB0776 | 89-9 | Aja | Loro | 4.62 | .11 | .52593 | .02389 | 1398 | 1520 | 1459 | 61 | A.D. 554 |
| LB0773 | 90-38 | Las Trancas | Loro | 4.08 | .19 | .46802 | .108 | 1188 | 1346 | 1267 | 79 | A.D. 746 |
| LB0111 | Pataraya | Tierras Blancas | Loro | 3.61 | .28 | .27746 | .02814 | 922 | 1090 | 1123 | 84 | A.D. 890 |
| LB0756 | 89-44 | Tierras Blancas | MH | 6.04 | .2 | .47964 | .02147 | 1293 | 1421 | 1357 | 64 | A.D. 656 |
| LB0777 | 89-26 | Aja | MH | 3.27 | .14 | .38626 | .07047 | 1162 | 1306 | 1234 | 72 | A.D. 779 |
| LB0112 | Pataraya | Tierras Blancas | MH2[e] | 3.93 | .24 | .39386 | .03484 | 968 | 1114 | 1158 | 73 | A.D. 855 |
| LB0778 | 89-55 | Aja | MH2 | 3.22 | .18 | .58684 | .0706 | 1015 | 1157 | 1086 | 71 | A.D. 927 |
| LB0775 | 89-2 | Aja | LIP | 3.31 | .09 | .45548 | .0345 | 1045 | 1141 | 1093 | 48 | A.D. 920 |
| LB0781 | 96-257 | Las Trancas | LIP | 2.17 | .2 | .22692 | .10963 | 720 | 880 | 800 | 80 | A.D. 1213 |
| LB0780 | 90-50 | Las Trancas | LIP | 2.02 | .2 | .47835 | .13821 | 649 | 801 | 725 | 76 | A.D. 1288 |
| LB0782 | 90-73 | Aja | LIP | 1.81 | .12 | .34321 | .38105 | 563 | 675 | 619 | 56 | A.D. 1394 |
| LB0783 | La Ballena | Aja | Inca | 1.89 | .08 | 1.25605 | .12047 | 548 | 612 | 580 | 32 | A.D. 1433 |

[a]"Nasca" indicates Nasca Valley below the point at which the Aja and Tierras Blancas rivers merge.
[b]BP calculated as years before 2013
[c]Denotes sample without b-values, thus measure is unreliable.
[d]Dosimetry values inaccurate
[e]Sample was designated MH2 "Viñaque"

Table 3. Radiocarbon Dates from Excavated Sites Included in our Sample.

| Site | Associated Material | Radiocarbon Dates (Years B.P.) | Calibrated Calendar Date (2σ) | Source |
|---|---|---|---|---|
| Pataraya | Loro and Wari[a] | 1131–1253 | A.D. 674–990 | Edwards (2010) |
| Marcaya | Nasca 3/4 | 1630–1760 | A.D. 130–540 | Vaughn (2004) |
| Upanca | Nasca 2-4 | 1740 ± 70 | A.D. 120–435 | Vaughn and Linares (2006) |
| La Puntilla | Nasca 1 | 2023 ± 38 | 159 B.C.–A.D. 63 | Van Gijseghem (2006) |
| Uchuchuma | Paracas/Nasca 1[b] | 2270 ± 70 | 415–170 B.C. | Van Gijseghem and Vaughn (2008) |
| La Puntilla | Paracas | 2009 ± 50 | 165 B.C.–A.D. 82 | Van Gijseghem (2006) |

[a]Loro and Wari remains co-occur at Pataraya.
[b]Uchuchuma has both Nasca 1 and Paracas remains.

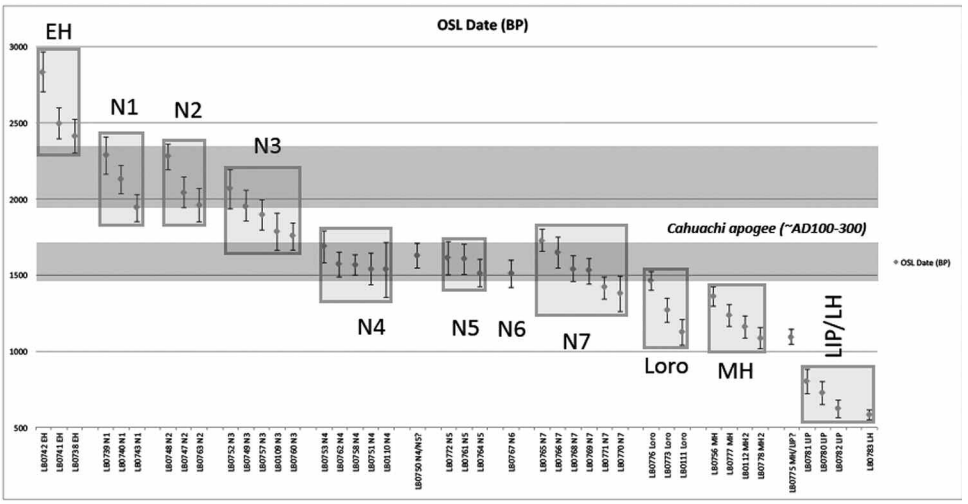


**Figure 3. Results of the luminescence study with OSL dates and one standard deviation included. Dates are expressed as years B.P. (before A.D. 2013). The boxes are drawn to be inclusive of phases. Two samples outside of boxes indicate lack of phase consensus, as described in the text. Time periods marked with gray indicate multiple overlapping phases. Note that only three samples (all are Nasca 3) date between A.D. 100 and 300, the apogee of Cahuachi.**

Up until this point, the intermediary nature of the Nasca 2 style has been difficult to verify stratigraphically. For example, Hecht (2009:228) suggests that, in Palpa, Nasca 2 is a short transitional phase and is clearly separate from Nasca 1, although this has not been stratigraphically documented in the CNR. The same can be said to occur in the SNR, where Nasca 2 sherds are often found in association with Nasca 3 materials at habitation sites (Schreiber and Lancho 2003), though less commonly at excavated sites (Vaughn 2005, 2009; Vaughn and Linares 2006). While Silverman (2002:87) identified 132 sites with Nasca 2 pottery in the Ingenio drainage, many of these sites are multicomponent and span Nasca 2 and Nasca 3 (see, e.g., Silverman 2002:Supplementary CD, N2 sec 4, N3 sec 4).

Strong (1957:25) identified Nasca 2 stratigraphically at Cahuachi as defining a phase between Proto-Nasca and "classic" Early Nasca. He called this phase "Cahuachi Polychrome." Archaeologists now recognize it as Nasca 2, although it does not include all ceramics now identified as Nasca 2 (see Silverman and Proulx 2002:27 for a discussion). Strong (1957:Table 3) illustrated the stratigraphic relationship between Nasca 1 through 3 using percentages of wares present in each arbitrary level at three different contexts at Cahuachi. Over a 2.5-m stratigraphic sequence, Nasca 3 pottery (Strong's "Nazca A polychrome") appears midway through the sequence, while Nasca 2 pottery (Strong's "Cahuachi Polychrome") always appears with Nasca 1 pottery (Strong's "Proto-Nazca"), suggesting contemporaneity between Nasca 1 and 2. Our results support Strong's observations of a significant overlap between Nasca 1 and 2 at Cahuachi.

The overlap between the end of Nasca 1 and 2 and the beginning of Nasca 3—the hallmark style of Cahuachi's florescence (Orefici 2011; Silverman 1993)—is also not surprising, given the frequent co-occurrence of these sherds at habitation sites. Our dates suggest that, between approximately 50 B.C. and A.D. 50, all three styles were in use in the SNR. Shortly after this time, Nasca 1 and 2 were abandoned, and Nasca 3 was the only remaining style in the region, a point that we return to below.

### *Nasca 4–7*

The second major deviation of our results from the Dawson Seriation is the significant overlap of Phases 4–7. LB0754 and 755 were not measured with alpha calibration because there was

no remaining material, and so these dates are not considered in the analysis. LB0759 has very high b-values and appears to have fading issues. Consequently, it was also removed from analysis. The remaining sherds phased to Nasca 4–7 overlap much more than previously expected. While it is not surprising that Phase 4 overlaps with Phase 5, given previous findings in Palpa (see Hecht 2013; Reindel 2009), it is surprising that these phases overlap with Late Nasca Phases 6 and 7. In every published chronological scheme for the south coast, these are assumed to postdate Nasca 5.

Phase 4 has always been difficult to place in chronological schemes. It has been deemed a temporal phase by researchers classifying by style (Proulx 2006), as well as by field archaeologists (Vaughn 2009), while it has been labeled a regional style by others (Browne 1992; Hecht 2013). Our luminescence results suggest that Nasca 4 is a distinct temporal phase when compared to Nasca 3, but that it overlaps significantly with Phases 5–7. Because Phase 4 appears after the height of prominence for Cahuachi (Orefici 2011; Silverman 1993), it might be considered within the post-Cahuachi Nasca milieu.

While pottery and iconography from Late Nasca are well known through museum specimens, the archaeological context of Late Nasca is still relatively poorly understood archaeologically. Results from excavations at Cocahuischo, located in the Tierras Blancas valley of the SNR, suggest that Phases 6 and 7 overlap stratigraphically at the site and date to A.D. 450–550, based on radiocarbon assays. These ages are consistent with our luminescence results (Whalen and González 2014). Moreover, pottery from these phases is far more stylistically diverse than previously thought (Whalen 2014).

The situation is only slightly clearer in the CNR, where only one Nasca 7 site has been excavated. Parasmarca, located in the Río Grande Valley, has predominantly Nasca 7 sherds in the upper stratigraphic levels, but also contains Nasca 1 and 5 components (Hecht 2009:226; Reindel 2009). No Nasca 6 sherds have been found in the CNR, including at Parasmarca (Hecht 2009:229). Complicating the picture is the fact that the various phases of pottery at Parasmarca are found in mixed contexts; stratigraphically, Nasca 5 and 7 are not distinguishable at the site (Hecht 2009:227). Nevertheless, radiocarbon dates at Parasmarca are later than at La Muña, a Nasca 4–5 site in Palpa that completely lacks Nasca 7 sherds. Therefore, archaeologists in the CNR specifically rebuff the notion that Nasca 5 and 7 are contemporaneous in the region (Hecht 2009:228). Furthermore, their radiocarbon dates for Nasca 7 are consistent with our absolute luminescence dates for this phase.

Finally, iconographic studies suggest that Nasca 7 was a relatively long phase. Indeed, the phase was divided into three subphases by Menzel (1964; see Proulx 2006:42 for a summary), while Proulx (2006:42) divides it into two subphases. Both authors assume that greater stylistic diversity correlates with longer periods of time. Our OSL dates are consistent with this notion and show Nasca 7 to be a very long phase, enduring for several centuries. Nevertheless, our results suggest that innovations in this style occurred relatively early and that the style was in use while other styles were also present in the SNR.

Clearly, Middle and Late Nasca were archaeologically complex with significant differences in their age distribution between the CNR and SNR. It will take more excavation and additional dating before we can resolve these issues.

### *The Late Intermediate Period in the SNR*

Our luminescence dates for the final periods of the Master Sequence did not reveal major surprises, as the dates are consistent with what we would expect for later prehistory. Two Middle Horizon Loro dates (LB0774 and 779) are far earlier than expected, given previous chronologies. It was found that dosimetry values for these two sherds were inaccurate, and therefore the sherds were removed from analysis. One sample (LB0775) with a date of A.D. 920 is consistent with Middle Horizon dates in our analysis. This particular sherd was designated "possible Middle Horizon" by some of the individuals who evaluated it; thus, we were unable to confidently phase it to either the Middle Horizon or the Late Intermediate period. Nevertheless, the luminescence date from the sample is more consistent with a Middle Horizon age.

Our results do reveal a gap during the Late Intermediate period from about A.D. 1000 to 1200.

This gap overlaps another recorded in the CNR between approximately A.D. 800 and 1200 (Unkel et al. 2012). Furthermore, despite SNR chronologies that have simply assigned the period between A.D. 1000 and 1476 to the Late Intermediate, as we have done here (Table 1), Conlee (2010, 2013) has shown that there is a lacuna of radiocarbon dates between A.D. 1000 and 1200, attributing this to an abandonment of the SNR correlated with heightened aridity during this time. Our luminescence dates are consistent with the gap in radiocarbon dates reported by Conlee (2013).

## Understanding Style and Time in South Coastal Peru

Our results suggest that the Dawson Seriation does include a significant chronological component. Many of the broader stylistic categories, including Paracas, Nasca, Middle Horizon, and Late Intermediate period, produced OSL dates as expected under the Master Sequence. At a more detailed scale, however, some of the stylistic phases did not demonstrate the expected patterns. In particular, Nasca 1 and 2 and Nasca 4 through 7 overlapped significantly, suggesting that the differences among these phases may not be simply temporal ones. From this, we propose that the Dawson Seriation also includes non-temporal factors, such as regional variations in chronology and regionally specific substyles.

Of course, we should expect overlap between phases as styles waxed and waned through time. Even if there were abrupt stylistic shifts, the error terms of OSL would artificially cause some blurring between temporal categories. In our interpretation, the consistent overlap in our sample is more than simply precision error associated with luminescence dating. Our dates suggest that there were time periods when two or more styles of pottery were being used simultaneously in the SNR region. This is not surprising, but many archaeologists have either explicitly or implicitly assumed that the stylistic phases of the Dawson Seriation represent discrete periods of time (but see Carmichael 2013). While such assumptions simplify many interpretations of diachronic changes in prehistory, such as shifts in settlement patterns and the consolidation of political power, we argue that they may obscure important variations in the evolution of societies in the Nasca region.

Although more sampling is necessary to evaluate the precise divisions in the sequence, we believe that our data demonstrate that for at least two periods, between approximately 250 B.C.–A.D. 50 and A.D. 300–500, there were multiple styles of Nasca pottery in production in the SNR. For the period between 250 B.C.–50 B.C., Nasca 1 and Nasca 2 pottery styles were being made and used in the Southern Nasca region. For approximately a century between 50 B.C.–A.D. 50, Nasca 1, 2, and 3 pottery styles were in use in the SNR. For the centuries between A.D. 300–500, a period that we have often assigned to Early and Middle Nasca in the SNR, our luminescence data suggest that four styles of Nasca pottery were being produced and used in the SNR: Nasca 4–7. Our data suggest that Nasca 7 pottery continued to be used in the region for several centuries after this time.

These periods bracket the florescence of the region's ceremonial center of Cahuachi (see Figure 3). Excavations at that site have demonstrated a preponderance of Nasca 3–phase pottery, and excavators there have suggested that this phase marked the apogee of the site as a ceremonial center (Bachir Bacha 2007; Orefici 2011:107; Silverman 1993:318). We posit that the multiple styles of pottery present in the region, both before and after the emergence of Cahuachi as a regional center, are evidence for the multiple groups that may have existed in the region during these time periods.

Nasca 1 and 2 styles, if contemporaneous, may represent two of several identified competing groups during the nascent stages of the developing "cult" centered at Cahuachi (Vaughn and Van Gijseghem 2007:819). Indeed, it has been argued that there were multiple competing groups in the SNR just prior to the emergence of Cahuachi as a regional ceremonial center (Van Gijseghem 2006). This may be reflected in the numerous styles of pottery present in the region at the same time. We propose here that Nasca 2 may have been one of those styles.

On the flip side, the possible contemporaneity of Nasca 4–7 styles may be the result of the waning influence of Cahuachi in the region. Cahuachi was still used as a ceremonial site, pilgrimage center, and burial ground after Nasca 3 (Kantner

and Vaughn 2012; Schreiber and Lancho 2003). Nevertheless, its waning influence left a power vacuum in the region (Vaughn 2009). The locus of power may have shifted north to Palpa in the CNR, where the large center of La Muña emerged (Reindel 2009; Sossna 2012). Given the results of our study, we also find it possible that other competing factions utilizing what we know as Nasca 4, 5, 6, and 7 pottery emerged as a result of this power vacuum, each with one or more distinctive pottery styles. Carmichael (1998b:226) originally postulated that competition among potters instigated innovations in Nasca 5-style pottery after the influence of Cahuachi diminished. Given the potential contemporaneity with Nasca 5 of Nasca 4, Nasca 6, and some Nasca 7 sherds in our study, we propose that this social milieu may have resulted in innovations in other styles assumed to be temporally distinct as well.

Of course, this remains a testable hypothesis, but if it cannot be falsified in the future it would have major implications for our understanding of Nasca prehistory. For one, it would mean that, instead of a continuous development of Nasca ceramic art over time (i.e., mutually exclusive temporal styles), as has often been assumed, there were actually points in time where multiple styles were in use. Some of these styles seem to have been produced over long windows of time, while others were much shorter in duration. In particular, in the centuries before and after the prominence of Cahuachi, multiple styles of pottery were present in the SNR. Furthermore, when Cahuachi reached its greatest influence, Nasca 3 became dominant and ceramic variability appears to have dropped considerably in the region. Given the results of our study, we estimate this time period to be between approximately A.D. 100 and 300. While it may be premature to consider why this might have happened, given our previous work in the region (e.g., Vaughn et al. 2006), we would not be surprised if this may have to do with the restricted production contexts of Nasca 3 pottery at Cahuachi.

## Conclusions

Archaeological typologies help us to categorize stylistic variation and to organize various aspects of the archaeological record. Because time is a crucial dimension in archaeological studies, the translation of typologies into chronologies is often a major goal of such categorization. But chronology building should be an iterative process. It is critical to test existing chronologies, especially those built on seriation and relatively small numbers of radiocarbon dates. Although time may be a major component of a typology, other factors—including, but certainly not limited to, innovation, the presence of regional workshops, competing religious ideologies, or production centers, and the rise of powerful polities—can also contribute to ceramic stylistic variation, and as a result, to our cherished typologies. New and developing archaeometric techniques have the potential to generate new and independent data to test existing chronologies. More importantly, they can produce data that lead to new hypotheses about the past.

In closing, we again ask the principal question posed in our study: "Is the Dawson Seriation about time?" Perhaps not surprisingly, our results suggest that the answer to this question is both "yes" and "no." Yes, the Dawson Seriation includes a significant component of time, as we and many others have noted. But the answer is also "no," because the Dawson Seriation does not appear to be *only* about time. Our OSL dates suggest that other, likely cultural, factors are at work. These play a significant role in structuring the ceramic variation coded within the seriation that has been used on the south coast of Peru for over a half century. We believe that additional OSL dating, as well as new excavations and other ceramic analyses, will go far in addressing these issues, and we invite the archaeological community to help us in this endeavor.

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*Supplemental Materials*. Supplemental materials are linked to the online version of this paper, which is accessible via the SAA member login.

Supplemental Text 1. Description of the methodological details of optically stimulated luminescence, as practiced in our study.

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