Peer Community In Archaeology

A step towards the challenging recognition of expedient bone tools

Camille Daujeard *based on peer reviews by* ***Delphine Vettese***, ***Jarod Hutson*** *and 1 anonymous reviewer*

Luc Doyon, Zhanyang Li, Hua Wang, Lila Geis, Francesco d'Errico (2021) A 115,000-year-old expedient bone technology at Lingjing, Henan, China. Missing preprint_server, ver. Missing article_version, peer-reviewed and recommended by Peer Community in Archaeology.
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This article by L. Doyon *et al.* [1] represents an important step to the recognition of bone expedient tools within archaeological faunal assemblages, and therefore deserves publication. In this work, the authors compare bone flakes and splinters experimentally obtained by percussion (hammerstone and anvil technique) with fossil ones coming from the Palaeolithic site of Lingjing in China. Their aim is to find some particularities to help distinguish the fossil bone fragments which were intentionally shaped, from others that result notably from marrow extraction. The presence of numerous (>6) contiguous flake scars and of a continuous size gradient between the lithics and the bone blanks used, appear to be two valuable criteria for identifying 56 bone elements of Lingjing as expedient bone tools. The latter are present alongside other bone tools used as retouchers [2]. Another important point underlined by this study is the co-occurrence of impact and flake scars among the experimentally broken specimens (~90%), while this association is seldom observed on archaeological ones. Thus, according to the authors, a low percentage of that co-occurrence could be also considered as a good indicator of the presence of intentionally shaped bone blanks. About the function of these expedient bone tools, the authors hypothesize that they were used for *in situ* butchering activities. However, future experimental investigations on this question of the function of these tools are expected, including an experimental use wear program. Finally, highlighting the presence of such a bone industry is of importance for a better understanding of the adaptive capacities and cultural practices of the past hominins. This work therefore invites all taphonomists to pay more attention to flake removal scars on bone elements, keeping in mind the possible existence of that type of bone tools. In fact, being able to distinguish between bone fragments due to marrow recovery and bone tools is still a persistent and important issue for all of us, but one that deserves great caution. [1] Doyon, L., Li, Z., Wang, H., Geis, L. and d'Errico, F. 2021. A

115,000-year-old expedient bone technology at Lingjing, Henan, China. Socarxiv, 68xpz, ver. 4 peer-reviewed and recommended by PCI Archaeology. https://doi.org/10.31235/osf.io/68xpz [2] Doyon, L., Li, Z., Li, H., and d'Errico, F. 2018. Discovery of circa 115,000-year-old bone retouchers at Lingjing, Henan, China. Plos one, 13(3), https://doi.org/10.1371/journal.pone.0194318.

Reviews

Evaluation round #1

DOI or URL of the preprint: **10.13140/RG.2.2.25864.03846**

Authors' reply, 02 February 2021

Dear Dr. Daujeard,

We wish to thank you for giving us the opportunity to submit a revised version of the manuscript entitled: A 115,000-year-old expedient bone technology at Lingjing, Henan, China.

We believe that, thanks to your suggestions and those from Reviewer #2 and D. Vettese, we were able to make modifications to our original work and improve the quality of our paper. In the present submission, you will find, in addition to the new version of our manuscript, a point-by-point response to the reviewers' comments as well as a version of our manuscript with track changes.

We look forward to hearing from you. Best regards,

On behalf of all the co-authors: Luc Doyon

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Decision by Camille Daujeard, posted 18 January 2021

Decision on the manuscript of Doyon et al.: "A 115,000-year-old expedient bone technology at Lingjing, Henan, China"

Given that the three reviewers are not equal in their suggestions concerning your manuscript entitled: "A 115,000-year-old expedient bone technology at Lingjing, Henan, China", I decided to ask for a revision of your article. You will find below my main recommendations.

First of all, this manuscript deserves publication. This work represents an important step towards the recognition of expedient bone tools among archaeological faunal assemblages. The comparison between the faunal remains from Lingjing (China, c. 115 ka) and those coming from an experimental sample of broken bones (horse remains), constitutes an interesting and suitable approach of that question. In my opinion, the data provided in that manuscript are in themselves sufficient for publication, even without being able to answer the question of the function of these bone tools. That may represent a second step in the research process and then another article, including notably, as stated by the authors, the use wear analyses.

However, concerning the experimental protocol and data presented here and the references used, I wonder whether they are sufficient to distinguish between bone tools elements and bone splinters due to marrow recovery, which is a persistent and important issue for all of us, but one that deserves a great amount of caution.

Thus, following the reviewers, authors may implement their statistical tests to consolidate their experimental data, and improve some important points concerning the Material and Methods, Results and Discussion. For example, concerning Material and Methods, a developped and detailed nomenclature of marks is required.

About statistics, authors should indeed give the confidence intervals for their percentages. Using percentages for about ten remains is not relevant.

Some references are also missing, and in addition to those cited by the reviewers, I would add others such as Blasco et al., 2008 about trampling marks that could generate some 'pseudo-tools'. In the same way, concerning the state of the art, I would also add the reference of Miller-Antonio et al. (1999), which states on the existence of tools on rhinoceros dental remains in the Palaeolithic site of Dadong in China. In this paper, the authors cite also the work of Sohn (1988), who reports the modification of bone at the Middle to Upper Palaeolithic Korean locality of Yonggul (Chommal) cave. The argument has been made for bone and antler use at Zhoukoudian (Pei 1938; Breuil 1939) and for worked bone from the Lower Palaeolithic localities of Donggutuo (Wei 1985) and Xujiayao (Jia & Ho 1990). Concerning the Research background, I may suggest to the authors to make a review of the articles mentioning the possible existence of expedient tools, at least for early Palaeolithic periods of the whole old world, such as La Cueva Morin (Freeman, 1978; cf. Controverse in Freeman, 1983), de Rebibbia Casal de'Pazzi (Anzidei, 2001) or Saint-Marcel (Daujeard, 2007) in Europe, among others.

Taking into account these few remarks, and above all those requested by the reviewers, the authors are invited to revise their manuscript and resubmit it to the PCI as soon as possible. Authors should pay attention to the detailed reviews made by Reviewer 2 and D. Vettese, who listed various points asked to be improved. Concerning the points highlighted by J. Hutson, authors may consider his remarks on the abstract and discussion about the question of the tasks done with the bone tools. Indeed, the question of the function of these 'expedient tools' will be developed in a future work, and the data processed here are not sufficient to address this issue in this article. Thus, the authors may limit their current work to the simple recognition of these tools, and only conclude here that some bones from Lingjing were intentionally shaped, which is itself a very important point that deserves publication.

Reviewed by Jarod Hutson, 24 November 2020

Review for "A 115,000-year-old expedient bone technology at Lingjing, Henan, China"

This article details an assemblage of purported expedient bone tools from Lingjing (Henan, China) and a series of bone breaking exercises designed to distinguish between bones knapped for use as bone tools and bones broken for marrow. The authors provided an excellent framework for the study of these purported expedient bone tools, with plenty of archaeological context and background research on bone tool use, and I applaud their efforts in this regard. Unfortunately, the authors dedicated more space to context and background than to the presentation of results and conclusions. None of the context and background qualifies as a new or original contribution (there are numerous articles by Doyon and colleagues that include most of the same information) and the results and conclusion presented are incomplete. I don't intend to diminish the work that the authors have already completed, but I think that the authors would agree that the results, analysis, and conclusions are incomplete. There are two quotes from the text that illustrate my point.

From the abstract: The [knapped bones] were used for tasks for which the [lithics] were less or not effective.

This is not a useful statement, especially for the abstract. We may hypothesize that bone and lithic tools could be used for different tasks, but this paper does not provide any evidence for or against this hypothesis.

From the discussion: The function of the bone tools is a topic to be explored…An experimental and use wear programme is currently being implemented to test this hypothesis.

Without further experimental and use wear studies, the reader can only conclude that the bones from Lingjing were intentionally shaped, not that they were used as cutting or hide-working tools. Sometimes (but not often) bone retouchers were intentionally shaped, perhaps to reduce the size of bone blanks to fit better in the hand. These were used as tools, but not the same type of expedient bone technology that the authors are suggesting. Since the authors mention that a use wear programme is currently being implemented, we must assume that there will be a follow up article on the results of that work. Therefore, this article will be irrelevant upon publication of the additional experimental and use wear results.

Because of these concerns, I must reject this article for publication. I hope that the authors do not take my

decision as a rejection of their work overall. I believe that the article is well written and well researched, but I think that the authors would agree with me that their work is not finished. As it is written, the article does not advance our knowledge of bone technology. With additional experimental and use wear studies, which the authors acknowledge is currently being implemented, this article will be publishable and will have a more lasting impact on the study of bone tool technologies, expedient or otherwise.

Specific comments on the work would be premature at this point because the authors have yet to test their hypotheses on the function of these expedient tools. I would welcome the opportunity to provide a second review when the authors complete their study.

Reviewed by anonymous reviewer 1, 07 December 2020

The work is precise, detailed and well structured. Clear in describing the different phases of research: from the experimentation to the analysis of archaeological finds. I share the hypothesis that some bone splinters in Pleistocene sites may also have been used as tools. I have often wondered if it just represented the use of a splinter produced during the slaughtering or extraction of bone marrow or, in some cases, it was intentionally produced to be used.

Row 345 - Material and Methods. I would like to to point out, from direct experience, that the long bones of equids are more compact and have more trabeculae than those of bovids and cervids. This makes a greater use of blows necessary. I would ask the authors for considerations on this matter.

Row 345, Material and Methods and fig. 2 - Another curiosity about the experimentation: is the choice of the area of the bone to be hit based on the recurrence of the points of impact on the anatomical elements of the archaeological sample or left to the decision of the operator? Some blows were inflicted near the epiphysis (e.g. radius), instead it is the point of easiest fracture or it is easier to break the bone by hitting the posterior face, as I happened to observe for the equidae radius.

Row 508 5.2 Archaeological data - I find it interesting to relate the position of the blows on the experimental bones to those of the archaeological bone remains. It would be useful to have a detailed study of the fractured identified bone remains (species and element) to compare them with the experimental data.

In the figures 5-6 of the bone findings it would be interesting to indicate the likely areas of wear (e.g. with arrows) or to insert at least one or two significant remains with details of the areas that the authors find interesting as traces of impact and wear.

Row 71 - Just a clarification the work to be mentioned by Polledrara where the study of fracturing is discussed is Santucci et al, (2016) - Palaeoloxodon exploitation in the late Middle Pleistocene site of Polledrara di Cecanibbio (Rome, Italy). Quaternary International, 406, 169-182

Reviewed by Delphine Vettese, 15 January 2021

The paper "A 115,000-year-old expedient bone technology at Lingjing, Henan, China" by Doyon and colleagues presents some quantitative and qualitative criteria to identify expedient bone tools based on the study of different bone fragment samples from the layer 11 of Linjing (Henan, China).

I recommend this manuscript for publication with major revision but I suggest some changes to help to improve the manuscript. I find this paper useful, however, I noticed some issues easily addressed. Please find the comments and suggestions below. Moreover, English is not my mother tongue. I do not consider myself able to judge the grammatical syntax of this text. However, the manuscript is clear and understandable.

It is highly appreciated the mention in the text of the contribution in this work of each author, and the analyses they performed.

Introduction and Research background: The presentation of the context study and the bibliographical review is quite complete and very well detailed. In the Research background, the paper of Mateo-Lomba et al. 2020, which developed an experimental study of bone expedient tools from long bone bovids, could complete the

listing of recent work on the subject. The authors clearly show the importance of highlighting expedient tools within faunal assemblages and how complex it is to identify them so far.

Maybe, as the convention established by Schwab and Patou, 2002 is used in this paper it should be quoted in the references.

Archaeological context: I am not a specialist in this region and context. However, I found the presentation complete, clear and very detailed regarding all the contextual aspects.

It could be appropriate to mention that the site is interpreted as a kill/butchery site in this part because it is used in the discussion to justify the use of bone fragments as expedient bone tools.

Nevertheless, I suggest adding the NISP and the MNI of the different species presented in the levels studied. I had some difficulty to find this information in the previous papers.

Material and methods: - Archaeological remains The authors should clarify if the 100 fragments composing the sample of RCS are from long bones, only cortical bones or cortical with spongy bones. Similar suggestion applies to the fragments of the CCS sample.

It will be instructive to add the ratio of long bone NISP (or compacta) to total NISP regarding the archaeological samples studied to know the level of compacta, spongy bones and long bones. This could permit to present better the three samples nature and composition.

The authors should provide some additional information about the “contiguous” scars to clarify if it means that they are incomplete because one overlapped the other (as mentioned in Galan and Dominguez-Rodrigo 2009 as “Double overlapping notches have negative flake scars that overlap with an adjacent notch.”).

Line 355: the number of remains studied for this paper is 1.498 while summing 127 (PBT), 100 (RCS) and 1260 (CCS), the result is 1487.

- Experimental program The protocol description is clear and very well detailed.

Lines 446-451 are the same of the lines 386-390 in the Archaeological remain part. The authors could only keep ones and precise that the same requirements are taking into account for both materials: archaeological and experimental.

I would like to know why the authors did not test the batting technique to extract marrow in addition to the hammerstone and anvil technique. Because it could have some different results in term of the fragment’s size or impact scars number.

Besides, I found that the number of fractured bones and therefore the number of fragments studied was relatively reduced. Why did not you use an extra sample of bovine or cervid bones for example, from previous experiments? Since there, regarding the archaeological data, it does not seem to be any difference observed according to the size of the ungulates treated at the archaeological site.

Results: Some results mentioned by the authors as significant should be supported with statistical tests such as spearman correlations test on the number of fragments per size interval for each sample or possibly an Anova test per row for the data in Figure 5. For example, regarding lines 521 and 524 and 545.

- Experimental data Nothing, it is a complete presentation to the results.
- Archaeological data Lines 515-517: “With the exception of four specimens from the PBT, none of the other diaphyseal fragments with flakes removal scars bears impact scars that could be interpreted as resulting from bone fracturing”. It could be necessary to precise which criteria are used to do this difference between the two scars and detailed more this assumption.

It could be interesting to have the number of following bifacial scars (minimum-maximum) according to the samples.

- Comparison between archaeological and experimental diaphyseal fragments Line 537: The authors could provide, inside the text, the number corresponding to the percentages to a better comprehension of the results.

The authors could add the number of remains with polishes and scars according to their type, maybe provide a contingency table, in the part of the results and discuss the results.

In the text, once it could be more legible to write in any letter that μ means average and σ means the standard deviation.

Discussion: Lines 634-636: The arguments exposed are very accurate. Moreover, could it be also due to the tools (hammerstone) used to extract the marrow (no matter what raw material choose: bone, stone, wood...) which, could be used to retouch the bone fragment?

Lines 641-642 and 646: Careful to the homogeneity, the standard deviation is noted as SD while in all the rest of the paper is noted σ.

Line 656. I suggest quoting the work of Mateo-Lomba et al. 2019, and Di Buduo et al. 2020. In addition, it could be a good opportunity to mention the complementary analyses, which will be performed, on the expedient bone tools identified. Besides, the authors should be changed “programme” by “program”.

Inside the discussion, it could be appropriate to add some words on the retouch tools identified, particularly regarding their sizes. It could be appropriate to then compare them with the expedient tools (in addition to the lithic tools). Also in Figure 8, this information could be added.

Line 667: The authors could add some word on the chaine opératoire of the bone, and the implication of the expedient bone tools for the site interpretation.

Figures and Tables: Regarding Tables 1, 3 and 4, it could be better to add the number at the percentages.

Table 2: “Only faunal remains” How the percentages were performed is not clear. The authors could precise it in the caption.

In Table 3, to be more homogeneous, the authors should change “endosteal” by “medullar” as mentioned in the methods.

It could be interesting to mention the presence or absence of abrasion and if it is relevant, the association with the impact scars or flake scars, and the other possible alterations, like concretions, cracking and the legibility of the fragments due to all the taphonomical alterations in Table 4.

It will be instructive if polish presence and intensity will be associated with the other criteria presented in the paper to identify the expedient bone tool.

The authors should clarify what means “Ancient fracture” if that means dry bone fracture?

Having all three sides of the bone illustrated and in a good quality value the paper. However, it might be welcome to highlight the different scars or removals (with arrows or staining).

Supplementary Information In the column of the tables, the authors should put “N” when it is necessary (empty now), or in the captions or head-table do not precise “N” means No presence (or absence).

The authors should precise why in the table p13 and p14 some cells are empty (example fragment 14L329 miss the flakes n°2 and 5 and adding the explanation in the captions.

In the SI tables, replace the Fig.8 and Fig. 9 by Fig.6 and Fig. 7.

In sum, this manuscript presenting criteria to identify expedient bone tools is relevant. It represents the first step to sort this type of archaeological object in a faunal archaeological assemblage. Moreover, as the authors said, this study should be completed by use-wear analyses and these expedient bone tools should be compared with additional experimental data to understand if and how they were used and for which purposes. “An experimental and use wear programme is currently being implemented to test this hypothesis.”

Nevertheless, a revised version would be required, edited to reflect the comments and suggestions above, notably regarding the statistical tests to support the criteria highlighted by the authors.

References: Di Buduo, G. M., Costantini, L., Fiore, I., Marra, F., Palladino, D. M., Petronio, C., ... & Sottili, G. (2020). The Bucobello 322 ka-fossil-bearing volcaniclastic-flow deposit in the eastern Vulsini Volcanic District (central Italy): Mechanism of emplacement and insights on human activity during MIS 9. Quaternary International. Galán, A. B., Rodríguez, M., De Juana, S., & Domínguez-Rodrigo, M. (2009). A new experimental study on percussion marks and notches and their bearing on the interpretation of hammerstone-broken faunal assemblages. Journal of Archaeological Science, 36(3), 776-784. Mateo-Lomba, P., Fernández-Marchena, J.

L., Ollé, A., & Cáceres, I. (2020). Knapped bones used as tools: Experimental approach on different activities. Quaternary International. Patou-Mathis, M., & Schwab, C. (2002). Fiche générale. Retouchoirs, compresseurs, percuteurs... Osa impressions et éraillures. Editions SPF, Cahier X, Paris, 11-19.