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COMMENTARY

Helping Students Synthesize Academic Literature: Development of an Excel Research Grid

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Abstract

One of the key challenges for undergraduate students is learning to read, understand, and synthesize academic literature. To help students develop these skills, a research grid assignment using Microsoft Excel was developed. This assignment breaks down the key steps to data synthesis, including identifying and summarizing key parts of academic literature and comparing these parts across academic articles. The ability to sort and highlight data in Excel allows students to easily identify patterns in the literature related to their specific research topics. Student feedback following two semesters of use in a core physical anthropology course suggests that the process of creating and using the research grid improved student satisfaction with the research process.

Keywords: *information literacy; synthesis; research grid; literature review*

Introduction

The ability to synthesize academic literature, or identify important connections between multiple authors' research and arguments, is an important learning outcome for students in higher education. This skill is critical for content-area writing, for undergraduates who have declared their major, and for graduate students. For many reasons, synthesizing literature is both difficult for students to learn and for educators to teach.

Synthesis requires first being able to summarize individual articles. Summarizing involves identifying the key claims and central ideas of each author and putting these ideas into the student's own words (Greene and Lidinsky 2008). Reading and summarizing academic literature can be especially difficult when students are writing in a field heavy with academic jargon, and an increased use of general scientific jargon is known to correspond to a decrease in readability (Plavén-Sigray et al. 2017).

Synthesizing information also requires an awareness of larger conversations in the field. It is particularly challenging for students to comprehend the scope of current research that exists about their topic, including the research methods that are used, key

theories, and the history of the field. An incomplete understanding of these items can impact students' decisions at multiple steps of the writing process, including topic selection, literature searches, organization, and writing. One last challenge is that students must identify their own viewpoints and identify how the literature intersects with their ideas.

To address these challenges in the synthesis and organization of complex academic literature, particularly for students who are early in their major, an assignment was created asking students to develop a research grid using Microsoft Excel. With this grid, students summarized various aspects of academic papers and then used sorting and highlighting tools provided in Excel to identify key trends in the research on their topic.

Participants and Setting

The research grid assignment was assigned to California State University, Chico (CSU Chico), students enrolled in a physical anthropology survey course. This is one of four "core" 300-level courses in the anthropology major, which together are designed to be the first courses that students take upon declaring the major (100- and 200-level anthropology courses count only towards GE credit in this program). While these four core classes can be taken in any order, they serve as prerequisites to theory-based or methods-based upper-division courses in the corresponding sub-disciplines. The major also includes two 400-level capstone courses (one in theory and one in methods) that students usually take in their final year. Students who are enrolled in the physical anthropology course attend three hours of lecture and one three-hour lab; the lecture and labs are taught by the same faculty member. Lecture enrollment ranges from 30 to 45 students each semester.

Students who are enrolled in this class are primarily anthropology majors (90%) or minors who have achieved sophomore or junior status. For some students (approximately half), the content of this course is completely new. Others have had a similar survey course as part of their general education. Nearly half (46%) of the students who enroll at CSU Chico are transfer students, with most coming from regional community colleges. Thus, many of the students who have already completed coursework in physical anthropology did so outside the University.

CSU Chico is a large Master's degree-granting university with over 16,000 full-time equivalent students. In 2016-2017, when this study was done, the student population had an average age of 22 years, 96% of students were California residents (though only 30% were from our northern California service area), 44% identified as white, and 30% identified as Hispanic/Latino. Additionally, 48.5% of students were first-generation students and 47% were eligible for a needs-based Pell grant.

The Challenge

This course is taught once a semester. Instruction rotates among four faculty members, each of whom assign a research paper that requires students to synthesize

literature on a subtopic in physical anthropology. This assignment addresses multiple learning outcomes for majors (see http://www.csuchico.edu/anth/), but the details of the assignment vary with each instructor. Prior to Fall 2016, the author required students to complete the following steps: a research proposal, outline, first draft that was instructor-edited, and final draft of the paper. The resulting student work, in addition to student feedback, suggested that students struggled most with the following areas:

- *Selecting focused, narrow topics to motivate detailed research*: Students often struggled to identify a focused research topic that reflected questions that are being actively researched in the field. While topic selection is sometimes regarded as one of the most difficult parts of a student research paper, this challenge is exacerbated for students who have not had a GE equivalent of the course and who are less familiar with the course content.
- *Conducting full literature searches*: Students often ended their literature searches when they had found (but not necessarily read) the minimum number of sources required. As a result, they often missed important contemporary research or major theoretical perspectives that addressed their topic of interest.
- *Reading and understanding academic literature*: Undergraduates who were early in their anthropology degree and/or new to their selected topics struggled to understand the jargon of the field, general academic jargon (see Plavén-Sigray et al. 2017), and the methods being described. This was evident in their inability to summarize key points of the papers and in a tendency to "patchwork" together quotes or paraphrased passages from academic papers. This second tendency also put them at risk of plagiarizing.
- *Synthesizing data:* Students struggled to identify the key trends in their research area and to use those key trends to structure their papers. Instead, students frequently organized papers around a list of articles they read, with one paragraph summarizing each article. Students who were successful in identifying key themes struggled to support those themes with empirical data from the literature.
- *Citing sufficiently:* Students often voiced difficulty with following a citation style (in this case The Chicago Manual of Style, Author-Date Style, which was adopted by the American Anthropological Association in 2015), and it seemed that part of the challenge was identifying the important parts of a reference (e.g., publication information, volume and issues of journals, and editors or authors of books). Additionally, some students failed to credit an original source for any of the theories or ideas discussed.

The Research Grid

The research grid assignment was developed to address the above student challenges by serving as a checkpoint in the literature search process and by providing a

tool to assist students as they organized and synthesized data. The grid was assigned after students had some in-class and at-home practice reading and summarizing academic articles from biological anthropology and after they had submitted a one-paragraph research proposal (including three academic references) and begun their literature search.

Students were introduced to Microsoft Excel in a brief in-class tutorial that demonstrated how to enter data into the spreadsheet, format the text, and resize rows and columns. Students were shown how to access Office 365 for free through the Microsoft Office 365 for Education program (https://products.office.com/en-us/student/office-in-education). They were also provided with links to Excel tutorials from Lynda.com and Microsoft for follow-up help. A sample grid with only three references was provided to students via the learning management system; students could download and use the sample as a template if they wished.

For part one of the assignment, students were asked to complete their own research grid using Excel, with one academic reference per row for 8-10 references (see Appendix A, Example of a Student Research Grid). Columns used to organize data from these references included:

- Date (year) of publication;
- Type of reference (e.g. primary research, review, book chapter);
- Method(s) used by researchers to generate data;
- Theories tested or questions researchers are asking;
- Summary of key evidence;
- Key words (or other main topics addressed);
- Other (to record additional notes or develop a new column relevant to this paper);
- Full Reference in Chicago style; and
- DOI or Permanent URL (a permanent web link to the reference).

The goal of this part of the assignment was to motivate students to read their selected literature and summarize key information and to give them practice writing references in Chicago Style and identifying permanent links to their sources. Students were asked to bring either an electronic version of their grid on a laptop or tablet or a printed version of their grid to lab. Students were given a grade based solely on the completion of the assignment by the due date.

Part two of the assignment was largely completed in lab over the course of about an hour. Students were shown how to sort data (for example by author or by date) and also how to highlight and color-code data using the tools in Excel. Students were given individual work time in class to use the tools they had (Excel or colored highlighters provided by the instructor to mark printed grids) to begin sorting their data and highlighting interesting trends they identified. They were specifically asked to consider:

- Development of the field over time;
- Key questions researchers in this field are asking;

- A theory/theories that have the most evidence (or, alternatively, are outdated);
- Authors who contributed to multiple papers;
- Key methods used to collect/analyze data;
- Areas missing from the current literature included in the grid; and
- Articles that are more/less relevant than others.

Students were then assigned to small peer groups (three or four students) based on similarities in their research topics, and they were asked to share where they were in the research process and the trends they were identifying. Peers were encouraged to ask questions of the grid's author and to look at the grids to see if they could identify any additional patterns. While discussion was occurring, the instructor moved among groups to assist and answer questions. Students could also use this time to ask clarification questions of their peers or the instructor regarding the content of the grids.

Groups were then asked to discuss the following questions:

- What would be good ways to organize the information into a paper?;
- Is the original topic of interest still appropriate given the research uncovered?;
- Is more evidence/research needed?; and
- Would the paper be more effective if the scope was narrowed and/or more detail was provided?

The goal of the in-class assignment was to actively engage students in the research process and to make evident connections that exist between sources, allowing a clear way to synthesize the data. Another goal was to motivate students to continue the literature search as needed. Finally, discussion of the grids served to transition the research paper process from source collection and note taking towards paper organization and writing. Well-developed grids could be used to provide notes when outlining and writing the paper.

Students were given a few additional days to update and complete their grids, highlighting with colors and footnotes the major trends that they identified, as well as adding additional references as needed. Students submitted their grids electronically to the instructor, and a second grade was awarded based on the content of the grid, including evidence of research invested, focus of the topic, and the identification of key trends.

Data Collection

Over the course of two semesters (Fall 2016 and Spring 2017), students were asked to provide feedback about the research process. After students submitted the final draft of the grid, they were asked to provide verbal feedback about what they liked ("plusses") and suggestions they had to improve the assignment or the process of using it ("deltas"). Additionally, after students completed the final draft of the research paper, they were asked to provide written responses to the following questions:

- What was the most helpful step in the research paper process?;
- What struggles did you have?; and
- Would you change anything about the research paper process?

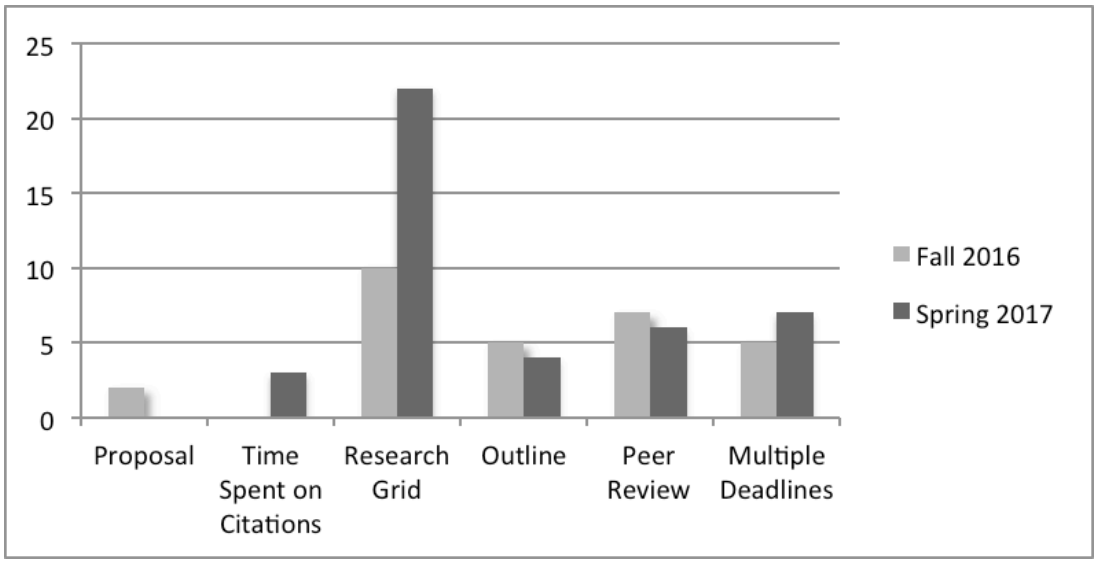
Results

Student feedback immediately after developing the research grids and discussing them in small groups was largely positive. Most student comments focused on an appreciation for the grid's organization and its ability to help them visually identify the "big picture" patterns in the literature and topics that should continue to be researched. Students expressed that they were more confident about beginning their papers. One student said, "it made me read!", and others agreed. Multiple students stated that they liked this process better than writing an annotated bibliography, and one specified that this was because they were less focused on the details of their writing and were more focused on the content. Students also liked having the DOI or permanent URL in the grid to easily access the papers. It was also noted that the more references students added, the more helpful the grids were. Multiple students shared that they would, or already had, used this technique for writing papers in other classes.

Students did express challenges with the research grid assignment, and these primarily fell into two areas: using Excel itself and understanding the categories of the grid. Two students stated that they "hate Excel." Other students struggled to learn the program from the brief tutorial given in class and recommended that a longer lesson be given in class to help them learn this technology. When the grids were initially assigned, most students expressed familiarity with the program, but it became evident during the process that there was a need for a longer Excel tutorial. Students particularly needed help with features like wrapping text into cells and sorting or filtering data. Other students expressed that they had a hard time understanding what information to write in the "methods," "theory," and "other" columns. While most students were positive about the grids, there was one student who "just didn't like it" and another who preferred spider diagramming, which this student had used in other courses to organize data for papers.

When students were asked at the end of the semester to provide open-ended feedback about the most helpful step in the research paper process, the research grid was the most common item mentioned. Table 1 shows a summary of this feedback. The data was categorized by activity or assignment mentioned, and categories are listed in the order the activity or assignment was completed. If one student identified multiple steps in the research process, they were all recorded. If a student stated that all steps were helpful, the data was not recorded. In the Spring of 2017, a lesson was provided where students practiced the Chicago Manual of Style citations; this lesson was not done in the Fall 2016 semester, so it is not mentioned then.

Table 1. Step(s) in the Research Process that Students Identified as Most Helpful



Discussion

Results suggest that the process of creating and using the research grid improved student satisfaction with the research paper process. Additionally, the grid was able to address the primary challenges identified with paper writing from previous semesters. These included:

- *Selecting focused, narrow topics to motivate detailed research and conducting full literature searches*: The formation of the grid served as a checkpoint in the literature search process, and peer discussion of the grids helped students evaluate the scope of their topic and encouraged them to narrow or shift their topics and/or continue the literature search, as needed.
- *Reading and understanding academic literature*: The grid motivated students to specify the methods used and theories tested in academic research. The research grid also required that students summarize the main ideas of papers before moving on to the synthesis of these ideas.
- *Synthesizing data:* The sorting and highlighting tools in Excel, in addition to peer discussions of the grids, provided a visual and interactive way to identify the key ideas in a research area, how those ideas have developed over time, and the types of evidence being used to support them.
- *Cite sufficiently:* Identifying key components of a reference (dates, authors, editors), as well as writing out the complete reference in the grid, allowed students to practice using the citation style and gave them easy access to all their references. Additionally, students were motivated to summarize content from each paper, thus identifying the contributions of each author and better understanding why citations were necessary. It also lessened the temptation to

pull language directly from the sources in a way that can lead to inadvertent plagiarism (Howard et al. 2010).

Students' concerns with the research grid can be addressed with clarification and additional training. Students sometimes struggled to know what to list in each column of the grid, and these categories could be modified (depending on the discipline and the paper assignment) and/or more direction could be given. Working on an example with the entire class would also help students understand what to write for each of these categories. Students also struggled to format their data in the Excel spreadsheet. It is highly recommended that instructors provide a clear tutorial (lasting 30 minutes to an hour) beforehand on how to use the relevant Excel tools, especially wrap text, alignment of text, editing tools, formatting rows and columns, and sorting and filtering data. Instructors could also use alternative spreadsheets, such as Google Sheets, though these programs would also require an introductory tutorial.

A content-area research paper can be a very difficult assignment for students because it involves so many challenging steps: conducting a literature search, reading and summarizing academic literature, synthesizing that information, writing, and using citations. These challenges are compounded when students are new to an academic discipline and are not yet familiar with the scope of research or the academic jargon. In this course, the author met with students for six hours each week and was able to work with students purposefully on each step of the project, including the writing and editing of their papers. Other instructors may find it useful to have the final assignment be the research grid itself, accompanied by a brief summary of the key trends identified for that research topic. The focus of the assignment would thus be the literature search and academic synthesis. Additionally, the Excel research grid could be helpful as a database for graduate students or faculty to store key ideas about the literature they read. Overall, the Excel research grid is a useful way to synthesize academic literature and to teach students to do the same.

Acknowledgements

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References

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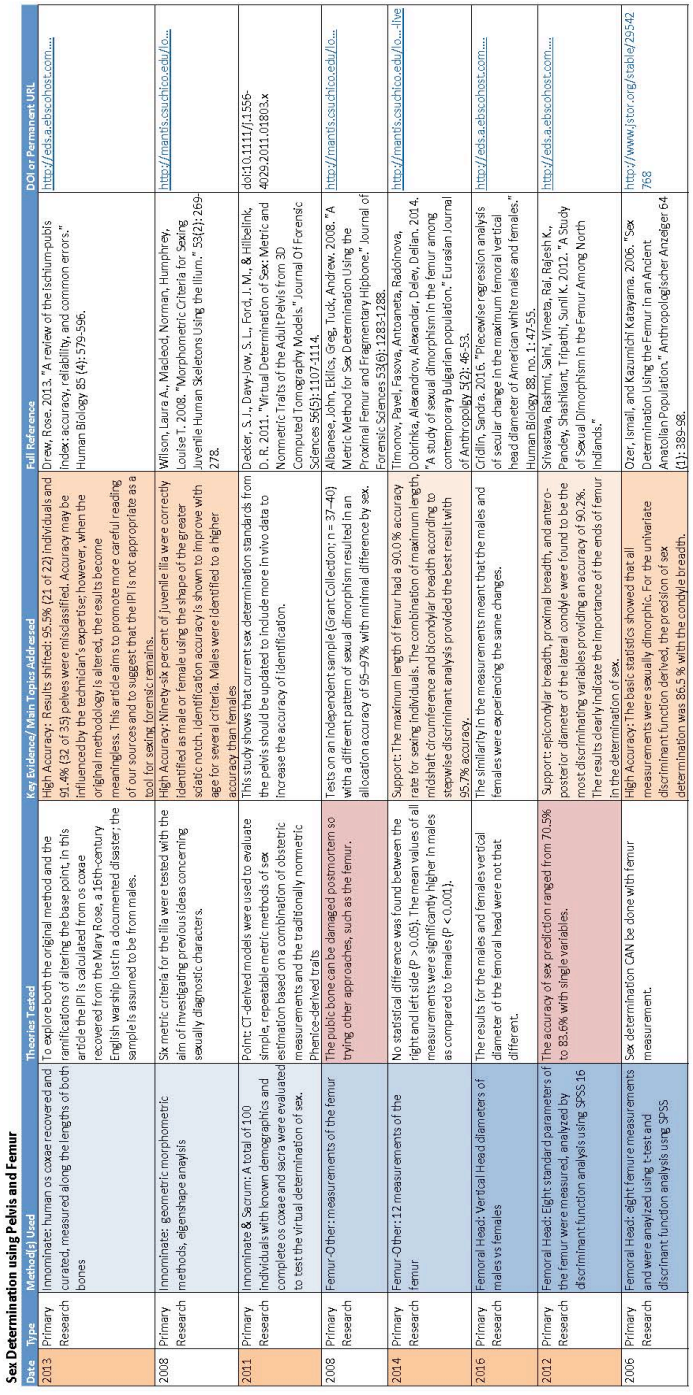
Howard, Rebecca Moore, Tricia Serviss, and Tanya K. Rodrigue. 2010. "Writing from Sources, Writing from Sentences." *Writing and Pedagogy* 2 (2): 177-192. doi:10.1558/wap.vi2.177

Plavén-Sigray, Pontus, Granville James Matheson, Björn Christian Schiffler, and William Hedley Thompson. 2017. "The readability of scientific texts is decreasing over time." *eLife* 6: e27725. doi:10.7554/eLife.27725

Appendix A: Example of a Student Research Grid



Sex Determination using Pelvis and Femur

Date	Type	Method(s) Used	Theories Tested	Key Evidence/ Main Topics Addressed	Full Reference	DOI or Permanent URL
2013	Primary Research	Innominate: human os coxae recovered and curated, measured along the lengths of both bones	To explore both the original method and the ramifications of altering the base point. In this article the IPI is calculated from os coxae recovered from the Mary Rose, a 16th-century English warship lost in a documented disaster; the sample is assumed to be from males.	High Accuracy: Results shifted: 95.5% (21 of 22) individuals and 91.4% (32 of 35) pelves were misclassified. Accuracy may be influenced by the technician's expertise; however, when the original methodology is altered, the results become meaningless. This article aims to promote more careful reading of our sources and to suggest that the IPI is not appropriate as a tool for sexing forensic remains.	Drew, Rose., 2013. "A review of the ischium-pubis index: accuracy, reliability, and common errors." Human Biology 85 (4): 579-596.	http://eds.a.ebscohost.com....
2008	Primary Research	Innominate: geometric morphometric methods, eigenshape anaylsis	Six metric criteria for the ilia were tested with the aim of investigating previous ideas concerning sexually diagnostic characters.	High Accuracy: Ninety-six percent of juvenile ilia were correctly identified as male or female using the shape of the greater sciatic notch. Identification accuracy is shown to improve with age for several criteria. Males were identified to a higher accuracy than females	Wilson, Laura A., Macleod, Norman, Humphrey, Louise T., 2008. "Morphometric Criteria for Sexing Juvenile Human Skeletons Using the Ilium." 53(2): 269-278.	http://mantis.csuchico.edu/lo...
2011	Primary Research	Innominate & Sacrum: A total of 100 individuals with known demographics and complete os coxae and sacra were evaluated to test the virtual determination of sex.	Point: CT-derived models were used to evaluate simple, repeatable metric methods of sex estimation based on a combination of obstetric measurements and the traditionally nonmetric Phenice-derived traits	This study shows that current sex determination standards from the pelvis should be updated to include more in vivo data to increase the accuracy of identification.	Decker, S. J., Davy-Jow, S. L., Ford, J. M., & Hilbelink, D. R. 2011. "Virtual Determination of Sex: Metric and Nonmetric Traits of the Adult Pelvis from 3D Computed Tomography Models." Journal Of Forensic Sciences 56(5): 1107-1114.	doi:10.1111/j.1556-4029.2011.01803.x
2008	Primary Research	Femur-Other: measurements of the femur	The public bone can be damaged postmortem so trying other approaches, such as the femur.	Tests on an independent sample (Grant Collection; n = 37–40) with a different pattern of sexual dimorphism resulted in an allocation accuracy of 95–97% with minimal difference by sex.	Albanese, John, Eklics, Greg, Tuck, Andrew, 2008. "A Metric Method for Sex Determination Using the Proximal Femur and Fragmentary Hipbone." Journal of Forensic Sciences 53(6): 1283-1288.	http://mantis.csuchico.edu/lo...
2014	Primary Research	Femur--Other: 12 measurements of the femur	No statistical difference was found between the right and left side ($P > 0.05$). The mean values of all measurements were significantly higher in males as compared to females ($P < 0.001$).	Support: The maximum length of femur had a 90.0% accuracy rate for sexing individuals. The combination of maximum length, midshaft circumference and bicondylar breadth according to stepwise discriminant analysis provided the best result with 95.7% accuracy.	Timonov, Pavel, Fasova, Antoaneta, Radóinova, Dobrinka, Alexandrov, Alexander, Delev, Delian, 2014. "A study of sexual dimorphism in the femur among contemporary Bulgarian population." Eurasian Journal of Anthropology 5(2): 46-53.	http://mantis.csuchico.edu/lo...=live
2016	Primary Research	Femoral Head: Vertical Head diameters of males vs females	The results for the males and females vertical diameter of the femoral head were not that different.	The similarity in the measurements meant that the males and females were experiencing the same changes.	Cridlin, Sandra, 2016. "Piecewise regression analysis of secular change in the maximum femoral vertical head diameter of American white males and females." Human Biology 88, no. 1: 47-55.	http://eds.a.ebscohost.com....
2012	Primary Research	Femoral Head: Eight standard parameters of the femur were measured, analyzed by discriminant function analysis using SPSS 16	The accuracy of sex prediction ranged from 70.5% to 83.6% with single variables.	Support: epicondylar breadth, proximal breadth, and antero-posterior diameter of the lateral condyle were found to be the most discriminating variables providing an accuracy of 90.2%. The results clearly indicate the importance of the ends of femur in the determination of sex.	Srivastava, Rashmi, Saini, Vineeta, Rai, Rajesh K., Pandey, Shashikant, Tripathi, Sunil K. 2012. "A Study of Sexual Dimorphism in the Femur Among North Indians."	http://eds.a.ebscohost.com....
2006	Primary Research	Femoral Head: eight femure measurements and were analyzed using t-test and discriminant function analysis using SPSS	Sex determination CAN be done with femur	High Accuracy: The basic statistics showed that all measurements were sexually dimorphic. For the univariate discriminant function derived, the precision of sex determination was 86.5 % with the condyle breadth.	Özer, Ismail, and Kazunichi Katayama. 2006. "Sex Determination Using the Femur in an Ancient Anatolian Population." Anthropologischer Anzeiger 64 (1): 389-98.	http://www.jstor.org/stable/29542768