

Additional Notes on Astragalus Bones

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Abstract

Experimental results demonstrate that astragalus dice scoring systems documented ethnographically for Native California almost invariably assign higher scores to less probable outcomes of rolls of the dice.

In many parts of the world and extending deep into antiquity, astragalus bones of cervids (e.g., deer and elk) and bovids (e.g., bison, sheep, and goats) were used in activities that embraced the concept of randomness, specifically as dice for gambling as well as non-gambling games, and as divinatory ritual objects appropriate to the needs of seers, soothsayers, and clairvoyants. Such applications followed from the fact that these hind foot bones have four distinct sides (Figure 1) and are easily made to roll on planar surfaces.

A recent publication (Koerper 2007) provides some quick information on the adaptation of astragali to a variety of play behavior, mostly in Native California. Much of the article was given to discussion of several versions of one kind of gambling game in which Pomo and Wappo bettors (Figure 2) rolled a single astragalus as a die (a.k.a. hucklebone, knucklebone) (Hudson n.d.; Loeb 1926:215; Barrett 1952a:230, Plate 16, 1952b:344-345; Driver 1939:193). The great majority of this gambling involved a deer astragalus, but Barrett (1952b:345) also mentioned employment of an elk astragalus.

Each of the four documented Pomo versions (Figure 1) has a schedule of point assignments differing from

that of the others. Scoring for the Wappo game (Figure 1) is identical to that of the Pomo die play discussed in Loeb (1926:215). An immediate impression from comparison of the point scores to the anatomy of the bone is that outcome point scores perhaps occur more or less in inverse relationship to outcome probabilities. In other words, generally the higher scored die positions seem to be the less probable outcomes.

Any formal attempt to investigate the probability issue by throwing astragali experimentally should necessarily consider that historically each of the games under discussion had been contested on loose dirt and/or sand surfaces. Consequently, in addition to the four scored side outcomes (Figure 1 - A, B, C, and D), Pomo and Wappo gamblers assigned points for two other events, a die coming to rest with either the narrow end pointed up or the wide end pointed up (Figure 1 - E and F, respectively). Parenthetically, there is evidence that such gambling was sometimes played on animal hides (Koerper and Whitney-Desautels 1999:71, Fig. 2; Koerper 2007:5), a circumstance for which E and F outcomes (see Figure 1) would presumably either not occur or be extremely rare. Another point of interest is Driver's (1937:125) report of a Yokuts' version played with two astragali where points were awarded only in the event of one die (1 point) or both dice (2 points) coming to rest with one or the other end standing up.

Hardness/softness and topography of dirt and/or sand playing surfaces are variables never described in the ethnographic literature. A significant range of

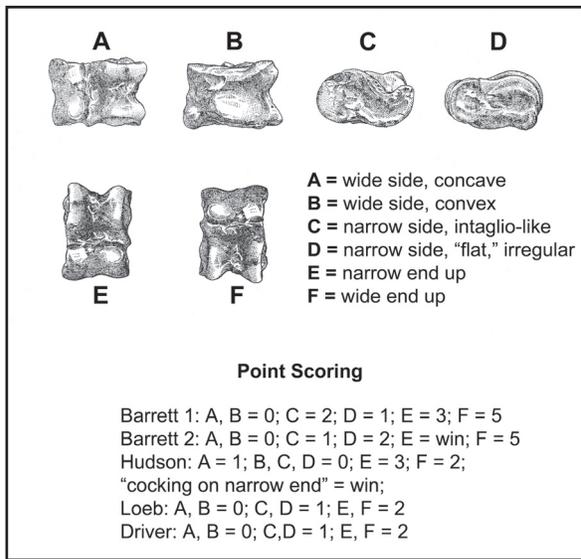


Figure 1. Point scoring for gambling games employing an astragalus. "Barrett 1," "Barrett 2," "Loeb," and "Hudson" refer to Pomo play; "Driver" refers to Wappo play.



Figure 2. Location map for Pomo and Wappo linguistic tribes.

conditions might have characterized these landing fields and therefore I opted for a simplified experiment that would generate outcomes for the four sides of an astragalus while precluding the possibility of dice coming to rest with either end oriented skyward. The goal was to derive only the broadest handle regarding these four outcome probabilities that might have occurred under aboriginal conditions. To accomplish this objective, dice were cast upon a well-worn, relatively flat Berber carpet.

Observations were first recorded for each throw of five dice at a time, 228 episodes (N=1,140). More recently, the experiment was replicated using a different set of five astragali, with the results little changed. The combined observations from the two experiments (N=2,280) demonstrate the combined wide sides to combined narrow sides ratio is very close to 3:1 (Table 1). The A to B to C to D ratio is not too far off 3:3:1:1. Comparing the probability data (Table 1) against the scoring schedules (Figure 1), and factoring in the reasonable assumption that E and F outcomes on dirt playing fields would have been relatively infrequent, one sees that in general terms there are concordances, albeit imperfect, of scores and probabilities, with one outlier (the Hudson scoring version (see Figure 1), for which there is significantly less agreement.

A bit less than a decade ago, a previous article in this journal (Koerper and Whitney-Desautels 1999) provided an abridged record of astragalus use in Native California while at the same time providing a cautionary tale. To wit, artifactual astragali had received but spare mention in site reports from coastal southern California, and it was suspected that among those specimens sorted into ecofactual sample collections, some had actually functioned as game dice, divination pieces, or amulets. The study described foot bones with evidence of use wear as might accumulate had the astragali been rolled over a surface or had turned about in, say, a medicine bag.

Table 1. Probability table.

Side	Outcome	Percent
A	883	38.7
B	836	36.7
C	299	13.1
D	262	11.5

Notes: Results based on 10 deer astragalus dice, each cast 228 times (N = 2,280) over a well-worn, relatively flat, Berber carpet. The topography of the landing surface did not permit any die to come to rest with either of its ends standing.

One purpose of that article (Koerper and Whitney-Desautels 1999) was to pique greater interest in astragalus finds, a strategy anticipated to motivate field and laboratory workers to track these bones, at least tentatively, into the artifact category for more considered examinations. Beyond satisfying a curiosity of mind regarding the probability and concordance questions, these present efforts were likewise undertaken to elevate the profile of the astragalus, in another attempt to force greater analytical scrutiny of archaeologically recovered specimens.

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