Name_____*KEY*_____

CS 184 * Modeling the Evolution of Cognition

Bioanthropology Site Visit Worksheet

SKELETONS: Examine the differences between a human and a nonhuman primate (in this case, chimp) skeleton

- How long is a human's big toe? *Not just the 1-2 inches you see from the outside, but 5-7 inches!*
- Is it longer or shorter than the human thumb? *Longer* - … a chimpanzee's thumb? *Longer*
- …than a chimp's toe? *May be absolutely shorter, but relatively longer compared to other toes*

- What differences do you see in . . .
  - Hands.

Fingers become shorter, straighter, more gracile
Palm shorter, less ridged, (Hominids NOT knucklewalkers, so need not support weight on hands)
Tho note: ALL primates have opposable thumbs on the hands on their forelimbs.

  - Spine & Foramen Magnum.

NHP spine arched curved, can include (in apes) large phalanges to attach heavy back, arm muscles
Human spine more "S" shaped, helps position weight over pelvis
Also, the spine enters (underside of) skull at Foramen Magnum which is positioned more to the rear of skull in apes and more toward the center in humans (and was already more central in Ardi!)

  - Heel.

NHP heel bone juts directly behind, parallel with ground
Human, heel bone points slightly down, forming an ARCH, making the human foot a more stable support for body weight

  - Toes

Since Australopithecus, big toe aligned with other toes (and encased in flesh)
For bipedal walking vs tree climbing

  - Pelvic bone.

NHP is long and flat, designed to attach large thigh muscles for climbing trees
Human is broad, shortened, bowled. Designed to attach gluteus muscles to help hold body upright, & humans (Hominids, since Lucy) no longer have huge thigh muscles

  - Knee.

NHP legs bowed, upper thigh (femur) bone does not sit directly on lower calf (tibia) bone
Human femur and tibia aligned, tibia has broad lat surface for femur to sit on - to support weight.

  - Compare the relationship between the pelvis and the femur (thigh bone)

Nonhuman primate femurs attach to the sides of its pelvis
In bipedal hominids, pelvis sits directly over femurs, so whole body weight rests on legs

Briefly describe a cognitive implication of the evolutionary changes in the . . .

  - Shoulder

Enables all primates to swing hands in front of face, promotes hand-eye-mouth coordination with all its implications for the development of tool use, mirror system development, etc.

  - Hand

More gracile hands can make more refined movements and, especially mediated by vision, can more subtly manipulate objects (e.g. for tool construction and use, as well as subtlties of communication).

  - Pelvis

Upright, bipedal posture frees hands from locomotion, allow for more carrying, using objects
Also narrows birth canal, causing mothers to die attempting to give birth to large-headed offspring
One adaptation to this: Produce more physically altricial (less well developed) infants, which are more dependent on others, and since motorically retarded, compensate by being more socially precocial

SKULLS: Compare the skulls of humans, contemporary primates, and our hominid ancestors . . .

- Which species/groups have "sagittal crests"?
  Some nonhuman primate species and a few early hominids (e.g. Australopithecus aeithiops)

- What are they for? Why might it be that WE don't have them?
  Attaching major jaw muscles, that allow high-power crushing (e.g. for nuts, other hard foods).
  Hominids shifted to using tools to do the hard work, soneed not depend on jaw strength
  Also sexually-selected in some species >> larger in males (e.g. sagittal crest in dom male gorilla)
  Not available to be exapted in this way in Homo

- What is the most striking difference in the teeth of the hominids compared to the other primates?
  Missing canines! (Much reduced in Ardi, virtually gone in Lucy)

- Why might this change have taken place?
  A tough one! Change in diet?? Change in food processing? (But remember, lost well before stone tools or fire!)
  Change in sexual selection (i.e. Australopithecus did not show common sexual dimorphism seen in many primates, where males were larger - suggests possibly monogamous???) ???

- How does the shape of the face (especially brow, jaw, chin) change across the hominid skulls?
  Overall, face flattens. Early hominids show more pronounced brow ridge, relatively heavier jaw, and little or no chin (even through H. neanderthalensis). As tools (and control of fire) take over more and more of the work of food processing, face (esp parts for eating) becomes less robust. Chin serves in part to anchor reorganized mouth muscles, specialized more for speech (rather than power-jaw & big teeth for feeding)

- Can you detect a change in the frontal pole? From which species to which?
  Difficult to see in skulls. Frontal pole (most anterior part of frontal lobe) clearly pinched in chimpanzee brain, and likely in Ardipithecus spp and Australopithecus afarensis ("Lucy"). But, by end of Australopithecine era, frontal pole filled out in Australopithecus africanus (e.g. "Taung Child" ~2.6 MYA).
  Note "Taung child" was found in association with eagle's next, hole in skull, probably prey to eagle.
  In humans, frontal pole is implicated in analogies & other tasks requiring considering multiple realities at once.

- What brain/skull features distinguish *Homo sapiens* from *Homo neanderthalensis*
  Neanderthal brain case is larger than human. In particular, occipital bun at rear of brain represents at least 1000cc of brain not found in humans. Not clear what function this may serve – possibly an elaboration of visual cortex (found in all primate occipital lobes) or perhaps some other structure causing displacement of occipital bun.

- Describe the size, shape & placement of the hyoid bone.
  It is a thin horseshoe-shaped bone that hangs in neck as an attachment point for various throat & mouth muscles. Since it is not articulated with any other bone, it is impossible to determine its position in life from the fossil record (since soft tissue – i.e. musculature - does not fossilize). But, there may also be slight shape/size changes, which researchers note since, in our species, this bone plays a critical role in the operation of articulate speech.

- List the 6 key hominid species we focus on, in the order of brain/skull size. Include estimated brain size in cc's.

Ardipithecus ramidus	*360cc*
Australopithecus afarensis	*400cc*
Homo habilis	*660cc*
Homo erectus	*950cc*
Homo neandertahlensis	*1400cc*
Homo sapiens	*1300cc*

Name KEY

TOOLS **Handle** these hominid stone tools, and imagine how you might **use** them out on the savannah . . .

- List an associated species and time (in MYA), and breifly describe key features of the stones, their manufacture, and use

- Oldowan *Homo habilis* *~2.5 - 1.7 MYA* *Cracked stones with one or more sharp edge*
  Probably mainly for vegetation, but also scavenging prey (e.g. scrape, break bones for marrow)

- Acheulean *Homo erectus* *~1.6 - 0.10 MYA* *Bifacial hand axe, disc, etc (Includes symmetry)*
  Impose predetermined shape onto stone; requires significant time & thus provisioning by others
  Some used on vegetation (digging, break roots, shells etc.) . Some for hunting (e.g. throw discoid)
  and otherwise processing prey (e.g. scrape hides for clothing, building materials)

- Mousterian *Homo neanderthalensis* *~0.2 - 0.03* *Includes refined blades, some hafted into spears*
  Requires collecting different materials from different sources (e.g. handle, blade, sinew) & hierarchically organizing them into functional, long-distance weapons. *(See also Levallois Method, below)*
  Hunting large game, as well as processing other foods as above

- Upper Paleolithic *Homo sapiens* *~0.15 –Present* *More refined & variable. Many more shapes for specific functions,*
  Made from much wider variety of materiasl, and require more variable construction techniques
  Include clear individual diffs such as artwork, "branding". *Many specialized uses.*

- Contemporary *Homo sapiens* *Today* *As above, but note now many tools **made by** other tools (e.g. by machines)!*

- What is the "Levallois Method", which species practiced it, and what might be its cognitive implications ?
  Seen in Homo neanderthalensis and Homo sapiens. Requires preparing the core. That is, original stone ("core") is worked with one type of tool to create the pieces which will then be further worked on by other tools to create refined blades, etc. So, more cognitively demanding (e.g. planning, sub-sub-goal structure) since requires a multi-stage process, with different tools for different stages.

- List some possible cognitive implications for each transition from one culture to the next . . .

- Perishable to Oldowan
  Indicates a likely dependence on tool use (especially as change in teeth also support). Shift from hand-mediated interaction, to hand-made object-mediated interaction. Also, location of tool supplies possibly different from location used, so indicates some planning ahead.

- Oldowan to Acheulian
  Acheulian developments suggest specific shapes anticipated, brought about, so more elaborate planning.
  More time-consuming to make, more different sorts of handling, knapping required, so more complex procedure
  Also requires some cultural provisioning, and promotes cultural (food) sharing through multiple food collection (hunt/gather) techniques practiced by various individuals/roles.
  Since require costly time, probably re-used, cached, carried. Caching requires good spatial memory and possibly a concern with prevention of theft. Carrying may require active inhibition of use until later, anticipated time.
  Also, more likely to depend on improved imitation skills and perhaps teaching.

- Acheulian to Mousterian
  Hafted tools require multi-tasking, in that different components of tools are collected in different places at diff times.
  Making requires hierarchical sub-assembly (prepare blade, handle, binding, designed to fit together & combine)
  Such combinatorics probably likewise observed in mimetic narrative & eventually speech (e.g. phonemes, morphemes, syntactial rules for building embedded sentences, etc) *(Mouth to hand? Hand to Mouth? Both??)*

- Mousterian to Upper Paleo
  Explosion of types, functions indicates greater flexibility, imagination, adaptability & refined motor control.
  May reflect greater specialization of makers/users within culture, including established mentor/apprenticeships
  Possibly influenced by/coevolve with finer articulation of hands >> articulation of seeing (parsing the world) >> articulation of speech production to direct (esp) learner's attention to details, functional features.