Psychology 429: The Development of the Social Brain
Weekly Assignment

Part A: Summary Section

Article: Dunbar, R. I. M. (1992). Neocortex size as a constraint on group size in primates. *Journal of Human Evolution*, *22*(6), 469–493.

1) Review of the main points of the paper (2-3 sentences): Two theories (social vs. ecological intelligence) are tested to determine which explains the evolution of greater cognitive abilities among primates, which is thought to be associated with larger primate brain sizes. The social intelligence hypothesis suggests that primates developed larger brains and greater cognitive abilities due to the complex nature of the social interactions between conspecifics while ecological theories suggest that primates have evolved larger brains and greater cognitive abilities because of the cognitive demand required to a) locate and monitor fruit food resources in their range area (ecological hypotheses) and b) extract such food resources in their ecological niche (extractive foraging hypothesis). Using comparative data of neocortex volume and several social and ecological indices, (e.g. group size, the proportion of fruit in the diet, range area size and extractive foraging classification), results suggested that neocortex volume was correlated with group size but not with range size, diet proportion, or extractive foraging classification, providing support for the social intelligence theory.

2) Two strengths of the research (and explain why):
a) I liked how the author mentioned the maternal metabolic constraint hypothesis and gave detailed explanations as to why it was not relevant to test this hypothesis in his investigation. This helped clarify that he was investigating *why* natural selection selected for primates to evolve greater cognitive abilities associated with larger brain sizes as opposed to *how* primates are able to develop large brains.
b) I liked how Dunbar explained why he classified some species as extractive foragers (e.g. marmosets) and not others (e.g. tamarins) because it eliminated some of the ambiguity that was present with Gibson's (1986) definition of extractive foraging (e.g. what exactly is an embedded resource?). It also drove home the idea of how extractive foraging could be used as an index of higher cognitive functioning by outlining the differences in the cognitive demands required between extractive foraging (e.g. hunting) and other forms of foraging (e.g. scavenging).

3) Two weaknesses of the research (and explain why):
a) Based on what is known about the integrative function of cognition, I don't feel there should be such a distinction between social and ecological demands in brain processing. It seemed that the article started on the premise that only one of the three hypotheses best predicts differences in brain size rather than an alternative hypothesis that they co-exist and maybe influenced different brain structures in different ways that was not captured when looking at the entire neocortex volume. It may be that there cannot be a useful social interaction without challenges posed by the environment that in turn might be constrained by working memory capacity.
b) Dunbar focused only on primates but it is my impression that there are other taxa that are highly social that may or may not have a large neocortex volume compared to the rest of the brain. For example, sea and river otters, or Dolphins have rather complicated social networks that may be adaptations to the environment (i.e. how to drive fish into a ball for easier consumption, or coordinating who is attacking where) and I felt more discussion of environmental pressures on social coordination was needed.

4) One quiz question that you might pose to your classmates with the correct answer:
According to Dunbar, there are 3 possible causes of information overload in primates. What are they? 1) The quantity of individuals that an animal must know and maintain a relationship with. 2) The animal's need to interpret information about its own relationships, as well as the relationships between other members within its group. 3) The nature/structure of the relationships themselves, rather than the number of members in the group.

5) One research question to pursue in the future (and explain why):
Is there significant variance in the neocortical size of individuals within a social group? And if so, is this variance significantly related to the individual's social ranking within the group? Answering this may help researchers further understand the underlying processes that dictate the formation of social hierarchies, such as why certain individuals are able to secure social dominance over others.

Article: Humphrey, N. K. (1976). The social function of intellect. In P.P.G. Bateson & R.A. Hinde (Eds.), *Growing points in ethology* (pp. 303-317). Cambridge: Cambridge University Press.

Question 1: What could be a possible lab test of social skill that Humphrey says is needed as a test of high-level cognition?

Question 2: Humphrey suggests that the "key role of creative intelligence to hold society together" (Humphrey, 1976, p. 306). If social intelligence involves being able to resolve social conflicts and share scare resources then is social intelligence a subset of creative intelligence? Or are they independent concepts that go hand-in-hand with each other?

Question 3: The forward planning required in a social interaction is described by using the decisional tree analogy. Do primates consider every possibility (i.e. tree branch) within this decisional tree when partaking in forward planning? Is this process serial or parallel? What kind of implications could serial or parallel neural processing have on the evolution of cognitive abilities in primates?

Baron-Cohen, S. (1995). Chapters 1-3. Mindblindness: An essay on autism and theory of mind. MIT Press.

Question 1: Is mind reading a categorical trait in that you have it or you don't (such as in cases of mindblindness or severe autism) or is it more continuous? Can some people be better mindreaders than others?

Question 2: What factors influence mindreading? Does mood affect the ability to mind read? Perhaps you can mind read better when you are happy or angry then when you are sad? Is it a limited resource (such as self control or regulation) or do we have endless ability to mindread?

Question 3: Are there any downsides to our mindreading ability? Are there situations where this ability may not be beneficial?

Question 4: Baron-Cohen refers to individuals, such as those with autism, that have a deficit in mindreading. Are there individuals that have exceptional mindreading abilities? If so, how might studying them further our understanding of mindreading and the social brain?

Article: Dunbar, R. I. (1992). Neocortex size as a constraint on group size in primates. Journal of Human Evolution, 22(6), 469-493

Question 1: Why was the correlation between body size and "absolute range area" and "absolute length of journey" removed from the analysis of the ecological hypothesis test?

Question 2: Given the partial correlations found for some aspects of the ecological model, could other kinds of tests or analyses be performed, or different types of data be collected that may lead to a significant relationship between brain size and ecological functions?

Question 3: How has past research regarding the ecological hypothesis one sided? What caused these experiments to be one sided? What is meant but "one-sided" in this context?

Question 4: why was the hippocampus not used as a determining factor given its ties to spatial information and spatial memory?

OTHER GOOD EXAMPLES:

1) Review of the main points of the paper (2-3 sentences):
Dunbar analyzed factors such as group size, neocortex volume and behavioural ecology variables like degree of folivory or home-range size in order to compare and contrast the social and ecological hypotheses regarding neocortex size as a constraint on group size in primates. He asserts that information overload in primates is derived from the structure of their social relationships and that there is a limit on the amount of relationships an individual can successfully facilitate. Following his analysis, Dunbar concludes that despite an initial ecological increase in neocortex size of primates, brain size evolved as a result of the socially demanding nature of their lives; thus, favouring the social intellect hypothesis over the ecological hypothesis.

2) Two things that you liked about the article (and explain why):
a) I liked that Dunbar critiqued the Encephalisation Quotient (EQ). Dunbar stated that the EQ is commonly used to measure brain size, but this isn't a good way to measure it. As Dunbar pointed out, the selection pressures on our brain and body differ; hence, the two systems evolve at different rates. Therefore using body weight as a baseline to graph brain size on isn't very accurate. Dunbar even pointed out that primates, even within a species, differ in their body size more than brain size. This was important, since it showed the Encephalisation Quotient (EQ) may not be a dependable way to measure brain size.
b) Dunbar also included an explanation of why nocturnal prosimians, monogamous anthropoids, and gorillas were excluded from the analysis. The data was not just thrown out in order to make his study look better, but instead Dunbar argued why those three were outliars.

2) Two things that you liked about the article (and explain why):
a) I liked the use of both the social intellect and ecological hypothesis in relation to each other. Previous studies considered them separately which led to the problem of being unable to test the other when one was supported. Also, there has been confusion over distinction between how the brain could impose restrictions on the size of the group over developmental time and how social and ecological factors could have selected for larger brains over evolutionary time. Here these problems are clarified and attempts are made to create a study that tests multiple theories at the same time.
b) I liked how the neocortex relative to the rest of the brain was determined to be the best indicator of brain size. By considering only parts of the brain to be relevant, unlike previous studies, it is argued to be a more appropriate measure. Also, the neocortex is the newest part of the brain, thus it is more likely to account for differences between species. This explanation led to a clearer reason as to why the neocortex was used as a measure of brain size and motivated the use of it as a measure in this study.

2) Two things that you liked about the article (and explain why):
a) I liked how the article took into account all possible ways of characterizing the differences in neocortical size before any conclusions were made based on the results. This distinction between neocortex volume, relative neocortex volume, and neocortex ratio allows for a clear and precise predictor for Dunbar's variables. The variables are analyzed more appropriately for what Dunbar is interested in determining, which is an accurate comparative analyses based on species-by-species inspection.