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I. Introduction

In this substantive work, Denham presents quantitative data on approximately 200 hours of observational research on infant and child carrying among the Alyawarra of Australia. His aim was to "demonstrate ways in which observational data collected with a hunter-gatherer society almost half a century ago can contribute to an understanding of our species". He does just this. While his data, at first sight, may appear to be out of date (being collected from 1971-1972), that interpretation would be misguided. These are valuable and timely data, given the current climate of research on cooperative care matrices and their significance for understanding the evolution of human behavior and reproduction. Denham's data represents thoughtful and detailed ethnographic and behavioral data collection.

In this analysis, Denham describes age- and sex-related patterns in carrying behavior as well as relationships between infant-child and consanguineal members of the group. We applaud his usage of consanguines, which asserts the importance of blood relations and provides a comparable dataset for future research with analogous kin in other societies. He analyzed the following four categories of child-rearing practices proposed by Ewer (1968) - carrying, caching, following, and nesting - but clarified that no single one "accurately characterized the Alyawarra", so he chose to focus, instead, specifically on caching, clinging and carrying (p. 42). He states that, "continuous carrying in any form was not common among the Alyawarra as has been reported among the !Kung San (Barr et al. 1991) and perhaps others"(p. 43). Denham found that the most common form of carrying among children was hip carrying, in which a child rested on a carrier's hip while being supported by the carrier's hands. Clinging, where a child is held on a carrier's back or shoulders, began around age 2. He compares this to nonhuman primate behavior, where infants cling onto their mother shortly after birth, and implicitly contrasts this with the inherently altricial state of newborn humans that are incapable of performing such actions until about age 2. Unfortunately, Denham could not report on the link between mothers' holding of infants and their breastfeeding of them. By observing from a single fixed vantage point, he was unable to see and systematically record breastfeeding. Although he states that there were few observations of ventral-ventral *carrying* (i.e. an infant being held closely to a carrier's chest), he briefly states that children and mothers exhibited ventral-ventral *holding*. This form of contact should be expected

and is seen frequently among natural fertility societies as it facilitates on-demand nursing. Among the Aka foragers of the Central African Republic, for example, mothers provided continuous skin-to-skin contact, allowing infants to nurse on demand (Meehan 2005), and routinely placed infants on the lap or in a sling, allowing mothers to immediately respond to crying or fussing infants and breastfeed them while foraging. Denham reports that young Alywarra girls often carry children. As girls age through adolescence, they carry children and infants more than boys of the same age and this suggests that girls "may be in training for motherhood" (p. 51). Similar patterns are seen among the Hadza, Aka, and elsewhere (Konner 2005, 2010; Kramer 2005, 2011). Crittenden and Marlowe (2008) note that the time spent practicing care for other children may have implications for one's future reproductive success, as they may benefit from learning and applying these practices when they have their own children. Related and unrelated juvenile helpers also have implications for a mother's pace of reproduction. Juveniles may lower energetic costs to mothers by providing assistance in foraging, obtaining small game, and assisting in childcare. Through their economic contributions via helping behaviors in juveniles, mothers can direct their energy towards reproduction (Kramer 2005).

Denham appears to favor models based on kin selection, the "genetic basis for mutual aid and allomothering" (p. 34), in which genetically related individuals invest in each other thereby increasing their own inclusive fitness. Available data suggests that cross-culturally, while infants and toddlers are cared for by a wide range of caregivers, related caregivers invest more heavily (Crittenden & Marlowe 2008). Data on patterns of cooperative care among the Aka show high investment from both paternal and maternal kin (Meehan 2005).The bias towards carrying and holding related children makes kin selection an appropriate model in which to situate alloparental patterns of investment. Further, Denham focuses on matrimoieties rather than patrimoieties, emphasizing a distinctly "female perspective" on Alyawarra kinship, which we praise. Kinship, residence patterns, and age of caregivers are all quite important factors with regard to patterns of allomaternal care. Denham's detailed kinship genealogies add to the significance of his findings.

Denham's observations are worthy of careful evaluation. However, by focusing exclusively on the carrying of infants and children among the Alyawarra, he does not situate his data within a larger comparative framework. We turn to these limitations now. First, while Denham attempts to mirror Hrdy's interpretations and makes an "ecological argument concerning alloparenting" (p. 18), he does not explicitly analyze Alyawarra subsistence strategy or dietary composition in detail (but see Denham 2014 and O'Connell and Hawkes 1984). After making the compelling statement that the Alyawarra "were locally nomadic but were not seasonally migratory" (p. 18), which suggests a mixed subsistence regime, some readers may wonder what this means. Subsistence patterns are quite relevant because the economy of any population has direct implications for percentage of time that a mother 'works', engages in 'leisure' activities, etc. These behaviors, in turn, relate to how much assistance a mother might need in the rearing of her

offspring and the demographic composition of the available helpers. Secondly, a number of researchers have looked at rates of infant holding as a form of allomaternal investment. It would have been helpful to see a systematic comparison of Alyawarra data on carrying with previously published data on holding. For example, Crittenden and Marlowe (2008) looked at allomaternal care among the Hadza of Tanzania using holding as a measure of direct care. Among the Hadza, mothers are the primary caregivers and tend to hold infants most often, followed by fathers and other related individuals. This may represent a common pattern among some sub-tropical hunter-gatherers (Konner 2005), but is strikingly different from Denham's data (p.58) which show that Alyawarra mothers provided only 2.85%, and fathers only 0.28%, of all carries of infants and children. Thirdly, while Denham notes that "sexual segregation and division of labor were overlapping factors that had major implications for the carrying of infants and children" (p. 21), he does not provide detailed data of this kind. His general description of the sexual division of labor among the Alyawarra (pp.21-23) would have been stronger if his research design had yielded data on time allocation patterns and foraging decisions. For example, the paper suggests that women sometimes hunted. If women were unable to take breastfeeding infants along on hunting trips, this would necessitate greater allomaternal assistance.

Despite these limitations, Denham has provided a rich analysis that certainly moves the field of distributed childcare forward. Now we would like to specifically address how his data contributes to the cooperative breeding literature and models of multiple attachment.

II. Cooperative Breeding

A brief scan of the current literature on evolutionary models of human behavior will demonstrate the proliferation of articles referencing the theoretical framework of cooperative breeding and/or distributed care. Cooperative breeding, as conceptualized by Sarah Hrdy (2009), is premised on the large number of calories needed to raise a human child from birth to self-sufficiency and the subsequent cultural and biological adaptations that occurred throughout human evolutionary history. Within this framework, to supplement the large number of calories needed, children receive both direct and indirect care (child care, nutritional support, household labor, etc) from alternative caregivers (Sear & Mace 2008; Hill & Hurtado 2009; Hawkes et al. 1989). This implies that some individuals may be temporarily foregoing reproduction to aid in the care and provisioning of the offspring of others, leading to an environment of both cooperation AND competition - neither being exclusive from the other - a duality Denham struggles to reconcile throughout his article, although perhaps unnecessarily. These exchanges are enacted within a complex web of relations related to ecology, systems of inheritance and residence, and individual trade-offs in energy allocation; patterns which have been extensively discussed and explored by many researchers (i.e.: Low 2008; Mace 2013; Scelza & Bird 2008; Snopkowski & Sear 2015).

Denham inventories three types of support needed for an ecological argument for a given society to beneficially adopt a cooperative breeding social structure, including "slow life histories…occupying the same area year round (i.e., non-migratory)…and living under harsh conditions" that create "special environmental challenges" in weather and food availability (p. 18). Humans are, in general, characterized by relatively slow life histories (as compared to other non-human primates); however, these trends fluctuate with relative life expectancy, age at menarche/adrenarche, interbirth interval, and nutritional status. General trends show that human life history characteristics tend to fluctuate with reference to the given environment; riskier environments characterized by low food availability and high child mortality resulting in a relatively faster life history profile and children in these environments disproportionately benefiting from the increased resource availability associated with the presence of additional care givers. While Denham was quite thorough in his description of many of these factors relevant to the development of a slow life history, and thus the benefit of adopting a cooperative breeding social structure, he leaves the connections implicit rather than making them explicit in reference to the Alyawarra. An extension of these relevant factors would greatly strengthen any argument concerning social and childcare structures. Returning to Denham's original claim, the second argument emphasizes the importance of living in the same area throughout the year. His definition may be slightly misleading. Perhaps, a better explanation is one that is more obviously inclusive of alternative settlement trends such as central place foraging, also known as central place provisioning (Marlowe 2006). These locations are repeatedly established with the movement of the group, based on resource availability (Bird & Bird 1997). This strategy does not fully restrict individuals from being mobile, but rather reduces mobility to changing ecological parameters, a description which is much more inclusive of populations frequently cited in the relevant literature such as the Aka of the Central African Republic (Meehan et al. 2013) or the Hadza of Tanzania (Marlowe 2010). In reference to his inclusion of ecological factors, however, we very much enjoyed seeing a detailed description of the ecology of the Alyawarra including disease burdens, food availability, climate, and Denham's related admission that these behaviors may seasonally vary.

We commend Denham's choice to highlight the importance of "alloparental" care, a term which itself is not sex specific. Although Alyawarra fathers almost never carry their own infants and children, we would have appreciated an inclusivity of paternal kin in the discussion of potential care givers rather than restricting relevant categories to "children's older siblings, mother's mother and more distantly related or unrelated others" (p. 5). While there is, indeed, ample cross-cultural research highlighting the impacts of siblings and maternal kin, there is also a rather robust literature on the positive impact of fathers and paternal kin (Gray & Anderson 2010; Gray & Crittenden 2914; Kramer 2010). Denham cites Hrdy's definition of a cooperatively breeding species as "any species with alloparental assistance in both the care and provisioning of young" (2009:30) a definition which is broad in its classification of potential care givers and more closely reflects the

critical role of both fathers and paternal kin in many small scale societies including many sub-tropical extant foraging populations which are characterized by dual inheritance patterns. While Denham briefly discusses the role of patrilineal descent and paternity certainty (pp. 33, 58-59), these issues are neither drawn out nor discussed within the context of impacting care patterns and resource availability. The feat undertaken by Denham to conceptualize his relatively distant fieldwork within a contemporary cooperative breeding model, however, is admirable.

III. Multiple Attachment

We were delighted to see Denham address the paradigm shift in the attachment literature, both in Anthropology and Psychology, away from models of monotropic attachment (i.e. mother-centered) to models that highlight the evolutionary and cross-cultural significance of multiple attachment relationships (Crittenden & Marlowe 2013; Meehan & Hawkes 2014). Currently, most analyses of attachment are conducted in laboratory environments among WEIRD (Western, Educated, Industrialized, Rich, and Democratic) (Henrich et al. 2010) populations. Here, Denham has offered a naturalistic data set from a mixed subsistence foraging population, adding to the burgeoning literature on the subject. Naturalistic observations allow us to further explore themes associated with attachment, childhood development, and relationship security (Meehan & Hawks 2013). Small-scale foraging population data add to the literature by emphasizing attachment as both biologically based and culturally influenced (Crittenden & Marlowe 2013). Although Denham offers a naturalistic data set that furthers cross-cultural comparisons, he does not reference attachment data from other foraging populations which would act to strengthen his own argument. While great emphasis is placed on behavioral observations and scan sampling data, Denham does not provide any qualified details concerning the purpose and/or motive of the caregivers beyond an assumption-based framework. As Denham clarifies in this article, "nothing of value concerning the motives, purposes, and actions of people who might have engaged in more specialized activities of cooperative breeding" can be explicitly implied (p. 85). This is due in part to the large gap in time between collection of his data and subsequent date of publication. We join Denham in calling for future research directed towards an integrated and holistic approach encompassing attachment theory and biological altruism, specifically in regard to allomaternal care and its potential influence on models of multiple attachment.

IV. Conclusion

We are struck with the richness of observations and the thoughtfulness of data interpretation provided by Denham throughout this paper. While it would have benefitted from a more integrated analysis and comparison with other relevant work among foragers, we feel that his contribution to the alloparenting literature will further inform our understanding of cooperative care. Although his data did not reach any novel conclusions concerning the cooperative breeding hypothesis, he certainly contributed valuable data on naturalistic observations of infant carrying

and childcare patterns among mixed subsistence foragers. We commend the fact that the raw data can be found online and utilized by other researchers (p. 16). Due to his usage of consanguineal kin, the data will be comparable to analogous kin relations in other populations and other species, which can only act to further our understanding of the wide network of care available to infants in small scale societies. Additionally, his acknowledgement of the paradigm shift from models of mother-centered attachment to multiple-attachment is critical. The reader is left, however, wanting additional information, such as a contextualized and detailed description of the ecology and subsistence regime of the Alyawarra. A true appreciation of the significant impact of allomaternal assistance would require a discussion of the daily foraging activities and subsequent needs of the recipient mother. This would not only further enhance our understanding of the constraints faced by Alyawarra mothers, but also inform our understanding of the actions of the alloparents and patterns of investment. Additionally, inclusion of activities related to childcare by paternal kin should be addressed to create a full profile of Alyawarra infant carrying. We remain hopeful that Denham might have data to contribute to this topic in the future. We are sympathetic, however, to the temporal constraints facing Denham in regard to when he collected his data as well as the restrictions and benefits posed by his choice of data collection methodology. Denham has clearly contributed rich and meaningful data to the allomaternal care literature and addressed a lacuna in the attachment literature. We hope that his detailed and robust naturalistic data will act as a call to arms for more researchers to incorporate behavioral observations into their assessment of cooperative breeding.

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