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The Bioarchaeological Investigation of Childhood and Social Age: Problems and Prospects

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Abstract Recently, the value of the study of children and childhood from archaeological contexts has become more recognized. Childhood is both a biological and a social phenomenon. However, because of specialization in research fields within anthropology, subadults from the archaeological record are usually studied from the biological perspective (bioarchaeology) or, more predominantly, the social perspective (social archaeology), with little research that incorporates both approaches. These polarized approaches to childhood and age highlight the dualistic way in which "biological" and "social" aspects of the body are viewed. Some recent literature criticizes bioarchaeological approaches, and calls for the incorporation of childhood social theory, including social age categories, into subadult health analysis. However, few studies have explicitly addressed the practicalities or theoretical issues that need to be considered when attempting this. This paper critically examines these issues, including terminology used for defining subadulthood and age divisions within it, and approaches to identify "social age" in past populations. The important contribution that bioarchaeology can make to the study of social aspects of childhood is outlined. Recent theoretical approaches for understanding the body offer exciting opportunities to incorporate skeletal remains into research, and develop a more biologically and socially integrated understanding of childhood and age.

Keywords Age · Bioarchaeology · Childhood · Social archaeology

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Introduction

There has been a recent flurry of activity in the study of children and childhood in archaeology and anthropology, especially in the past 10 years, with the publication of many papers, books and theses (for example, Baxter 2005a; Benthall 1992; Bluebond-Langner and Korbin 2007; Cohen and Rutter 2007; Finlay 2000; Gottlieb 2000; Ingvarsson-Sundström 2003; Kamp 2001b; Lewis 2007; Lorentz 1998; Moore and Scott 1997; Panter-Brick 1998; Park 1998; Rega 1997; Schwartzman 2001; Scott 1999; Sofaer Derevenski 2000; Stearns 2006; Wileman 2005), as well as an increase of conferences and conference sessions[1] on this topic.

Recently, there has been a rising tension between social archaeologists and bioarchaeologists in their approach to the study of human remains (Sofaer 2006), although this is perhaps more evident in Britain than in the American school of anthropology (Hamilton 2007; Mays 1997). This tension is also being played out in the study of childhood in past populations. Following developments of the new paradigm of childhood sociology (Prout 2005, p. 83), the social view seems to predominate in the study of children from archaeological contexts. It is still the belief of some archaeologists that the skeleton cannot tell us anything about a society or culture (cf. Gowland 2002; Sofaer 2006). This is iterated by Egan's (1998, p. 10) observation that: "(t)he skeletons of dead children have produced a mass of evidence about causes of childhood deaths and about health and illness; but the life and culture of the *living* [italics in original] has received much less attention." This statement illustrates the dualistic way in which the biological and social aspects of the body are often viewed. Increased research interest on aspects of social identity in archaeology, including age, illustrate a conscious move away from biological determinism and highlights a forming rift between the approaches (Insoll 2007a; Sofaer 2006, p. 119).

With the increased research and publication on children and childhood from the past, questions including the appropriate terminology and age categories used in subadult bioarchaeological analysis are being asked (Kamp 2001b; Perry 2005). Few

[1] Examples of conferences and conference sessions with the theme of the archaeological study of children and/or childhood include: Symposium on "Prehistory's children and children's prehistories" at the Society for American Archaeology Meeting, at Anaheim, California, April 1994; Some of the contributions in Sofaer Derevenski (2000) are from papers originally presented in the "Children in the past" session at the Theoretical Archaeology Group Conference in Liverpool, UK, December 1996; Schwartman's (2001) book was inspired by the "Children and anthropology: Perspectives for the 21st century" session at the International Congress of Anthropology and Ethnological Sciences, at Williamsberg , Virginia, US, July 1998; Symposium on "Infant feeding and nutrition: New approaches to childhood health in prehistory" at the American Association of Physical Anthropologists Meeting, at Columbus, Ohio, US, April-May 1999; Session at the American Anthropological Association Meeting, at Washington DC, US, November-December 2001 (Baxter 2005b); The Archaeology of Infancy and Childhood Conference, at Kent, UK, May 2005; Children, Identities and the Past Conference, at Bergen, Norway, March-April 2006; The "Babies Reborn: Infant/children burials in prehistory" session at the Congress of the International Union for the Prehistoric and Protohistoric Sciences, at Lisbon, Portugal, September 2006; Children and Childhood in Human Societies cluster meeting, at Burlington, Canada, October 2006; The "The patter of tiny feet: The bioarchaeology of infants and children" session at the British Association of Biological Anthropology and Osteoarchaeology Conference, at Reading, UK, September 2007; and The Society for the Study of Childhood in the Past (SSCIP) conference on "Investigating childhood", at Oxford, UK, September 2007.

bioarchaeological studies integrate social age categories into the analysis of skeletal populations (Gowland 2002, 2006; Perry 2005). These are important issues, as the age categories that are used have implications for the analysis and interpretation of biological data, including aspects of mortality, fertility and other indicators of health, and also for comparison among bioarchaeological studies and with health data from living populations.

There is little written on the practicalities, problems and prospects of incorporating social childhood theory into the bioarchaeological analysis of subadult health. This paper brings together the relevant theoretical information from childhood social theory, archaeological mortuary ritual analysis, and aspects of the bioarchaeological methods that are vital to consider when adopting this approach. First, the issues of terminology in subadult research are presented. Following this, a short historical overview of the development of both subadult bioarchaeological health analysis and childhood social research in anthropology is presented. For more detailed accounts of these developments in bioarchaeology and social archaeology, see Lewis (2007) and Kamp (2001b) respectively. The practical and theoretical issues of applying childhood social theory to bioarchaeological research, and the potentials of bioarchaeological techniques for understanding childhood are then discussed.

Terminology and Age Categories within "Childhood"

When reviewing the literature on children and/or childhood from archaeological contexts, it is evident that problems exist with terminology used for this period and age categories within it. As mentioned, it is important to discuss these points because the age categories used in bioarchaeological analysis have implications for archaeological interpretation and also future comparison of these data among different studies. The purpose of this review is not to provide a solution to terminological issues by advocating specific terminology, but rather to make readers aware of some of the problems.

It is important to distinguish the different 'types' of age (Ginn and Arber 1995; Gowland 2006; Lewis 2007, p. 2; Sofaer 2006). These are:

1.) physiological or biological age (including skeletal and dental age), estimated from the biological changes in the body;
2.) chronological age, the time since birth; and
3.) social age, the culturally constructed norms of appropriate behavior and status of individuals within an age category.

It should also be noted that there are clear links between biological and social age. For example, Gowland (2006) has stated that we may refer to an age obtained from long bone lengths as a biological age, when in fact it is affected by a number of social and environmental factors.

Unfortunately, in archaeological and bioarchaeological research there are instances where the basis upon which age is estimated is not acknowledged. Also, the 'types' of age are often not distinguished within archaeological research. For example, Gowland (2006, p. 144) noted that the age definitions given for the Anglo-

Saxon cemetery of Millgate, Nottingshire (Harman 1989), which approximate those reported for many cemetery studies, are based on all three different 'types' of age.

In the United Kingdom and North American anthropological literature, the terms "subadult", "non-adult", "juvenile" and "child" are all used interchangeably for individuals who have not reached adulthood (Hoppa 1992; Saunders 2000; Scheuer and Black 2000a, b; Scheuer and Bowman 1995). These categories are also themselves problematic. "Subadult" implies that the individuals are hierarchically inferior to adults (Lewis 2007, p. 2; Sofaer 2006, p. 121). It could be argued that this mimics the modern Western cultural construction of children, where they are often perceived as incomplete beings compared with adults (Baxter 2005a, p. 18). "Non-adult", which has been used as an alternative to "subadult" (for example, Bennike *et al.* 2005; Heuzé and Cardoso 2008; Lewis 2007), has the same problem because this age category is defined in contrast to what they are not: "adult". In using this dualism, children are defined as a deviant from the norm, a process known as "Othering" (de Beauvoir 1949; Said 1978). Rothschild (2002, p. 1) has likened this dualistic relationship between children and (male) adults to the relationship that exists between females and males:

> (c)hildren, like women, exist at the weaker end of the dichotomized dimensions of male/female, adult/child. They are feminized, in the sense of being other-than-male and other-than-powerful, and they exist in a category that includes the elderly, the enslaved, and other weak, muted, and marginalized groups.

The use of the term "juvenile" is problematic because it is also used widely in the European literature to refer to a specific age category within subadulthood (Table I) and is sometimes divided into "juvenile I" and "juvenile II" with a variety of ages assigned (Lewis 2007, p. 2). The use of the terms "adult" and "child" have also been criticized in that by juxtaposing these concepts there is a construction or iteration of modern Western notions of roles and relationships that mask the complexities of social age (Rothschild 2002, pp. 3–4; Sofaer Derevenski 1994b, pp. 7–9, cited in Baxter 2005a, p. 19). "Childhood", constructed in a dichotomized relationship to "adulthood", also brings with it meanings of dependence and passivity, compared with independent and active adults (Prout 2005, p. 10). The theme of oppositional dichotomies and the inadequacy of these frameworks as a tool for understanding childhood in modern society is becoming apparent in recent texts on childhood social theory (Prout 2005).

Historically, there have been many different ways of dividing the human lifespan, and today terminology varies between medical pediatrics, and developmental osteology and anthropology, and also within these fields (Table I). Within anthropological research, there are problems with varying definitions of childhood or subadulthood and age categories within this group. Unfortunately, in bioarchaeology, it is sometimes the case that age categories are defined using definitions in the literature, which are not necessarily relevant to biological development, social identity or roles in childhood. For example, Lewis (2007, pp. 1, 5–6) has noted the problem of the different definitions used in biological anthropology for the "infant" age category. Some assign this term to individuals younger than 1 year of age, based on the accepted medical definition (Table I), while others use this term to refer to individuals up to 3 and 5 years of age (Lewis

Table I Age Divisions of the "Subadult" Period[a]

Age division	Clinical paediatrics (Forfar *et al.* 1998, 2003; Scheuer and Black 2000b, Appendix A)	Bioarchaeology – Continental Europe (Knussman 1988)	Developmental osteology (Scheuer and Black 2000a, b)	Bioarchaeology – British (Lewis 2007, p. 2)	Evolutionary anthropology (Bogin 1997, 2003)	Medical anthropology (Panter-Brick 1998, pp. 1, 66–67)
Prenatal	Up to the time of birth	-	Up to the time of birth	-	-	-
Embryo	The first 8 weeks (2 lunar months) of intra-uterine life	-	The first 8 weeks (2 lunar months) of intra-uterine life	First 5 weeks of intra-uterine life	-	-
Fetus	From week 9 to birth	-	From week 9 to birth	From 8 weeks of intra-uterine life to birth	-	-
Trimester	One-third of the time of normal pregnancy, thus first, second and third trimesters	-	One-third of the time of normal pregnancy, thus first, second and third trimesters	-	-	-
Preterm	From < 37 weeks (258 days) gestation	-	From < 37 weeks (258 days) gestation	-	-	-
Fullterm	From 37–42 weeks (259–293 days) gestation	-	From 37–42 weeks (259–293 days) gestation	-	-	-
Post-term	> 42 weeks (294 days) gestation	-	> 42 weeks (294 days) gestation	-	-	-
Stillbirth	Infant born after a gestational period of 24 weeks who shows no signs of life (in UK reduced from 28 weeks in 1992; Forfar *et al.* 1998, p. 3)	-	Infant born after a gestational period of 24 weeks who shows no signs of life (in UK reduced from 28 weeks in 1992; Forfar *et al.* 1998, p. 3)	Infant born dead after 28 weeks gestation	-	-
Perinate, perinatal	Literally around the time of birth- from 24 weeks gestation to 7 postnatal days	-	Literally around the time of birth- from 24 weeks gestation to 7 postnatal days	Around birth, from 24 weeks gestation to 7 postnatal days	-	-
Neonatal, neonate	From birth to 28 days	-	From birth to 28 days	From birth to 27 days	From birth to 28 days	-

Table I (continued)

Age division	Clinical paediatrics (Forfar *et al.* 1998, 2003; Scheuer and Black 2000b, Appendix A)	Bioarchaeology – Continental Europe (Knussman 1988)	Developmental osteology (Scheuer and Black 2000a, b)	Bioarchaeology – British (Lewis 2007, p. 2)	Evolutionary anthropology (Bogin 1997, 2003)	Medical anthropology (Panter-Brick 1998, pp. 1, 66–67)
Post-neonatal	29 days to the end of the first year of life	-	29 days to the end of the first year of life	28–346 postnatal days	-	-
Infant	From birth to 1 year	Infans I 0–7 years -infans Ia: birth to two years -infans: Ib 2–7 years (infant: 0–1 years, young child: 1–7 years; Martin and Saller 1957) (infant I: 0–4 years, infant II: 5–14 years; Ascádi and Nemeskéri 1970)	Birth to the end of the first year	Birth to the end of the first year	2nd month to end of lactation (usually by the age of 36 months)	0–1 year
Childhood	From 1 year to puberty/adolescence. Sometimes arbitrarily divided into: -early childhood: 0–5 years; -late childhood: about 6 to about 12 years, although Forfar *et al.* (1998) give the childhood range as 1–15 years	Infans II 7–14 years (7–15 years; Martin and Saller 1957)	From 1 year to puberty/adolescence Sometimes arbitrarily divided into: -early childhood: 0–5 years; -late childhood: about 6 to about 12 years, although Forfar *et al.* (1998) give the childhood range as 1–15 years	1–14.6 years	3rd–7th year	1–15 years -early childhood: 1–5 years -late childhood: 5–15 years (UNICEF (1996) defines childhood as 0–15 years of age)

Juvenile and/or adolescence	-	Juvenil From 15 years until closure of the spheno-occipital synchondrosis (about year 22). (youth: 14–20 years; Martin and Saller 1957) (juvenile: 15 to 22–24 years; Ascádi and Nemeskéri 1970)	Adolescence /puberty 10–13 years (girls), 12–16 years (boys)	Adolescence 14.6–17.0 years	Juvenile 7–10 years (girls), 7–12 years (boys) Adolescence 5–8 years after the onset of puberty

- Age division not defined.

[a]This table shows some of the ways in which the subadult period in the human lifecycle has been divided and categorized in pediatrics and some of the subfields of biological anthropology. It is not intended to be a comprehensive or complete summation of all the works in these research areas that have described and/or applied different age categories in their analysis. The authors also acknowledge that adulthood has been divided and categorized in the medical and anthropological literature (Beall 1984; Gowland 2002, 2006; Sofaer 2006).

2007, pp. 5–6). Lewis (2007, pp. 5–6) argues that it is problematic to include individuals up to 5 years of age in an "infant" age category because it masks the major physiological and social development that occurs between birth and 5 years of age. It also adds to the confusion about what constitutes a child. Unfortunately, in some cases age categories are not defined at all and/or are inconsistent within studies (Crawford 1991, p. 19).

The selection of age categories depends on particular research objectives. For example, Panter-Brick (1998) uses the definitions of childhood (based on chronological age) outlined by the United Nations Children's Fund (UNICEF) for purposes of comparison to available modern health data (Table I). Bogin (1999a, b, 2003), following an evolutionary perspective, uses stages defined by the growth and developmental events within an individual's life span. For the postnatal period, these are infancy, childhood, juvenile stage, adolescence and adulthood (Table I). He considers childhood as the period from about 3 until 7 years of age, where there is a moderate growth rate compared with individuals younger than 3 years old and involves dependency for feeding. The stage begins with the cessation of breast-feeding, which varies within and between populations, and ends with the cessation of brain growth at the end of the stage, which also varies between individuals (Bogin 1999a, 1999b, 2003). Using an evolutionary argument, he states that this stage of biological development has been 'inserted' into the hominin life history thereby allowing extra time for brain development and learning (Bogin 1997).

In this paper, the term "subadult" is based on biological age, unless described or implied otherwise, and is used for convenience to refer to infants and children. This term is not used to imply a hierarchical relationship between "adults" and "subadults". Because the definition of this term varies among bioarchaeologists (for example, Domett 2001; Lewis 2007; Saunders 2000) we are not defining the "cut-off" point between "subadult" and "adult". The term "childhood" refers to a social age category. We recognize that the definition of "childhood" varies cross-culturally and over time within societies. In distinguishing between biological and social concepts of "subadulthood" or "childhood" we run the risk of losing sight of the important interrelationships between these aspects that contribute to this important life stage. However, it is this distinction between approaches to age used by bioarchaeologists and social archaeologists that is central to understand when dealing with some of the theoretical and methodological tensions in the study of childhood in the past.

Subadult Bioarchaeological Health Research

"Bioarchaeology", although a term originally applied to zooarchaeological research (Clark 1973), is now used in the US to refer exclusively to the study of human remains from archaeological contexts (Buikstra 1977; Larsen 1997, p. 3). In the UK "bioarchaeology" is becoming more common, although many people in the field continue to identify themselves as "biological anthropologists", while on-site contract biological anthropologists are often referred to as "human osteoarchaeologists".

At the beginning of the last century, subadults from archaeological contexts were often overlooked. This can be understood in the context of the research interest at

that time of human taxonomy with a focus on description and metrics (Washburn 1951). "Physical" anthropologists were mainly interested in comparative craniometry, which required the analysis of adult crania (Gould 1996; Hooton 1930; Hrdlicka 1924). Comparatively, subadult crania were deemed useless because they were often found disarticulated in archaeological contexts as a result of their unossified sutures. Hooton (1930, p. 15) typifies the disinterest in the analysis of subadults at the time:

> (i)n the case of infants and immature individuals, the cartilaginous state of epiphyses and the incomplete ossification of sutures, as well as the fragility of the bones themselves usually results in crushing and disarticulation. In any event, the skeletons of young subjects are of comparatively little anthropological value.

The disinterest led to a notable absence of research on growth. This was identified by Johnston (1968, p. 57):

> (d)espite the obvious fact that variation in adult morphology arises primarily through the action of differential developmental processes, studies of the nature and manifestation of such processes among skeletal populations are painfully few in the scientific literature. Just as traditional physical anthropology has concentrated upon the skull at the expense of post-cranial remains, there has been an almost complete concentration upon adults to the virtual exclusion of the immature … The result has been the neglect of such skeletal remains … followed by the almost complete absence of knowledge concerning the features of growth of any groups …

Johnston (1961, 1962) was a pioneer in the study of subadult investigations of growth, development and mortality from the Indian Knoll skeletal sample.

Since this time, with the recognition of the potential wealth of information that can be gained from the study of subadults, a large number of bioarchaeological studies have investigated mortality, growth and growth disruption in subadult samples (for example, Buckley 2000; Humphrey 2000, 2003; Kamp 2001b; Lewis 2000, 2002a, 2004, 2007; Lewis and Roberts 1997; Lovejoy *et al.* 1990; Mays 1995, 1999; Saunders 2000). It is now acknowledged that subadult human remains are particularly useful for the study of patterns of health and disease in prehistory, in that they are the most demographically variable and sensitive indicators of biocultural change (Buikstra and Ubelaker 1994, p. 39; Van Gerven and Armelagos 1983, p. 39). Disease, subsistence mode, weaning patterns and inherited disorders may leave evidence on the dentition and bones of subadults and thus provide clues to aspects of the health of the community and of the environment in which they live (Buikstra and Ubelaker 1994, p. 39). The merits of the investigation of subadult health are succinctly described by Goodman and Armelagos (1989, p. 239):

> (m)onitoring the health of infants and children can provide the prehistorian with a rich variety of information about the health of a community. As this segment of the population is very sensitive to environmentally and culturally produced insults, changes in morbidity… could provide one of the first signs of changes in environment and culture.

Childhood Social Theory in Archaeology

> Each of us was once a child. As we grow older, many of us have children and grandchildren of our own. It is impossible to imagine a society without children. Yet children have been notably absent from archaeological narrative (Sofaer Derevenski 2000, p. i).

In 1962, Phillipe Ariès produced the first study of the history of childhood in his book *Centuries of Childhood: A social history of family life*. This work described the changes in the concept of childhood from mediaeval to early modern Europe. He argued that Europeans did not develop a concept of childhood until the seventeenth and eighteenth centuries and, before this time, children were not devoted any special time or attention. Although Ariès' (1962) work has been severely criticized (Hanawalt 1986, 1993; Kuefler 1991; Shahar 1990), it is important in illustrating that childhood is a socially and culturally constructed category, a central tenet in childhood social theory (Allison and Prout 1997; Prout 2000b).

The rise of feminist approaches in anthropology during the 1970s sparked an initial interest in the place of children in the archaeological record (Sofaer Derevenski 1997). However, the main emphasis was on the place of women in prehistory (Scott 1997, pp. 6–7; Sofaer Derevenski 2000). Sofaer Derevenski (1997) talks of the inception of gender archaeology in the 1970s, but the reluctance to explore the archaeology of childhood. This disinterest in the study of childhood has been attributed to the perceived notion of the under-representation and fragility of subadults in archaeological contexts (Lewis 2007, p. 20), and to the notion of "childhood" in modern Western societies as being unimportant in contributing to economic and political life (Nieuwenhuys 1996; Sofaer Derevenski 1997). It has also been argued that the study of childhood was delayed because the academic circles, composed of adults, acted to marginalize children's lives and voices (Caputo 1995, p. 19; Prout 2005; Roveland 2001, p. 46). Similarly, the exclusion of infants and children was also evident in social anthropology (Benthall 1992; Gottlieb 2000).

Lillehammer's (1989) publication of her paper: "A child is born. The child's world in an archaeological perspective" has been described as the "birth" of the archaeological investigation of childhood (Baxter 2005a, p. 16). Lillehammer (1989) acknowledges that children were left out of archaeological investigation, and advocates an approach that focuses on the child's relationship with the environment and the adult world. Shortcomings of Lillehammer's (1989) work include her adoption of a modern perception of the association between children and "toys" and that children had to be "found" in the archaeological record (Gowland 2002, p. 8). Since this time, as noted, there has been much research from the social perspective of children and childhood from the archaeological record (Finlay 2000; Ingvarsson-Sundström 2003; Kamp 2001b; Moore and Scott 1997; Scott 1999), a theme of interest that is also evident throughout the social sciences, particularly sociology (Bowman 2007; Corsaro 2005; Hopkins and Barr 2004; James *et al.* 1998; James and Prout 1997; Jenks 2005; Prout 2000a, 2005; Qvortrup 1990; Qvortrup *et al.* 1994).

There are several main themes in contemporary sociological, anthropological and archaeological work on childhood. As mentioned, one is of childhood as a social and

cultural construction. Another is the investigation of children's agency and the role that children play in societies (Baxter 2005b; Bluebond-Langner and Korbin 2007; Caputo 1995; James and Prout 1997; Politis 2006; Prout 2000a; Scott 1997, 6–7). These themes are discussed further in the following section in reference to their application in bioarchaeological analysis.

Childhood Social Theory and Identifying Social Age in Bioarchaeological Analysis

This section discusses the prospects and problems of the use of childhood social theory in bioarchaeological research. First, the role that children play in society is considered. In discussing this, the importance of an approach that considers biological factors, and therefore the contribution of bioarchaeology, to understanding childhood is illustrated. Following this, theoretical and methodological aspects of the use of social age categories in bioarchaeological research are critically examined.

The Social Child

Most cultures recognize a childhood period in the human lifespan (Bogin 1997, p. 63; Stearns 2006, p. 3). What is universal in humans is the extended period of immaturity, but there are numerous ways in which cultures negotiate this, making childhood a life stage with variable length and diverse associated social roles (Prout 2005, p. 111). The modern Western notion of childhood is a biologically defined period of extended dependence (Kamp 2001b, p. 3). Sofaer Derevenski (2000, p. 11) argues that this has led some archaeologists to ignore children's important place in past societies and reduce them to passive beings not participating in social or economic life.

Without looking at the construction of childhood and the role that children play in their society, bioarchaeologists may unwittingly portray children as passive victims of their environment. However, children *do* determine the majority of the day-to-day activities of the family in terms of the care that is provided to them, the contribution that they make to the household and society, as well as their social relationships with their parents, siblings and extended family.

Human infancy and childhood is a crucial and vulnerable time biologically (Prentice and Prentice 1988; Trevathan 2005) which requires a lot of energy input from adults and often other children (Stearns 2006, p. 1). This immaturity is one of the reasons why infants have been portrayed as passive victims of environmental circumstances. However, it is partly because of the biological immaturity of infants and children, and therefore susceptibility to morbidity and mortality, that important social arrangements for their care and well-being exist and that certain social age identity categories are present in human societies.

It is understood that childhood diseases and mortality, and the preventions of these, would have been an important preoccupation of parents and their wider community in the past (Stearns 2006, p. 1). Biological immaturity during infancy and early childhood contributes to high mortality in these age groups. Weiss (1973) has estimated expected subadult mortality rates in prehistory and in the pre-antibiotic

era of between 30–70%, based on a number of ethnographic sources. Waldron (1994) has estimated that in pre-industrial times subadult deaths made up around 30% of the skeletal population, based on data from "developing" countries. Lewis (2007, p. 22) has cautioned that there are problems with using these mortality data as a standard, because the health and economic conditions of these populations are influenced by industrialized countries. However, what is known is that, not only in the prehistoric period, but also in the absence of infection control with antibiotics, subadults made up a substantial proportion of deaths.

As noted, the social meanings of infancy and childhood are different across cultures, which are intricately linked to the social, cultural and historical factors in the society. Subadult morbidity and mortality are important factors to consider when understanding the social meanings of childhood and the social relationships between adults and children. For example, Nancy Scheper-Hughes (1985, 1992) well-known, if somewhat controversial, medical anthropological work on mothers and infants in Northeast Brazil has concluded that in response to high subadult mortality, a social construction of delayed maternal attachment and a form of "selective neglect" of their young developed. Bioarchaeologists, by assessing age specific mortality rates, can therefore contribute to understanding childhood and the treatment of children within past societies.

From birth, humans have communication skills, which are important in the facilitation of social childcare relationships. Complex socio-biological models of the relationship between maternal behavior, hormones and the suckling infant have been described in the literature (Winberg 2005). However, there are criticisms of some of the biologically deterministic models of maternal–infant bonding (Maher 1992). Through close contact after birth, mothers have been shown to regulate the newborn's temperature, respiration, crying and nursing behaviors. Similarly, the baby may regulate and therefore increase mother's attention through initiation and maintenance of breastfeeding and the efficiency of maternal exploitation of ingested calories by gastro-intestinal hormone release (Winberg 2005). It can be argued from an evolutionary standpoint that infants are socially "primed" from birth to increase the nurturing behavior from adults and other children, therefore ensuring their survival. When born, an infant has the ability to perform behaviors including making eye contact, following movements of a caregiver's face and crying, all of which have been shown to contribute to ensuring the proximity of the mother (Katz *et al.* 1973; Winberg 2005). An example of the impact of this "signaling" of the infant to enable close proximity of the mother or caregiver is shown in cross-cultural studies of "traditional" societies where co-sleeping of some sort with infants is the norm (Barry and Paxson 1971). This is an example of the important part that infants play in eliciting social interaction with their family members from the time of birth and the social arrangements that are set up to meet the infant's needs.

Based on evidence from ethnographic works, historical records and archaeological evidence, it has been argued that children were major contributors to economic production in prehistoric societies (Cain 1977; Kamp 2001a, b, 2002, Kamp *et al.* 1999; Kramer 2005a; Nag *et al.* 1978; Ritchie and Ritchie 1979; Wileman 2005). For example, Maya boys of Xculoc, Yucatán Peninsula, Mexico between the age of 7 and 15 years produce more than half of what they consume (Kramer 2005b). However, industrialization and capitalism could have contributed to an increase in

child labor in some ethnographic and historical records. It has also been noted that the contribution of children to economic activities varies considerably among societies (Wileman 2005, p. 57). Historical archaeological investigations also show that children are important agents in creating their environment, by creating their own material culture, social spaces and social networks (Wilkie 2000).

It is well-known in biological anthropology that health data need to be interpreted in the context of the cultural environment (Goodman and Leatherman 1998). This interpretive tool was recognized in the 1980s with the adoption of the biocultural general adaptationist model by Goodman *et al.* (1984a). This model has the underlying premise that because human health and disease occur in an ecological setting and are ultimately affected by human behavior, it is crucial to understand interactions among people and between people and their environment (Brown and Inhorn 1990). Bioarchaeologists therefore generally incorporate information on the cultural context of children's roles and activities in their society in interpretation of their data. For example, Lewis (2002b), in explanation of the high child mortality from a later period site in mediaeval Britain, argued that many rural and urban children from as young as 7 years of age were sent to work as apprentices (Cunningham 1995) in conditions which would have been deleterious to their health. In doing so, this approach views children in the context of their social actions in society, and is therefore complementary to this important theme within social childhood theory.

As noted, it has been observed that the social view seems to predominate in the study of childhood in the past (Prout 2005). However, the biological factors, as discussed above, are important in contributing to understanding social aspects of childhood. Because of the perceived distinction between natural and social phenomena, and in turn research approaches, Insoll (2007b, p. 4) reminds us that there:

> … sometimes seems to be within the archaeology of identities an emphasis upon forgetting the prosaic, but equally important foundational rudiments such as biology, in favour of the more popularly perceived social theoretical elements … the empirical body from which adequate interpretation and theory are generated in pursuing past identities must also not be neglected; otherwise there is a danger that empty shells are created.

Social Age Categories

As noted, recently it has been advocated that social age categories should be used in bioarchaeological analysis (Kamp 2001b; Perry 2005). This section addresses the theory and methods important when attempting this endeavor.

Just as infancy and childhood as age categories are culturally constructed, the age categories or life stages within childhood are relative to the societies on which they are based. As Kamp (2001b, p. 4) acknowledges, in relation to the definition of childhood stages archaeologically:

> Like gender, age categories and roles are culturally defined and must be investigated, rather than assumed. It is not tenable to simply assume that

> specific age categories derived from modern Western models will correspond to socially significant stages for other cultures, past or present. In fact the reverse is true. It should be expected that every society will have its own age categories and its own definitions of childhood. This means that an optimal first step in the study of prehistoric children would be a determination of significant cultural age categories and their basic characteristics.

Much of the tension in the investigation of age in the past arises from the assumption that we can link "biological" to "social" age. Sofaer (2006, p. 127) states "(t)he desire to turn biological categories into social ones by creating implicit and direct links between the two, causes problems by trying to turn a process (ageing) … into a class (age)." She states that distinctions between the categories, particularly "child" cf. "adult", are the product of the current limitations of osteological methods for age estimation in adults, and that using biological developmental standards for ageing results in the construction of artificial divisions of social and mental development between these categories (Sofaer 2006, pp. 126–127).

Another issue that adds complexity to defining social age is that the definition of childhood can change over time within a society. For example, the age in which children are perceived to be adults in legal documents in Anglo-Saxon Britain changed from 10 years in the seventh century to 12 years in the tenth century AD (Crawford 1991). Also, in contrast to modern Western society where social age is closely linked to chronological age, in many "traditional" societies, stages of maturation are acknowledged in defining age (Cox 2000; Fortes 1984). These stages take into account not only the chronological age but also the skills, personality and capacities of the individual (Kamp 2001b, p. 4). Stoodley (2000) has argued in a study of burial rites in early Anglo-Saxon Britain that "age identity" was only loosely related to biological age. To analyze and understand these age categories it is important to acknowledge that the number of age categories may vary from one population to the next (Kamp 2001b, p. 25). There is also the issue that age categories may vary with gender and other social attributes including class (Kamp 2001b, p. 25; Lesick 1997; Voutsaki 2004). There is a tendency when assessing age categories to think in terms of the singular (Insoll 2007b, p. 6). However, while different categories are important, aspects of identity are 'multivalent' or defined by multiple elements (Insoll 2007b, p. 6; Kealhofer 1999, p. 63).

The problem of using biological age to determine the social age of a child is becoming more widely acknowledged in the literature (Baxter 2005a, p. 98; Lewis 2007). Some texts are starting to state explicitly the 'type' of age used when presenting results and analyses. For example, it is acknowledged by Lewis (2007, p. 2) in her book on the bioarchaeological study of children, that the categorical terms within subadulthood "are used for ease of reference and provide a biological basis for discussion; they are not intended to describe the complex social experience of the youngest members of every society, past or present", while few are even attempting to identify transitions in social age through the analysis of burial ritual (Gowland 2002, 2006).

To summarize, various issues complicate the incorporation of social age categories into bioarchaeological research. Given that societies have different notions of what constitutes a child and definitions of social age categories that may

not always match those based on chronological age (Fortes 1984), bioarchaeological data collected and presented using these social age categories can pose problems for the comparison of these data with different populations. One way to get around this, although work intensive, could be to explicitly present data within age categories traditionally used in bioarchaeological health analysis (Table I) for comparative purposes as well as those as defined through analysis of social age categories. However, this could be seen to accentuate the chasm between the biological and social approaches to age.

Defining Social Age through Archaeological Analysis

> Most of the studies of childhood paleo-health and nutrition are weakened because they fail to use archaeological data to establish age group boundaries. Studies usually start with a definition of groups that seems logical to the investigator, then test for differences between the groups, rather than beginning the exploration by looking for differences that might imply local age definitions. Because the burial remains, which are often the basis for research into children's health and nutrition, are one of the primary sources for establishing age groups archaeologically, this area of investigation should be one of the pioneers in such a process. (Kamp 2001b, p. 10).

However, this endeavor requires large enough samples. There are also issues with deriving social age categories from past populations, especially from prehistoric societies where we are not able to draw on historical records of child and adult status and their social roles and relationships. However, the complexity of interpretation of bioarchaeological data using historical records has also been noted (Perry 2007). The alternative is using ethnographical data and/or an analysis of the burial ritual of subadults within the larger skeletal sample, both of which have problems.

Mortuary treatment including grave wealth can be considered when assessing the socially important age categories in a population (Saxe 1970; Tainter 1978). It has been shown in ethnographical and archaeological work, for example, that infants and children are often buried differently from adults in terms of burial location, position and grave goods (Boric and Stefanovic 2004; Jamieson 1995; Kamp 1998; Murail *et al.* 2004). These can reflect beliefs about personhood and social age categories.

However, it is well-known that there are problems with an approach that ascribes differing mortuary treatment to status during life (Parker Pearson 1982; Scott 1993; Ucko 1969, pp. 266–268; Wason 1994). Archaeologists have rethought the perspectives employed by the so-called New Archaeologists, where mortuary rituals were seen as a "… passive reflection of abstract concepts of society and social structure" (Parker Pearson 1999, p. 84). It is now acknowledged that there are a variety of reasons for the grave wealth interred with given burials. Parker Pearson (1999, p. 7) states that grave goods may represent the possessions of the deceased or the mourner's gifts to the dead. In addition, it is also argued that concepts of honor and sacredness may be more important than material wealth within a society's value system (Parker Pearson 1999, p. 84).

It has been argued that, although the rules of mortuary interpretation using Saxe (1970) work, for example, may hold true for adults, these may not be applicable to children. As Crawford (1991, p. 18) explains:

> The symbols of the ritual form a text through which to read about the individual. But the conspicuous determining factor of 'childhood' status is dependence on the adult world. Under such circumstances, the 'individuality' of the juvenile may be lost – the child exists only as a possession, an economic process of the parent or guardian. The individuality of the child in the burial may be subsumed into that of family status, so that a child's grave, in this case, may provide only a text by which to read of the associated adult's status. On this basis, the burial would not yield age-specific signifiers, since the juvenile ritual will merely reflect that of an adult.

Although these factors of burial treatment complicate interpretation of the subadult mortuary remains, these need not necessarily detract from the importance of looking at these aspects of burial ritual to assess social age categories. Rather these issues need to be considered to help strengthen analysis and interpretation of childhood in past populations.

So, where do we start in bioarchaeological investigations defining childhood and its subdivisions? Bioarchaeologists already incorporate information on the cultural context of children's roles and activities in the interpretation of health and mortality data, but some are also looking at developing a more integrated biological and social picture of childhood and age. Several studies have attempted this and give theoretical and methodological insights to the endeavor. For example, Crawford (1991) has produced a review of research that investigates child grave goods and social status in fifth to seventh century Anglo-Saxon England. She argues, in the context of interpreting subadult grave symbolism, that researchers need to consider questions such as: does the mortuary ritual as applied to subadults reflect ascribed status; and can they be considered personal possessions or does the ritual reflect the status of the adult buriers? (Crawford 1991).

Perry's (2005) work also provides theoretical and methodological insights. She has analyzed the health of the subadults from the Byzantine Near East. Available historical evidence indicates that the Byzantine Empire had established legal codes defining the ages at which an individual could marry, and marking a cultural transition to adulthood, which began at around 13–15 years. Perry (2002, p. 269, cited in Perry 2005, p. 97) found that, compared with individuals from a Roman period community and a Byzantine period urban trading centre, the Byzantine Rehovot contained a high number of older children and adolescents (defined as 7–15 years). Perry (2002, p. 270, cited in Perry 2005, p. 97) argues that the higher mortality in these age groups marks a period of "self-sufficiency" possibly being the cause of physiological stress coinciding with increased labor. Perry (2005, p. 97) comments that by adhering to modern Western notions of age categories, these individuals who were probably married and independent, were incorrectly defined as "subadults". This is a good example of the importance of the recognition of both "social age" and "biological age". Using McDade's (2003) life-history theory of resource allocation to biological processes for interpretation, these young individuals who were socially self-sufficient and working, probably fared worse than

biologically mature individuals because of the trade-off in energy that was needed to carry out these demanding tasks and their continued biological growth and development.

Wiley and Pike's (1998) demographic work on modern populations advocates the use of developmental age categories in assessment of early mortality. They suggest that the infant mortality rate (IMR) ignores the complexities and patterns of mortality that are important to understanding why subadults die when they do. Alternatively they advocate analyzing mortality using stages such as crawling and weaning. In this way, children's roles and activities in relationship to their environment are the focus (Wiley and Pike 1998), which follows the central theme in childhood social theory of children as social actors. This could potentially be applied to understanding aspects of social age groups in skeletal samples. For example, whether there are any patterns of health and/or mortuary treatment that are related to developmental stages in life including crawling and weaning could be investigated, taking into account that the duration and timing of these stages are also mediated by the social environment and therefore can differ among societies. Weaning as a social construct can be determined through isotopic analysis of teeth, as discussed below.

Ingvarsson-Sundström (2003, p. 170) hypothesizes in her work on skeletal remains from the Middle Helladic period that changing identities from "subadult" to "adult" is when a girl or boy moved, either physically or metaphorically, to start their own family. This could perhaps be determined through isotopic analysis of young females and males at given sites to assess whether the enamel chemistry fits with the local signature of the people in this area (Bentley 2006; Bentley *et al.* 2002; Ericson 1985). Of course, in using these methods there is an assumption that individuals will have moved to another "geological area" to start their family.

Sofaer (2006) provides an important theoretical discussion with the aim to reduce the chasm between bioarchaeological and social archaeological approaches to understanding age. She states that one way to meet this aim is to refine methods for estimation of subadult sex and adult age, thereby removing the methodological barrier, as discussed, which artificially constructs a divide between adults and children. A problem with this is that skeletal sexual dimorphism does not reach a sufficiently high level to be reliable for estimation before puberty (Scheuer and Black 2000b, p. 15). For age estimation there is also a problem, because in adulthood the changes in the body do not have as strong a relationship with chronological age compared with subadulthood when there are major growth and development changes occurring (Sofaer 2006).

In line with current sociological theory, Sofaer (2006, p. 129) discusses the use of conceptualizing the body as a "hybrid", the notion of the body as being socially and biologically unfinished and therefore the cumulative formulation of a complex entity that develops over time (Prout 2000b; Shilling 1993). Here, the body is viewed as both a material and a cultural object. With this approach there is a move beyond the biocultural model, where osseous change is seen as an adaptation to the environment, and also from simply drawing inferences between people and objects in mortuary contexts, and therefore beyond the nature-culture dualism, to an analysis of the total milieu in which people are situated and the objects in which they interact causing changes to the material body (Sofaer 2006, p. 141).

To illustrate this approach, Sofaer (2006, p. 140) refers to her study of individuals from the island of Ensay, Outer Hebrides. This research focused on the analysis of gendered activities, where she attributes the differences in osseous changes in the spines between adult men and women to load-bearing using baskets, which were carried primarily by women. Sofaer (2006, p. 140), using the concept of hybridity takes this one step further and looks at the life course in which these activities were carried out. She argues that because these gendered skills were acquired in childhood these were having an effect on the body early in the life course. Sofaer (2006) interprets that particular social objects such as creels had an effect of causing accelerated degenerative changes in the adult body. Here, gendered activities can be traced to particular objects that played a role in "literally shaping women's bodies over the course of their lives" (Sofaer 2006, p. 140).

Sofaer's (2006) approach fits with the recently adopted, phenomenological archaeological approaches and influences from third-wave feminism where scholars are beginning to move from viewing the body as an inert artifact to the body as a site of lived experience, through idealized representations, treatment of the dead body, and evidence of habitual gestures and postures (Joyce 2005; Meskell 2000; Yannis *et al.* 2002).

Lorentz (2003) uses a similar approach in her research on modifications of children's bodies from Cyprus. Focusing on the analysis of headshaping, contextual burial analysis and anthropomorphic depictions, the young body was viewed either as a depiction (figurine), or physically, as being able to be manipulated and modified by material practices both in life and death. This approach acts to draw together specific entities that are presented as dualistic in the literature including: nature–culture, mind–body, agent–artifact.

The biological age could be incorporated into this analysis to tell us about the life cycle events that are important to these social practices of body modification during childhood. Further research into age-related growth and malleability of the cranial structure could also be useful as this is possibly intertwined with cultural ideas about manipulation and modification.

Robb (2002) has produced a study incorporating skeletal remains and concepts of biography and the life course, including the treatment of the body after death, to explore age in an Italian Neolithic individual. He considers factors such as growth, illness, ageing and death as important data to be incorporated into cultural interpretations (Robb *et al.* 2001, p. 161). Focusing on ageing (the process of change in life), as opposed to distinguishing the specific age and associated cultural objects, it steps away from "reiterating the linear transformation from biology to sociality" (Sofaer 2006, p. 128).

Bioarchaeological Approaches to Childhood

Although it is not an aim of this paper to discuss these approaches, bioarchaeological methods and analysis of growth, growth disruption and mortality (Goodman *et al.* 1984b; Humphrey 2000; Larsen 1997; Lewis 2000, 2007) can be used to investigate childhood health and, therefore, as discussed, aspects of their social environment. Isotopic analysis of bone and teeth and an investigation of bone morphology can also give potential insights into childhood.

Breastfeeding and weaning (defined here as the process of the supplementation of solid foods, not a single event of the cessation of breastfeeding) are important social constructs of child-rearing that can be inferred through stable isotope analysis. These practices can have important consequences for subadult health, maternal health, roles of males, females and children in childcare and other work, as well as fertility (Bocquet-Appel and Naji 2006; Maher 1992; Sellen and Mace 1997). Various bioarchaeological studies have investigated breastfeeding and weaning using stable isotopes, as well as patterns of mortality and morbidity (Herring *et al.* 1998; Katzenberg *et al.* 1996; Richards *et al.* 2002; Schurr 1998; Wright and Schwarcz 1998).

Dietary analysis is also important for looking at social aspects of childhood. An interesting isotopic study of diet in Sudanese Nubia has interpreted variation between the subadult and adult cohorts to suggest a set of dietary practices specific to infancy, subadulthood and adulthood (Turner *et al.* 2007). Ethnographic analysis has shown that allocation strategies closely follow cultural definitions of childhood, vulnerability and gender (Messer 1997), thus emphasizing the potential of isotopic analysis contribution to childhood social age analysis.

Another possible avenue, although not previously assessed for its feasibility in subadult samples, is the investigation of activity patterns from muscle insertion sites on bones. This could give information regarding physical activities that the subadults were carrying out. For example, the cross-cultural occurrence of individuals at around 5 years of age generally becoming more active and self-sufficient (Bogin 1997) has been used to explain the apposition of bone in an archaeological population at this time (Mays 1999). Studies of modern children, which have shown that bone mass and density is influenced by mechanical loading and muscle stress support the potential for this type of analysis (Ruff 2003; Welten *et al.* 1994). However, in investigating this topic, factors including nutritional stress and normal biological patterns of linear and appositional bone growth, especially around puberty, would have to be considered.

There are important theoretical and methodological issues that also need to be considered when estimating biological age in subadults. These are well covered in the bioarchaeological literature and are not expanded on here in any detail. For example, the biological changes on which ageing methods for subadults are based, although, as mentioned, having a stronger relationship to chronological age compared with adults, still have variation at the intra-individual, inter-individual and inter-population level (Halcrow *et al.* 2007; Heuzé and Cardoso 2008; Tompkins 1996). Another problem not discussed in the literature, which has implications for the assignment of children to certain age categories, relates to the use of different methods to estimate biological age within skeletal samples. Dental ageing methods provide a tighter age range than do ages based on lengths of bones and so the precision of the age estimate depends on the methods used. For example, a child aged using size of bone elements or lengths of long bones may have a wider age range that spans two categories compared with an individual aged using dental methods.

Other theoretical and practical issues in bioarchaeology also well-covered in the literature include issues of selective mortality bias, preservation of subadult skeletons and the "osteological paradox" (Goodman 1993; Lewis 2007; Saunders

and Hoppa 1993; Wood *et al.* 1992). It is well-recognized in bioarchaeology that the presence of bony pathology may actually indicate that the individual is healthier than someone with no lesions, in that the individual was strong enough to live through the episode of morbidity, hence the term: "osteological paradox" (Ortner 1991; Wood *et al.* 1992). Conversely, a lack of skeletal evidence may be the result of a person dying without sufficient immune response, before the development of a chronic disease. Goodman (1993) argues, therefore, that age at death is an important variable to consider in the interpretation of these apparently paradoxical results. For example, if an infant dies around the time of birth and has no evidence of pathology, we can assume that this individual is less healthy than an older infant who has pathological lesions.

Conclusion

The past decade has witnessed an increased interest in children and childhood in archaeological research. The social perspective appears to be the dominant approach. With this, the biological approach has been criticized and there have been calls for the incorporation of childhood theory, which requires the use of social age categories, into bioarchaeological analysis. The social archaeological and bioarchaeological approaches to assess age and childhood demonstrate the dualistic way in which "social" and "biological" aspects of the body are viewed. This paper has discussed the practical and theoretical issues that need to be considered for this endeavor. Issues discussed included terminology and age categories used and the problems of identifying "social age" in past populations. The importance of the consideration of biology in the analysis of childhood and age in past societies was outlined. New theoretical approaches for understanding the body are useful to place the skeleton into discussions of childhood in the past, and in turn allow us to develop a more integrated biological and social picture of childhood and age.

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