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Is birth attendance a uniquely human feature? New evidence suggests that Bonobo females protect and support the parturient

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ABSTRACT

Birth attendance has been proposed as a distinguishing feature of humans (*Homo sapiens*) and it has been linked to the difficulty of the delivery process in our species. Here, we provide the first quantitative study based on video-recordings of the social dynamics around three births in captive bonobos (*Pan paniscus*), human closest living relative along with the chimpanzee. We show that the general features defining traditional birth attendance in humans can also be identified in bonobos. As in humans, birth in bonobos was a social event, where female attendants provided protection and support to the parturient until the infant was born. Moreover, bystander females helped the parturient during the expulsive phase by performing manual gestures aimed at holding the infant. Our results on bonobos question the traditional view that the "*obligatory*" need for assistance was the main driving force leading to sociality around birth in our species. Indeed, birth in bonobos is not hindered by physical constraints and the mother is self-sufficient in accomplishing the delivery. Although further studies are needed both in captivity and in the wild, we suggest that the similarities observed between birth attendance in bonobos and humans might be related to the high level of female gregariousness in these species. In our view, the capacity of unrelated females to form strong social bonds and cooperate could have represented the evolutionary pre-requisite for the emergence of human midwifery.

1. Introduction

Birth assistance has been proposed as a distinctive human trait and it has been related to the difficult delivery process in our species (Rosenberg & Trevathan, 2002; Wittman & Wall, 2007). At the basis of the long, painful and unsafe delivery in humans lays the strict relationship between the size of maternal birth canal - determined by the anatomy of pelvic bones - and the size of neonatal head (Trevathan, 2011). In the course of the hominin evolutionary lineage, the pelvis anatomy changed over time in response to different selective pressures connected to bipedal locomotion and childbirth (Trevathan, 2015), with other ecological factors playing an important role (Wells, DeSilva, & Stock, 2012). In particular, the "*bipedalism-encephalization conflict*" has been thought to be the reason of the extreme altriciality of our neonates and was labelled by Washburn (1960) as the *human obstetric dilemma*. Although recent studies highlighted the role of other physiological mechanisms in determining the timing of delivery in *Homo sapiens* (Dunsworth, Warrener, Deacon, Ellison, & Pontzer, 2012), the general idea behind Washburn's *obstetric dilemma* remains reliable, as sadly confirmed by the rate of maternal and neonatal mortality due to obstructed labour in our species (World Health Organization, 2005). In addition to this size relationship, human parturition is mechanically difficult also because the birth canal has a twisted shape that produces a unique pattern of rotational birth (Trevathan, 2011). Indeed, human infants are typically born facing away from the mother (i.e. *occiput anterior*) and this position makes it problematic for the mother to use her hands to facilitate the expulsion. The *obstetric dilemma* and the *occiput anterior* presentation are thought to represent the biological foundation of birth attendance in humans. According to this view, the outcome of the evolutionary history of human childbirth resulted in a sort of "*obligate midwifery*", with attendants being present to support the mother and facilitate the delivery (Rosenberg & Trevathan, 2002; Trevathan, 2015). Although the notion of "*obligate midwifery*" is widely accepted in the biomedical and anthropological literature (Dundes, 2003; Weiner, Monge, & Mann, 2008), there is still much debate about the species in which this pattern emerged due to the rarity of hominin female fossil pelvis and the variety of factors determining pelvis anatomy (for an extensive review see Gruss & Schmitt, 2015). It is not the goal of this paper to revisit this disputed argument that it is beyond our area of expertise, we just aim to add another point of discussion by

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drawing the attention towards the process of parturition in one of our closest living relative.

Humans differ from their closest living relatives in their need for assistance during delivery (Brandt & Mitchell, 1971). The more favourable relationship between the dimensions of the maternal birth canal and neonatal head size in nonhuman primates results in less difficult and more rapid deliveries and this is particularly true for great ape species in which infants are small in relation to maternal body size (Rosenberg & Trevathan, 2002). The typical mode of neonatal emergence from the birth canal in nonhuman primates seems to be the *occiput posterior* (i.e. the infant is born facing the mother's *ventrum*), which enables nonhuman primate parturients to hold and pull the infant out by themselves, making the mother self-sufficient in achieving the delivery (Trevathan, 2011; but see Hirata, Fuwa, Sugama, Kusunoki, & Takeshita, 2011).

All primates are social animals but the composition of primate social groups and the extent of social interactions differ considerably from species to species (Fleagle, 2013) and this certainly reflects on the moment of parturition. According to the species and the inter-individual relationships, females might give birth in isolation or within their social group and, in the latter case, the type and extent of social interactions with other group members could greatly vary, as confirmed by the available studies describing parturition in nonhuman primates (*isolation*: Duboscq, Neumann, Perwitasari-Farajallah, & Engelhardt, 2008; Nowak, Porter, Lévy, Orgeur, & Schaal, 2000; Starin, 1988; *within group without social interactions*: Kinnaird, 1990; Peker, Kowalewski, Pavé, & Zunino, 2009; Turner et al., 2010; Windfelder, 2000; *within group with extensive social interactions*: Ding, Yang, & Xiao, 2013; Douglas, 2014; Pan et al., 2014). There are several factors determining this paucity of observations. In diurnal species deliveries usually occur at night, thus making their observation very difficult (Jolly, 1972). In the wild, mothers may seek safe/hidden places, thus increasing the difficulty in following the deliveries, whereas in captivity mothers can be separated from their group for veterinary reasons, thereby precluding the possibility of investigating the social dynamics occurring during birth.

It is currently impossible to draw conclusions on the extent of birth sociality in nonhuman primates due to the absence of multiple reports on the same species that does not permit to comprehend whether some forms of social support are present/recurrent in species other than humans. Such an approach is essential to control for the high individual behavioural variability and to link the results to the social characteristics of the species.

Here, we present the first quantitative analysis on the social dynamics during three daytime births in captive bonobos. The bonobo (*Pan paniscus*), together with the chimpanzee (*Pan troglodytes*), is the closest living human relative (Prüfer et al., 2012). Both *Pan* species live in a fission-fusion social system, meaning that they live in large social groups, so-called *communities*, that can count up to 150 individuals (for an extensive review see Boesch, Hohmann, & Marchant, 2002). Individuals of the same community typically split to form sub-groups, so-called *parties*, whose composition changes over time (Boesch et al., 2002). Although the social system is the same, compared to chimpanzees, bonobos show a much higher degree of cohesiveness, with different *parties* ranging in adjacent areas and travelling in the same direction (Furuichi, 2009). Bonobos and chimpanzees are both characterized by male philopatry and female dispersal (Kano, 1992) and this leads to a higher degree of relatedness between males than between females (White, 1996). According to the principle of kin-selection (Hamilton, 1964), a higher level of cooperation among males should characterize both *Pan* species. However, this is not the case. Whereas chimpanzees follow this general biological rule (Morin et al., 1994), bonobos represent a well-known exception with females showing a higher degree of cohesiveness, alliances and support than males (Surbeck, Mundry, & Hohmann, 2011; Tokuyama & Furuichi, 2016). These strong relationships provide unrelated females with the ability and the potential to be dominant over males (Furuichi, 2011; Gruber & Clay, 2016). Moreover, it seems that female gregariousness, together with a relaxed feeding competition, allowed bonobos to evolve as a less aggressive and more tolerant species compared to chimpanzees (de Waal & Lanting, 1997; Furuichi, 2011; Hare, Wobber, & Wrangham, 2012; Kano, 1992; Palagi, Paoli, & Borgognini Tarli, 2006).

With regard to bonobo births, only four births have been reported in captivity (Bolser & Savage-Rumbaugh, 1989; Kirchshofer, 1963; van Elsacker, Vervaecke, Walraven, & Verheyen, 1993) and one in the wild (Douglas, 2014), but in such studies the description of the social environment is either missing because the mother was isolated from other group members by the zoo staff (Bolser & Savage-Rumbaugh, 1989; Kirchshofer, 1963) or it is qualitatively described (Douglas, 2014; van Elsacker et al., 1993).

In this study, first we will test some hypotheses to understand if birth in bonobos shares some of the general elements characterizing traditional birthing practices in humans. The results obtained on bonobos will be then discussed through a comparative approach focussed on the two *Pan* species and on humans. Our study aims at contributing to the current debate on the evolutionary origin of "*midwifery*" questioning whether birth attendance could have been already present before the evolutionary emergence of the "*obligation*" of assistance.

1.1. Spatial proximity to the parturient

Review of the cross-cultural literature reveals that giving birth in presence of others is almost a human universal (Newton & Newton, 2003; Schiefenhövel, 1983). There are few exceptions to this universal pattern, as in the case of the !Kung population of South Africa where the concept of isolated birth represents a cultural ideal linked to the high symbolic value attributed to personal courage (Shostak, 2014). Also by the !Kung, however, isolated birth is a rarely achieved ideal, especially for women giving birth for the first time (Konner & Shostak, 1987).

If bonobo parturients prefer to give birth in presence of others, we predict that they should not tend to isolate themselves from the rest of the group (*Prediction 1a*). Moreover, if a social interest towards the parturient is shown also by bonobos, we predict that group members should gather around the mother during the hours of delivery compared to other days (*Prediction 1b*).

1.2. Female birth attendants and behavioural expression of arousal

In humans, birth attendance is typically undertaken by women who provide emotional and psychological support to the mother and who are generally her friends or kin (Cosminsky, 2003; Ford, 1945; Newton & Newton, 2003). Bonobo females establish strong and long-lasting affiliative bonds, even though they are not closely related (Furuichi, 2011; Tokuyama & Furuichi, 2016). If bonding also plays a role during the delivery in bonobos, we predict that females should stay in closer proximity to the parturient (≤ 1 m, including physical contact, *Prediction 2*) and display higher levels of behavioural expression of arousal than males (*Prediction 3*).

During delivery, bonobo bystander females could be attracted by three different elements: the mother, the placenta and the newborn. If close proximity is a *parturient*-oriented behaviour, we predict that female cohesiveness should be higher in the first phase of the delivery, before the baby is born and the placenta is expulsed (*Prediction 4*).

1.3. Protection

In humans, birth attendants are in charge of protecting the mother and the newborn from a great variety of both real and symbolic dangers, such as attacks of wild animals (Konner & Shostak, 1987), physical injuries or negative supernatural forces (Dundes, 2003). Also the common exclusion of men from birthing practices may reflect a form of protection, given that men are often very anxious and apprehensive and