Abstract
In this article, nascent jealousy’s ultimate foundation is theorized as an adapted psychological mechanism that evolved in the environment of evolutionary adaptedness (EEA) to prepare 1-year-olds for defending against premature weaning upon the closely spaced birth of a sibling. This position rests on evidence that nascent jealousy is expressed through jealousy protest, a constellation of caregiver-directed protests and bids for exclusive attention, and evidence that its onset occurs at approximately 9 months of age. Given that the period of human gestation is 9 months, we propose that jealousy protest’s form and timing were compelled by the possibility that the end of an infant’s first year could be met by competition with a newborn sibling. That possibility placed infants at risk of malnutrition and mortality due to entailing the loss of exclusive access to mother’s milk, while infants were at an age when they were still heavily reliant on breast milk for survival. At this juncture, threat posed by the birth of a sibling was compounded by conditions of the EEA, where the sole viable source of breast milk was an infant’s mother, and her supply of milk was sufficient for sustaining only one child at a time. We conclude by offering suggestions for future research and discuss implications for the theory of parent–offspring conflict as a foundation of adaptations in children.

Keywords
parent–offspring conflict, jealousy, breastfeeding, weaning, birth spacing, kwashiorkor, ontogenetic adaptation, sibling rivalry, environment of evolutionary adaptedness (EEA), psychological adaptation

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physical attractiveness, smiling, and eye contact (Eibl-Eibesfeldt, 1970; Goldberg, 1977), rather than jealousy, an emotion that leads to advancing similar goals but at another child’s expense. The notion that jealousy, an emotion that is widely construed as a personality flaw, can be applied to children and placed in a positive light may be anathema to many in the field of developmental psychology, a group that has been criticized for its recalcitrance toward this line of thought (Hart, Carrington, Tronick, & Carroll, 2004; Hawley, Little, & Rodkin, 2007; Vaughn, Vollenweider, Bost, Azria-Evans, & Snider, 2003).

Reluctance to explore jealousy’s adaptive function in children is not entirely unwarranted. Investigative attention to jealousy in children is hampered by limitations in children’s use of language, and so researchers attempt to interpret behavioral expressions. However, behavioral expressions of jealousy are not easily distinguished from actions that are motivated by other negative emotions, especially when such emotions occur simultaneously (Pollet & Hoben, 2011). For example, jealousy has been implicated in child distress upon the birth of a sibling. Naturalistic studies found that usurpation which precipitates jealousy is interwoven with other stressors, including separation from mother during childbirth, changes in household routine, and reduced quality of parenting due to the physical and emotional demands of pregnancy and caring for a newborn infant. Faced with ambiguity, researchers have chosen to interpret children’s negativity upon a sibling’s birth as the outcome of environmental factors (Dunn, 1992), while dismissing the possible contribution of a child’s feelings of jealousy.

Evolutionary theorists have been especially reluctant to address jealousy in infants. Hesitation has been driven by tradition in which jealousy is classified, not as an early-emerging “basic” emotion, but rather as a “complex” emotion that does not emerge until the latter half of the second year of life. This position grew from research on the emotion of shame which found that the ability to experience this emotion depends on the child having acquired sense of self, an accomplishment that taps cognitive skills which are unavailable to infants less than 18 months of age (Lewis, Sullivan, Stanger, & Weiss, 1989). This work led theorists to assume that findings on shame were applicable to jealousy (Fischer, Shaver, & Carnochan, 1989; Masiuch & Kienapple, 1993). However, it is not clear that shame is unavailable to infants less than 18 months of age (Reddy, 2003, 2010; Trevarthen, 2005), and the assumption that self-recognition is essential to jealousy has yet to be empirically verified (Campos, Walle, & Dahl, 2010; Hart, 2016; Hobson, 2010, 2012; Panksepp, 2010). Furthermore, the assumption that findings on shame apply to jealousy was based largely on the fact that unlike basic emotions, such as anger and fear, jealousy and shame are not paired with a distinctive facial affect expression (Ekman, 1973). However, some have questioned the relevance of attention to facial affect expression toward classifying emotions (Buss, 2013; Sabini & Silver, 2005). Buss (2013) has argued for classifying sexual jealousy as a basic emotion, notwithstanding the absence of a distinctly associated facial affect expression, on the basis of its adaptive function toward reproductive success.

Limited support for traditional views of jealousy as a complex emotion has given way to considering that a nascent form of jealousy may be available to infants less than 18 months of age. Receptivity toward this possibility has been bolstered by studies in the field of social cognition that have uncovered evidence that the ability to process collaborative activities and triadic social exchanges may be within the capacity of infants as young as 6–12 months (Hamlin, 2014; Tomasello, 2014; Tomasello et al., 2005; Wynn & Bloom, 2014). These studies documented young infants’ abilities to decipher social exchanges that are not directed toward themselves, to formulate moral judgments of the characters involved in those exchanges, and to draw inferences with respect to the goals, intentions, and upcoming actions of those characters. Hart (2015, 2016) has argued that these findings disclose a level of cognitive sophistication that speaks to the possibility that by the latter half of the first year, an infant is able to process an exchange between his mother and another infant. Thus, it is feasible that when observing his mother treat another child with affection, an infant is able to interpret that exchange as representing a violation of his expectation, based on a lifetime of favored access to his mother, that he alone is the object of his mother’s affection and the prime beneficiary of her largess.

Notions of nascent jealousy as an early-emerging emotion have been upheld by experimental studies that manipulated the object of maternal attention. These have compared 5- to 13-month-olds’ responses during an experimental condition, in which mother’s positive attention was directed preferentially toward a baby or a lifelike baby doll, versus a control condition, in which it was directed toward a nonsocial object or an adult. They have consistently found that infants demonstrated greater evidence of perturbation during the experimental condition (Draghi-Lorenz, Reddy, & Costall, 2001; Hart & Carrington, 2002; Hart, Field, Del Valle, & Letourneau, 1998; Mize & Jones, 2012; Mize, Pineda, Blau, Marsh, & Jones, 2014). The fact that maternal inattentiveness toward her infant was held constant across conditions rules out the possibility that infants’ greater negativity in the experimental condition could be attributed simply to being ignored. Given that mothers were not pregnant, it seems unlikely that perturbations could be attributed to confounding stressors that have been problematic in naturalistic studies. Thus, as in similar experimental research on favoritism using toddler- and preschool-aged children that uncovered similar patterns of response (Bauminger, Chomskey-Smolkin, Orbach-Caspi, Zachor, & Levy-Shiff, 2008; Szabo, Dubas, & van Aken, 2014; Teti & Ablard, 1989; Volling, McElwain, & Miller, 2002), investigators have consistently interpreted infants’ greater negativity in the experimental condition to a nascent form of jealousy.

Evidence of nascent jealousy as emotionality that is within the capacity of young infants opens opportunity for exploring features of its expression that can serve as clues toward understanding this phenomenon as an evolutionarily adapted mechanism. Some of those clues and their implications are presented in this article.
Nascent Jealousy as an Evolutionarily Prepared Phenomenon

An inherited mechanism underlying sexual and romantic jealousy has been indicated by evidence of continuity across cultures (Hupka, 1991). It has also been indicated by universal trends in gender differences in adults (Buss, Larsen, & Westen, 1992; Daly, Wilson, & Weghorst, 1982; Kruger et al., 2013; Shackelford & Buss, 1997) and evidence of gender differences in nascent jealousy (Hart et al., 2004), suggesting an evolved design feature. Jealousy has also been observed across species, such as chimpanzees, gorillas, horses, and dogs (de Waal, 2005; Goodall, 1986; Harris & Prouvost, 2014; Morris, Doe, & Godsell, 2008). Evidence of a primordial form of jealousy in nonhuman species was obtained in research that documented heightened agitation during an experimental condition in which dogs witnessed their owners attending to another dog (Harris & Prouvost, 2014). This finding corresponds to reports of weaning distress in chimpanzees (Goodall, 1986) in that it exposes jealousy as a mechanism of importance to protecting valued relationships, including those which are not sexual or romantic.

Nascent jealousy in human infants has been interpreted as an endogenously based feature of temperament on the basis of its early emergence during infancy despite limited experiences of competition or dethronement (Hart, 2010, 2015). Without entertaining the role of an endogenous influence it is difficult to explain why infants as young as 5 to 6 months (Draghi-Lorenz et al., 2001; Hart & Carrington, 2002; Hart et al., 2004), including firstborns, are troubled by observing their mothers’ direct positive attention toward a baby. Given that a smiling mother and a baby are benign stimuli when presented separately, there are few ways to account for an infant’s negative response when these two stimuli appear together. In light of the earliness and readiness with which it is acquired, nascent jealousy is understood as a robust phenomenon that formed, like other early and easily acquired motivational states (Nesse, 1990; Ohman & Mineka, 2003), as an outcome of psychological preparedness that evolved in the EEA (Panksepp, 2010).

The Second Year of Life

Nascent jealousy is also notable for its course of unfolding during a period that spans the latter portion of the infant’s first year. Whereas nonmobile 5- to 6-month-olds’ expressions of nascent jealousy are limited to negative facial affect, approach postures, and heightened arousal (Draghi-Lorenz et al., 2001; Hart & Carrington, 2002; Hart et al., 2004), mobile 10- to 13-month-olds exhibit acute caregiver-directed protests and bids for exclusive attention (Hart & Behrens, 2013; Hart, Field, Del Valle, et al., 1998). These affective and behavioral presentations are interrelated with each other and with a pattern of neurological activity (Mize & Jones, 2012; Mize et al., 2014) that has been associated with jealousy in adults, yielding a constellation termed jealousy protest (Hart, 2015; Hart, Field, Letourneau, & Del Valle, 1998).

As demonstrated by mobile infants, jealousy protest is remarkably similar to descriptions of the manner in which jealousy is presented by toddler- and preschool-aged children (Bauminger et al., 2008; Cummings, Zahn-Waxler, & Radke-Yarrow, 1981; Hart & Harris, 2014; Masciuch & Kienapple, 1993; Szabo et al., 2014; Teti & Ablard, 1989; Volling et al., 2002). This correspondence is significant for it suggests that a rudimentary repertoire of responses for defending against favoritism is in place by the end of the infant’s first year of life. This timing may be key to understanding why jealousy protest could have been adaptive to survival in the EEA. Evolutionary developmental psychologists point out that the significance of an evolved behavior can be approached by asking what specific obstacle was an individual in the EEA routinely faced with at a particular time in ontogeny and how was it resolved (Bjorklund, 2015; Bjorklund & Yunger, 2001). Thus, rather than simply asking, why was jealousy important to children, it may be profitable to ask, what problem, in particular, made jealousy vital to 9-month-olds?

Problems faced by infants as they approached their second year of life can be appreciated by considering social features of the EEA. This context is poorly understood (Simpson, 1999), but it is clear that there were infants and that few resources could have been more vital to an infant than his mother’s milk. In the small cooperative groups where our ancestors lived (Eibl-Eibesfeldt, 1970), an infant’s mother may have been the only lactating female in the clan. Thus, an infant’s sole source of milk was probably his own mother. Even if other lactating mothers were in proximity, and even if those mothers were willing to share some of the benefits that are inherent in breastfeeding, such as comfort, protection, and thermoregulation (Hrdy, 2005; Konner, 2010), it is unlikely that they would have gone so far as to take full responsibility for nursing an additional child for a period lasting 3–4 years. Doing so would have placed their own infants at risk of mortality (Gray, 1982; Lancy, 2015), and as Hrdy (2007) points out, an alloparent was unlikely to provide caregiving to nonbiological offspring if doing so would have come at a cost to her own offspring’s viability.

This portrayal is supported by examining traditional societies, where just a few hundred years ago the mortality rate of children under 5 years of age was 50%. Unfortunately, this reality is still not unknown in harsh environments, where food supplies are scarce and where women are undernourished and overworked (Dettwyler, 1995; Konner, 2010; Stuart-Macadam, 1995). If they are lactating, their milk supplies can be depleted to the point of being insufficient for nourishing even one child and can even be withheld if that infant is sickly and deemed likely to perish (Bjorklund & Jordan, 2013; Hobcraft, McDonald, & Rutstein, 1983; Jetiffié & Jetiffi, 1978). Due to the metabolic demands of breastfeeding two children at the same time, women living in harsh environments refrain from suckling more than one child at a time (Christian, 2008; de Onis, 2008). Prohibitions against nursing two children simultaneously are deeply engrained in numerous societies. Some engage in practices where an infant is placed at risk of neglect or
abandonment, or even infanticide, if he is born with a twin or has an unweaned older sibling, or following his mother’s death (Daly & Wilson, 1984; Geary, 1998; Gray, 1982; Hrdy, 1992, Lancy, 2015; Scrimshaw, 1984).

Because nursing mothers who live in such conditions are keenly aware of the prohibitions and risks of nursing two infants, they wean one child before giving birth to another (Konner, 2010). Unfortunately, without the nutritional, immunomodulatory, antimicrobial, and anti-inflammatory properties of mother’s milk, weanlings then become vulnerable to malnutrition which, in turn, places them at risk for cognitive deficits, stunted growth, morbidity, and mortality. In less developed countries, the major cause of death in 1- to 5-year-old children is disease, and in over half of those cases, the underlying cause of disease is malnutrition (Christian, 2008; Dyson, 1977; Ellison, 1995; Lawrence & Lawrence, 2015; Prentice, 1991). In comparison with well-nourished children, malnourished children are twice as likely to die, and severely malnourished children are 7 times as likely to die (Worthman, 2010).

Of deaths among children in the 1- to 5-year age range, over half occur in 12- to 23-month-olds. Those cases tend to occur following short succeeding birth intervals (Christian, 2008; de Onis, 2008; Dyson, 1977; World Health Organization [WHO], 2006), as illustrated in a prospective longitudinal study conducted in sub-Saharan Africa (Fotso, Cleland, Mberu, Mutua, & Elungata, 2013). It found that in comparison with last-born children, children who experienced the birth of a sibling by the age of 20 months were more than twice as likely to die by their second birthday. Consequences are even more dire for infants who experience the birth of a sibling by their first birthday. In such cases, rates of mortality in 12-month-olds have been found as high as 77% (Berg & Brems, 1989). A WHO report points to “the period around weaning as a time of particular susceptibility . . . This partly explains why in Africa, where weaning usually tends to be in the second year of life mortality between 12 and 23 months of age can be particularly high” (Dyson, 1977, pp. 294–295) and can even exceed rates of mortality at birth.

Due to overwhelming evidence of risks associated with close birth spacing, health organizations for several decades have unanimously and vigorously advocated for family planning that results in birth intervals that extend beyond 24 months and for continued breastfeeding throughout that interval. Initially, this policy was adopted for promoting benefits to newborn infants and mothers. However, in light of growing understanding of malnutrition as an outcome of premature weaning and as the leading underlying cause of child mortality, admonitions against close birth spacing have increasingly been promoted for also extending benefits to existing children, especially those in the second year of life (Berg & Brems, 1989; Hobcraft et al., 1983; U.S. Agency for International Development [USAID], 2002; WHO, 2006).

Apparently, the perils of premature weaning upon a sibling’s birth are well known among the people of Ghana. A serious form of protein–energy malnutrition, with swollen abdomen its most prominent sign, is known as Kwashiorkor. That name was adopted from the Ga language by Cicely Williams, the eminent pediatrician who was appointed the first director of the Maternal and Child Health section of the WHO upon her recognizing the disease as a form of advanced malnutrition and identifying breastfeeding as its cure. She explained that the name literally means “the disease the deposed baby gets when the next one is born” (Williams, Oxon, & Lond, 1935, p. 1151) and described symptomatology as “a connotation of jealousy between siblings, as well as physical sickness” (Williams, 1973, p. 334).

### Conclusions and Directions for Future Research

Trivers suggested that various psychological and behavioral characteristics of children were adaptations that emerged for the purpose of attracting or augmenting levels of parental investment. In particular, weanlings adapted to usurpation through the evolution of “psychological weapons” (1974, p. 249). We assert that this theory is borne out by evidence that infants are armed with a repertoire of responses for defending against favoritism. That repertoire is jealousy protest, a constellation of caregiver-directed protests and attention-getting behaviors for protecting exclusive access to a caregiver.

Furthermore, evidence that jealousy protest has onset at approximately 9 months of age suggests ontogeny that is timed with the duration of human gestation. Toward the end of the first year of life it was possible for an infant to be confronted with the problem of having to compete with a newborn sibling for mother’s milk. Moreover, he would have had to do so while his digestive and immune systems were too immature to permit survival without this source of nourishment, and while living under conditions of the EEA where the sole viable source of breast milk was his mother, and her supply of milk was insufficient for sustaining more than one child at a time. This nature of threat to infant survival is exceedingly well documented across a range of disciplines, including pediatrics, nutrition, lactation, public health, epidemiology, and demography, as well as in ethnographic and qualitative accounts by anthropologists and cultural psychologists. In each of these disciplines, close birth spacing and premature weaning have been identified as posing threat to the survival of infants who live in harsh conditions where there are few healthy substitutes for mother’s milk (Christian, 2008; de Onis, 2008; Dyson, 1977; USAID, 2002; WHO, 2006; Williams et al., 1935). Thus, we propose that the 9-month period of human gestation concludes just as jealousy protest is set in place, and this is not mere coincidence. Dovetailing between these two events leads us to propose that the problem faced by 9-month-olds in the EEA was premature weaning upon the birth of a sibling, and the solution to that problem was a psychological adaptation for defending against favoritism that is expressed as jealousy protest.

Given that the period of human gestation is 9 months, a sibling’s birth would have been a threat from which infants were shielded during much of their first year, a period that
rendered exclusive access to mother’s milk virtually guaranteed. Granted, most infants in the EEA probably did not encounter competition with a newborn sibling until they were somewhat older. However, there was significant diversity in weaning ages and birth spacing among prehistoric populations (Stuart-Macadam, 1995; Tsutaya & Yoneda, 2015; Waters-Rist, Bazaliiskii, Weber, & Katzenberg, 2011). Variation depended on child health, sex and birth order, health of the mother, resource availability, and local customs. Although relatively infrequent, succeeding birth intervals as brief as 1 year must have occurred, in which case they must have entailed risk of such magnitude (Berg & Brems, 1989; Dyson, 1977) as to have compelled psychological adaptation. Moreover, nascent jealousy’s onset in the first year of life does not preclude the possibility that it, like all emotions, continues to unfold through a course of development that leads to more mature forms. With increments in cognitive attainments, nascent jealousy is likely to become increasingly sophisticated (Campos et al., 2010; Hobson, 2010, 2012; Lewis, 2010) and possibly more robust. Cross-sectional research on jealousy’s expression in infants and children up to the age of 7 years found that its peak level of robustness is demonstrated by 20-months-olds (Masciuch & Kienapple, 1993), suggesting a progression in externalizing presentations of jealousy that peaks just as the likelihood of a newborn sibling’s birth becomes more probable.

Despite compelling evidence that jealousy is within the capacity of infants and children across a wide range of ages, it is unclear how its nascent form in infancy relates to its expression at later stages of development. Such uncertainty may have contributed to discrepant interpretations of findings that have detracted from appreciating parent–offspring conflict as a potential foundation of adaptations in children. One example can be found in work on jealousy protest in the context of weaning where it is referred to as “weaning distress.” Whereas Fouts and Lamb (2005) found little evidence of weaning distress in 3- to 4-year-old Bofi forager weanlings, Ainsworth’s (1967) (Ainsworth & Tracy, 1972) report on 12-month-old weanlings in Uganda described weaning distress, “as great a trauma as traditional psychoanalysts have always claimed weaning to be . . . They behaved like children after a traumatic institutional separation” (Ainsworth & Tracy, 1972, pp. 7–8). Although Fouts and Lamb (2005) upheld their findings as evidence that disproved evolutionary theorists’ notions of jealousy as an evolved psychological weapon, it is possible that cessation of breastfeeding triggers weaning distress, but only in infants as young as those observed by Ainsworth. This possibility calls for investigative attention to weaning distress as a function of child age. It may also be useful to incorporate attention to related compounding influences, especially birth order (Hossain, Mani, & Islam, 2015; Sahu, Nair, Singh, Gulati, & Pandey, 2015). The birth of a sibling may be even more challenging to infants who have older siblings. Middle-born children are at increased risk of parental underinvestment (Salmon & Daly, 1998; Sullaway, 2011), a situation that may be especially disadvantageous for those who are unweaned infants.

Attenuated expressions of jealousy by the age of 4 years have also been observed outside contexts that involve lactation. Laboratory studies (Teti & Ablard, 1989; Volling et al., 2002) that manipulated the direction of a parent’s preferential attention among children observed lesser presentations of jealousy in preschoolers than in toddlers. Attenuation was attributed to preschoolers’ superior capacity for emotion regulation (Teti & Ablard, 1989), leaving it unclear whether decreases in observable presentations of jealousy were matched by decreases in felt experiences of jealousy. As for other negative emotions (Lewis, 2015), preschoolers’ dampened expressivity could have reflected superior capacity to mask an emotion, a social skill that children of this age can deploy upon recognizing that an authentic display of emotion is inappropriate or unwelcome. In fact, it is possible that over time, internal experiences of jealousy may actually become more acute or florid. Increases in cognitive capacities that enable experiences of emotions, such as shame, may serve to exacerbate the experience of jealousy. Research using physiological measures of emotional reactivity may be helpful toward separating children’s felt experiences of jealousy from their observable presentations. Such treatments could help establish whether phenotypically distinct expressions of jealousy share a common foundation.

Further insight into parent–offspring conflict as a potential foundation of adaptations in children may be gleaned through attention to continuity in nascent jealousy’s expression, not only across age, but also across eliciting conditions. It is possible that parent–offspring conflict played a rather circumscripted role in propelling nascent jealousy as an ontogenetic adaptation (Bjorklund & Ellis, 2014) that is relevant strictly to its expression during infancy and solely within contexts that involve competition with a newborn sibling for mother’s milk. Even so, one can speculate that an adaptation of this nature could have instigated subsequent responses and adaptations (Frankenhuis & Del Giudice, 2012). One plausible pathway can be contemplated by drawing on an operational definition of jealousy in adults, as the response that occurs when “a person either fears losing or has already lost an important relationship with another person to a rival” (Parrott, 1991, p. 4). Reference to the emotion of fear is provocative for it seems compatible with interpretations of jealousy-evoking situations as a triggering sense of threat in children (Teti & Ablard, 1989). This leads to speculation that fear may also be responsible for stimulating nascent jealousy in infants. If so, it is possible that infants process threat posed by a newborn sibling much as they process evolutionarily relevant threats, such as snakes and spiders (Nesse, 1990; Ohman & Mineka, 2003). Those sorts of fears have been found responsible for engendering perceptual biases that precipitate a range of ensuing fears, some rational, some not (DeLoache & LoBue, 2009). Inquiry into whether a similar process applies to nascent jealousy may reveal that the ontogenetic adaptation that originated by the virtue of its role in enhancing fitness of infants who were threatened by a newborn sibling precipitates responsivity and/or hypersensitivity to
other situations where an important relationship appears to be threatened by a rival.

In sum, we call for inquiry into behavioral and physiological expressions of nascent jealousy across situations that do and do not involve nursing mothers or infant siblings. Fruitful efforts will utilize prospective, longitudinal approaches that can identify stable individual differences across age within a range of eliciting conditions where exclusivity in a valued relationship is challenged by a rival. Such efforts should help shed light on whether parent–offspring conflict was a context that led solely to nascent jealousy or if it gave rise to nascent jealousy and a cascade of ensuing presentations and possible adaptations. The latter possibility leads to the intriguing notion that parent–offspring conflict had far-reaching implications for the development of jealousy beyond infancy.

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