Developmental Context Effects on Bicultural Posttrauma Self Repair in Chimpanzees

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Longitudinal studies have shown how early developmental contexts contribute significantly to self-development; their influence extends through adulthood, informs sociality, and affects resilience under severe stress. While the importance of sociality in trauma recovery is recognized, the relationship between developmental and posttrauma contexts and recovery effects is less appreciated, particularly in cases in which recovery contexts differ widely from the culture of origin. Using an attachment-based model of bicultural (competence in two cultures) development, the authors examined the role of self in posttrauma repair of chimpanzees (*Pan troglodytes*) who had been differentially reared by humans during neuroethologically formative periods and subsequently used as biomedical subjects. Results show that variations in posttrauma schema correlate with early socialization patterns. Self-resilience supports, but also may constrain, recovery depending on the compatibility of internal self models with recovery resources. Trauma severity notwithstanding, the cultural context of origin emerges as a critical factor in designing effective therapeutic intervention and assessments in primates, humans inclusive. Finally, the results underscore the ethical implications for the practices of cross-fostering nonhuman primates and their use in research.

Keywords: bicultural, chimpanzee, self, trauma, identity, attachment

"Give me the boy until the age of 7 and I will give you the man." The exact source of this saying is unknown. At various times, C. G. Jung, Sigmund Freud, St. Ignatio Loyola, and St. Francis Xavier have been credited. Origins aside, the idea has been around for a long time, and absent the rather stern overtones, multiple studies confirm the essence of this adage: Early social experience has a formative, lasting effect on the developing brain (Perry, Pollard, Blakely, & Baker, 1995; Schore, 1994; Siegel, 1999).

Receptivity to and fidelity of attachment processes are shown by the persistence of childhood trauma effects. Traumatic disruption from a single threatening event alone can create life-long changes in social learning abilities and neural organization (Herman, 1992; Perry et al., 1995; Schore, 2005). Further, the nature and quality of attachment style are correlated with the ability to survive severe

trauma (de Zulueta, 2006; Krystal, 2004). These findings and an accumulation of studies linking childhood trauma to adult psychological disorders focus attention on how variations in developmental context affect brain and behavior in diverse altricial species (Bowlby, 1973; Bradshaw & Schore, 2007; Lee & Moss, 1999; West, King, & White, 2003). A robust literature on the subject attests to the important ecological and evolutionary roles played by attachment (Bjorklund, & Grotuss, 2006; Bjorklund & Rosenberg, 2005).

Less well known are the complex relationships between developmental pathways and posttrauma recovery schema. Just as the developing self depends on early relational contexts, so does the self in the process of posttrauma repair (Herman, 1992: Schore, 2003b). The expression of an individual's experience is fundamentally socially mediated and reflective of the ecosocial context in which he or she is embedded (Kirmayer, 2005). Interpreted more broadly, these concepts apply to bicultural (i.e., competence in two cultures; LaFromboise, Coleman, & Gerton, 1993) settings where the self sense of coherence may be challenged in the process of acculturation and negotiating alternative contexts at various points within a lifetime (Cederbald, Pruksachatkunakorn, Boripunkul, Intraprasert, & Höök, 2003; Matsudaira, 2006; Padilla, 2006). Consequently, in recovery, an individual's ability and style of social engagement are predicted to reflect both how and with whom the self has developed (attachment context) and how and with whom repair occurs (recovery context).

However, overall, the topic of bicultural experience has not been well studied in developmental psychology (Padilla, 2006). Even less investigation has been effected in communities where migra-

tion and violence have fragmented cultural integrity. Despite the fact that trauma recovery has become a pressing issue in communities around the world, mental health programs have been criticized for failing to design culturally appropriate intervention plans for non-Western communities suffering from war and displacement (Bracken, 2002; Igreja, 2003; Igreja, Kleijn, & Richters, in press; Oxfeld & Long, 2004; Silove, 2002; Tolfree, 1995). Researchers working with separated children[1] (United Nations High Commission for Refugees, 2000) point to the "lack of attention to the context in which children have been raised and the differential impacts contextual variations may have on child development" (Mann, 2007, p. 18; Yeo, 2003). Survivors face the task of rebuilding a life in a radically different culture by force of both their own change and changes in the community in which they find themselves in the wake of war and other profound disruptions (Herman, 1992; Marsella, 2008). A parallel situation confronts other vulnerable populations, cross-fostered (reared by other than a member of own species, enculturated) primates.

Using a bicultural attachment–based model, we examined the influence of self-development parameters in posttrauma recovery of chimpanzees (*Pan troglodytes*) as a function of differential rearing contexts. Human-reared chimpanzees comprise a broad constituency, many of whom are subsequently subjected to laboratory confinement and use in biomedical research. While the impact of cross-fostering on adult behavior (Bjorklund & Rosenburg, 2005) and its effects on chimpanzee self-identity (Temerlin, 1980) are recognized, little study has been conducted for any species, human or otherwise, on posttrauma repair from the standpoint of internal models of self created through varying developmental contexts (see, however, Krystal, 2004). In this study, we utilized cross-cultural attachment models (Greenfield, Keller, Fugligni, & Maynard, 2003; Kirmayer, 2005) to explore self-resilience as a facilitator of trauma recovery and its role as a potential constraint to psychological well-being when intrapsychic mechanisms and constructs fail to adequately adapt to external recovery contexts.

Our analysis contributes to a newly articulated trans-species psychiatry and psychology that has emerged from vertebrate-common, human-inclusive psychobiological models, that is, a shared model of brain, behavior, and mind that simultaneously accommodates humans and other animals (Blanchard & Blanchard, 1984; Bradshaw, Capaldo, Lindner, & Grow, 2008; Bradshaw & Finlay, 2005; Bradshaw & Sapolsky, 2006; Brüne, Brüne-Cohrs, & McGrew, 2004; Brüne, Brüne-Cohrs, McGrew, & Preuschoft, 2006; Fabrega, 2006) and that extends even to the concept of the self (Northoff & Panksepp, 2008). Such cross-species fluidity expands and enriches cross-cultural studies as well as provides deeper insights into humans' closest genetic relatives who, like so many in human communities, have suffered from violence and social breakdown.

Finally, these findings poignantly underscore the ethics of holding chimpanzees in captivity (Brüne et al., 2004; Mastrepieri, 2003; Troisi, 2003). It has been recognized that the stress of captivity and use in research are responsible for a suite of symptoms diagnosed in human political prisoners, genocide survivors, and victims of domestic violence (e.g., complex posttraumatic stress disorder [PTSD]; Bradshaw et al., 2008; Brent, Lee, & Eichberg, 1989; Lilienfeld, Gershon, Duke, Marino, & de Waal, 1999; Nash, Fritz, Alford, & Brent, 1999; Troisi, 2003). However,

despite acknowledging the profound psychobiological, emotional, and cognitive comparability of humans and other primates (see Nelson & Winslow, in press), ethical comparability is denied. Scientific recognition compels ethical recognition to prevent trauma by addressing both the causes and effects of maintaining nonhuman primates in captivity (Brüne et al., 2006).

Bicultural Model of Self-Development and Repair

Attachment (early caregiver–infant bonding) is the first stage in the broader spectrum of socialization (Bowlby, 1969/1999). Developmental processes have been central to theories of psychology in one form or the other since the formal beginnings of psychology (Freud, 1900/1966; Klein, 1975). However, attachment took on a completely different status when the link between environmental and genetic aspects were realized (Schore, 1994, 2003a, 2003b; Siegel, 1999). What has been observed behaviorally—social dynamics, learning, and psychological development (Bowlby, 1969/1999)—is now understood to be mirrored in neurobiology across altricial species (Bradshaw & Sapolsky, 2006; Schore, 2005). This knowledge provides answers as to why attachment experiences are so enduring.

Socially dominated development coincides with periods of rapid brain growth and the shaping of evolving affective and self-regulatory systems (Schore, 1994, 2005; Siegel, 1999). Altricial vertebrate brain development is experience-dependent and highly sensitive to environmental input and change (Bradshaw & Schore, 2007; Meaney, 2001; Orosz & Bradshaw, 2007). Culturally contingent socioaffective attachment processes also form the medium through which identity is created (Greenfiel et al., 2003; Schore, 1994). Through processes of bonding, infants generate an internal relational model of themselves that negotiates with the dynamic environment (Bowlby, 1969/1999; Klein, 1975). Early development is a, if not the, formative process that shapes the psychophysiology of an individual, his or her sense of identity, and an understanding of how to exist and behave in a social surround and to form satisfying emotional and physical relationships (Perry, 2007; Schore, 2003a, 2003b; Siegel, 1999; Stern, 1985). The self is social and relational (Chen, Boucher, & Parker Tapias, 2006).

Bowlby (1969/1999) observed that infants in the first months have no preference for their biological parents relative to other individuals and only develop a preference for those who provide attention and care over a period of time. Developmental evolutionary psychology attributes epigenetic plasticity to the evolution of the social brain (Dunbar, 1998): Extreme neuroethological plasticity is one way in which the complexity that sociality demands can be accommodated dynamically (Bjorklund, 2006; Bjorklund & Grostus, 2006; Bjorklund & Rosenberg, 2005). Attachment experiences therefore create a type of relational expectation: "How a person construes the world about him (sic) and how he expects persons to whom he might become attached to behave . . . are derivatives of the representational models of his parents that he has built up during his childhood" (Bowlby, 1990, p. 65).

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[1] The United Nations High Commission for Refugees (1994) defines separated children as those "under 18 years of age who are separated from both parents or from their previous legal or customary primary caregiver" (p. 4).

Psychological outcomes reflect interactions between biological processes and social surround by constituting "a map and charter" of values, beliefs, and function of the experienced social world (Kirmayer, 2005, p. 195).

If the self is understood as an embodied relational expectation calibrated to conditions set through socially mediated processes, then stress can be understood as what accrues when an experience falls outside the individual, cultural, and species-specific relational expectation and environmental envelope (see Blaffer-Hrdy, 1999; Greenfield et al., 2003; Lee, 1987; West et al., 2003; Yeo, 2003). When stress becomes chronic or traumatic, self-coherence is threatened. It is this relational sense of self, nucleated through early bonding that forms the vital reservoir from which an individual draws under duress. In a retrospective on Holocaust survivors, Krystal (2004) concluded that "the essential attribute that permitted survival, . . . the continuation of minimal essential functions, prevention of traumatic surrender and psychogenic death, . . . and successful resumption of normal life" was early secure attachment experience (p. 67).

Self-repair, the ability to rebuild a sense of coherence and mobilize social networks under stress (Cederbald et al., 2003), is therefore rooted in a culturally informed conception of the person (White & Marsella, 1982). Recovery involves the refashioning of an identity largely informed by early socialization that has been severely challenged through trauma and, in many instances, demands adaptation to an environment radically different from cultural origin (Herman, 1992, 1997; Stairs, 1992). Subsequently, like other processes that relate to self-development (e.g., social learning, referential pointing, individual and group identity, and self-awareness; Bjorklund & Rosenberg, 2005), self-repair mediates inner representations that enabled survival with the posttrauma surround. The appearance of functional competence (e.g., ability to physically survive) should not be confused with psychological and emotional competence: Psychosocial stress may be less visible but constitutes an equal, if not greater, threat to well-being (Herman, 1997; Marsella, 2008). Cross-fostering is one example of how interactions between early self model and recovery context in a bicultural setting affect mechanisms of self-repair.

Cross-fostered individuals include humans (e.g., "wild children" Berbert & Truffaut, 1970; feral children, Candland, 1995; Perry, 2007), animals raised by humans (e.g., jackdaws and geese; Lorenz, 1952), or an individual of one animal species raised by individual(s) of another species (e.g., an orphaned hippopotamus adopted by an aged tortoise; Roach, 2006; the kitten adopted by Koko, a gorilla, Patterson, 1987). Although there are noted differences among both species and individuals, there is one generally consistent result: The infant develops a strong, persistent bond to the primary caregiver, even superseding associations with members of his or her own species (see Roy, 1980). It is epigenetic plasticity and sensitivity to social surround that enables cross-fostering: the ability of a member of one species of one developmental context to perceive, adapt, find meaning, and function in the social context of another species.

Multiple researchers have shown that species-atypical rearing produces species-atypical social cognition in chimpanzees (see Tomasello, Kruger, & Ratner, 1993). Unsurprisingly, chimpanzees, who are social brained (sensu Dunbar, 1998), self-aware (Gallup, 1968, 1970; Temerlin, 1980), have culture (Goodall, 1986), and share common psychobiologies with humans (Brad-

shaw & Sapolsky, 2006), show extreme plasticity in socioaffective and cognitive development and receptivity to learning human behavior, values, habits, and psychology. As Bjorklund (2006) noted in reference to cross-fostered chimpanzees: "The animals in question are humans' closest genetic relatives, the rearing environment is similar to that experienced by human children, and the cognitive/behavioral change is toward a more *H. sapiens* way of thinking" (p. 233). Psychosocial boundaries typically aligned with species-specific physiognomy are predicted to be more porous and result in differential coping strategies and species identity along a bicultural continuum ranging from chimpanzee to human-dominated contexts.

Method

A detailed analysis of the relationship between early social context and psychological and behavioral outcomes in trauma recovery was performed for three sets of attachment contexts commonly experienced in cross-fostered chimpanzees. The study was conducted at the Fauna Foundation, a sanctuary outside Montreal, Canada. To minimize gender-based socialization differences, experimenters selected three males representative of general behavioral classes and development characteristic of chimpanzees in captivity.[2] All had been cross-fostered but had been exposed to differential attachment contexts (Table 1) and subsequently had experienced severe sustained trauma. Prior to coming to sanctuary, each lived multiple years in a biomedical laboratory, the Laboratory for Experimental Medicine and Surgery in Primates (LEMSIP) in New York, as experimental subjects[3] (Table 2; Figure 1). While at LEMSIP, each was consistently or eventually "single-housed" 24 hr a day in a 150 cm × 150 cm × 210 cm (5 ft × 5 ft × 7 ft) cage that was suspended from the ceiling along a row of other similarly caged chimpanzees. The cages were empty with the exception of a ball, hanging tire, or like object (Figure 2). Food was predominantly "lab chow," with occasional fruits or vegetables, and water was available from a spout. After leaving the laboratory and during tenure at sanctuary, each had equal access to enhanced sanctuary environmental resources. Bicultural rearing patterns and behaviors were evaluated referent to free-living chimpanzee data (see Goodall, 1986; Table 1).

The three attachment models were selected to conform to distinct points along a continuum of varying developmental pathways ranging from normative free-ranging chimpanzee contexts (in which genetic and epigenetic constitutions are maximally aligned) to nearly total human-dominant contexts (in which genetic and epigenetic constitutions are minimally aligned). *Chimpanzee-intact* individuals (Tom; Figure 3) are born in the wild and early reared in normative chimpanzee society until capture (typically between infancy and early childhood) where the early formative context resembles a secure attachment style (intact) relative to

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[2] In clinical studies, participant anonymity is protected. Researchers are required to procure their consent and, where competency is uncertain, the approval of the participant's guardian or supervising physician. Protection holds even for deceased subjects. In the case of nonhuman animals, consensus cannot be obtained. We use their given names in lieu of the practice of anonymity in an effort to discontinue their objectification.

[3] One chimpanzee, Tom, had been in other laboratories prior to LEMSIP.

Table 1
Cultural (Species) Context Dominance by Developmental Stage

Developmental stage	Self model			
	Free-living chimpanzee	Chimpanzee-intact self	Chimpanzee-fragile self	Human-intact self
Infancy	C	C	C/H	C/H
Juvenile	C	H	C/h	H
Adolescence	C	H	C/h	H
Adult	C	H	C/h	H
Posttrauma context compatibility		C/H	C/h	H

Note.   C = Chimpanzee-dominated social context; H = human-dominated social context; h = Minimal, captivity-appropriate human context.

chimpanzee culture. *Chimpanzee-fragile* (Regis; Figure 4) are captive-bred and laboratory-reared. The term *fragile* is used to describe the lack of predictability of attachment figure in terms of identity, attachment style, developmental goals, and values under laboratory protocol. Laboratory captive-bred chimpanzees are variably reared, but all are generally prematurely weaned, taken from their mothers by coercion or force at infancy, bottle fed by one or more humans, and experience irregular peer socialization and little to no adult chimpanzee interaction during infancy/childhood. *Human-intact* (Billy Jo or Billy; deceased; Figure 5) refers to chimpanzees who, even if they received brief rearing by their biological mother, experienced predominantly human attachments (Table 2).

Consistent with human studies and past protocols for the psychological study of apes (see Bradshaw et al., 2008; Fabrega, 2006), the qualitative clinical evaluation of the chimpanzees' psychological state entailed structured interviews with caregivers, direct observations, review of case histories and laboratory records, and assessment of trauma exposure, presenting problems, precipitants, and behavior. Individuals meet criteria outlined in Fabrega's (2006) approach to cross-species evaluation stipulating that symptoms qualify as pathological when behavior and psychological states (a) are relatively persistent and expressed exclusive of any given specific context, (b) cause an interruption or significant change in an individual's life arc, (c) comprise identifiable psychological and somatic distress; or (d) constitute significant behavioral alterations relative to an understood social and cultural space.

Results

Representatives of both chimpanzee self models (intact and fragile) exhibit symptoms associated with the trauma sustained during laboratory confinement, repeated experimental procedures, and social and physical deprivation (Table 2). For example, each morning, prior to eating, Tom exhibits a gagging reflex whose origin remains medically undiagnosable. Regis has a history of physical and emotional frailty, weakness, and anorexia. However, consonant with their rearing histories (i.e., both interacted at developmentally significant times with conspecifics; Tables 1 and 2), once in sanctuary, they reintegrated socially with conspecifics successfully after an initial adjustment period and function with considerable comfort (Figure 6).

Species identity response (indicated by significant distress by an infant when taken from his or her biological mother; Temerlin, 1980) may occur as early as 46–76 days of age. Given the practices during the period when Tom was captured, it is probable that he spent up to 3 years or more with his biological mother. He was regarded as a "nice guy" even by LEMSIP personnel.[4] In sanctuary, he is considered an affable, stalwart member of the community with a decided sense of self and confidence. For example, when first introduced to the outdoor islands, Tom readily explored them and almost immediately ran over to climb a tall tree (Figure 7).

Socially, he is accessible and exhibits interest and capacity to engage with members of chimpanzee and human species, including the development of a deep bond with a human male. He is involved in social groups as a respected alpha chimpanzee male exhibiting species-normative behavior. While it took time to resolve his role in the group and mediate his aggressiveness toward females and other disruptive interactions, he now participates in a variety of social situations, requiring only brief periods of self-selected solitude. This same pattern of behavior is observed in other sanctuaries where chimpanzees who have been reared by their biological mother up to the age of 2 years or more retain a capacity to socialize with conspecifics despite later human bonding; indeed, many are considered to be the "social glue" in the living groups that are recreated in sanctuary (P. Ragan, personal communication, May, 2008).

In contrast, Regis exhibits a fragility characterized by a suite of physiological and psychological disorders common to other laboratory-reared chimpanzees taken from their biological mother and provided with irregular socialization in the laboratory nursery (Table 2). A former laboratory caregiver described the typical laboratory-rearing experience as follows: "The babies remain with their mother for a very short period and then are taken away. The infants are devastated, depressed, lethargic, traumatized, fearful, lost, unable to sleep for a day or two, and have difficulty adjusting to a bottle" (N. Megna, personal communication, July 7, 2008). Although Regis' rearing was disorganized, he has retained the

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[4] However, despite his positive reputation, it was obvious he was under considerable stress. LEMSIP records show that Tom did not always cooperate with laboratory needs, and he required anesthesia even for a simple cage changing for cleaning.

Table 2
Developmental Pathways, Symptoms, and Preferences

Developmental stage	Free-living chimpanzee	Chimpanzee-intact self: Tom Born circa 1967	Chimpanzee-fragile self: Regis Born 1988	Human-intact self: Billy Born 1968–Died 2006
Infant rearing	Infancy(0–5 years) with mother and other family members	Free-living maternal rearing until likely no older than 2–3 years	Removed from mother within few days of birth, human reared in lab nursery, bottle-fed, alone in incubator and cage until 6 months old	Human reared
Early social composition	Mother and female relatives (chimpanzee family) within entire group	Likely mother and female relatives (chimpanzee family) within entire group	Human lab caregivers, bottle fed, caged with one peer, socialized with peer playgroups	Human with none to little chimpanzee contact, mostly singly housed
Weaning age	At 3–4 years old; nursing terminates < 5 years old (average interbirth period)	Capture forced premature weaning at approximately no more than 2–3 years old	Required nutritional supplement of bottle until 4 years old	Unknown but likely < 1 year old
Juvenile socialization (age 5–7)	Mother, extended family, and multiple peers	Little to no peer socialization	One peer with no adult chimpanzee	Dominated by single human and single female chimpanzee peer on occasion mediated through human adult
Adolescent socialization (age 7–12)	Mother and extended family, with other adolescents and adults	Unknown	Singly housed 6–7 years; housed with one peer at ages 7–9; left lab at age 9	Series of human "owners"
Subadulthood socialization (age 12–15)	Mother and extended family, with other adolescents and adults	Unknown, with history of multiple labs prior to LEMSIP	In sanctuary with two peers within varying larger social group	With adult male humans until age 15 when brought to LEMSIP
Adult socialization (age > 15)	Extended group with peers and male and female adolescents and adults	Unknown lab housing prior to being singly housed in 150 cm × 150 cm × 210 cm (5 ft × 5 ft × 7 ft) lab cage at LEMSIP	In sanctuary with two peers within varying larger social group	Singly housed in 150 cm × 150 cm × 210 cm (5 ft × 5 ft × 7 ft) lab cage at LEMSIP; male caregivers until rescue from LEMSIP at 29; at sanctuary, preference for single housing
Laboratory description		Quiet, independent, "nice guy," uncooperative	Emotional, difficult, needy; fearful, anorexic, and depressed	Dangerous, volatile, angry, aggressive
Age sent to lab		Approximately 3 years old	Born in lab	15 years old
Duration in lab		30 years at three facilities	9 years at one facility	14 years at one facility
Medical procedures sustained		Underwent > 369 knockdowns; 63 liver punches/wedges, lymph node, and bone marrow biopsies; used in hepatitis B vaccine study; infected with HIV[a]	Underwent > 177 knockdowns; liver biopsies; infected with rhino virus that included periods of isolation[b]	Underwent > 289 knockdowns; 50 liver punch/wedge, bone marrow, and lymph node biopsies; used in hepatitis B, measles, polio, tetanus and HIV vaccine studies; infected with HIV[b]
Posttrauma recovery socializations		Socially bicultural	Preference for known chimpanzee peer socialization	Poor to no chimpanzee socializing; preferred human interaction
Posttrauma behavior and symptoms		Fluid; adjusted position of dominance; engages with male chimpanzees in play and grooming; preferred companion is a specific human male	Uncertain, lack of self confidence; behavior highly dependent on familiar peers; insists on being in company of other chimpanzees	Remained isolated from chimpanzees; had sleep disorder and labile appetite; exhibited symptoms of withdrawal and depression; identified with humans
Attachment style		Aloof but engaged and respectful once he decides to be in a relationship with a human or other chimpanzee	Dependent and childlike; tends to follow the lead of his small peer group; whimpers if left alone	Entirely dependent on humans socially and emotionally; he rejected and was rejected by other chimpanzees

Note. LEMSIP = Laboratory for Experimental Medicine and Surgery in Primates.
[a] Partial list as LEMSIP records are incomplete; protocols and procedures at other labs are unknown. [b] Partial list as LEMSIP records are incomplete.
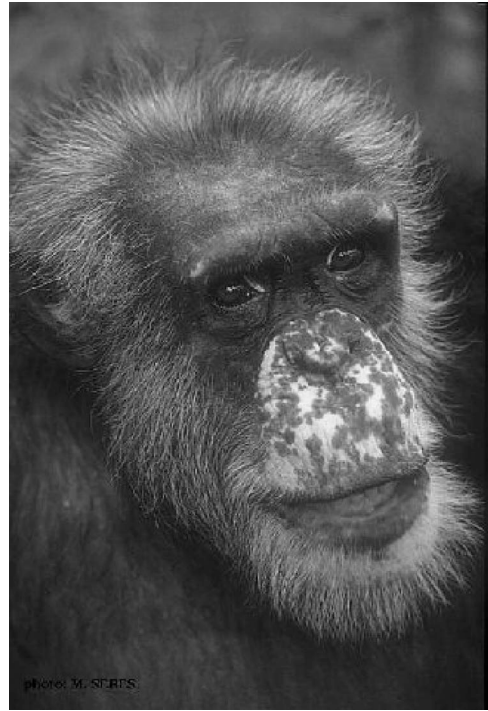
Figure 1. Darting, a procedure to anesthetize a chimpanzee, at the Laboratory for Experimental Medicine and Surgery in Primates. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

ability to communicate and interact with others. However, his most secure and consistent bonds are with former laboratory chimpanzees of the same age. This teenage peer group acts as his adaptive facilitator. For example, when Regis first encountered the outdoor area, he showed much more caution than Tom, only venturing outside with the persistent, strong encouragement and accompaniment of his peer group. Even today, when uncertain, he regresses to childlike behaviors. Further, he cannot tolerate being alone and whimpers until he is able to be in the company of another chimpanzee. This behavior is not consistent with free-ranging chimpanzees of his age-group (Reimers, Schwarzenberger, & Preuschoft, 2007).

Human-intact-reared chimpanzee behavior and symptoms strikingly reflect the depth to which early social contexts influence outcome through adulthood, as details of Billy's behavior demonstrate. Similar to other chimpanzees cross-fostered during the same period (e.g., Lucy; Temerlin, 1980), Billy was likely human-reared

Figure 3. Tom at Fauna. Photograph courtesy of M. Seres. Reprinted with permission of the Fauna Foundation.

from infancy. His ability to live compatibly with humans extended well beyond the developmental age when difficulties in maintaining a chimpanzee in a human environment arise. For example, while Billy wore a collar, restraint was rarely required, and he spent the majority of his time engaged in human activities: taking car rides, going for ice cream, "hanging out," and fishing with his human "owner(s)." The laboratory veterinarian confirmed a strong, emotional bond existed between Billy and his last owner. When not on excursions with his owner(s) or performing in en-

Figure 2. One of the 150 cm × 150 cm × 210 cm (5 ft × 5 ft × 7 ft) cages in which each of the three chimpanzees lived at the Laboratory for Experimental Medicine and Surgery in Primates. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

Figure 4. Regis soon after arrival at Fauna. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

Figure 5. Billy at Fauna. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

Figure 7. Tom in the tree his first day out on islands at Fauna. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

tertainment, he was occasionally caged with a female chimpanzee named Sue Ellen.

After 15 years of intimate living with humans, Billy was sent to LEMSIP where he spent the next 14 years with no immediate or direct physical contact with Sue Ellen or any other chimpanzee, except when he and Sue Ellen were housed together in a failed attempt to force them to breed. During these encounters, he was extremely aggressive and attacked her. (Breeding among siblings, or chimpanzees who were raised as siblings even without biological relation, is highly anomalous in free-living chimpanzees; Goodall, 1986; Reimers et al., 2007).

According to LEMSIP records, Billy was observed regularly banging and shaking his cage violently, particularly when someone approached, and he was considered to be "hostile," "uncooperative," "aggressive," and depressive (LEMSIP personnel, personal communication, May, 2007). After one experimental procedure, when recovering from anesthesia, he chewed off his thumb (Figure 8). He sought to negotiate with personnel by using human-learned behaviors such as performing handstands followed by hand clapping and

a "lip flip" facial expression acquired from his past training for entertaining.

Even with transition to sanctuary, his depressive moods persisted. Sanctuary staff reported that Billy often walked away in the middle of even low-energy play and "looked sad." Despite multiple efforts to socially house him, Billy was unable to correctly produce and interpret normative chimpanzee behavior and facial expressions (Smith, 2003) and failed to exhibit typical chimpanzee reassurance behavior with or toward other chimpanzees (e.g., running to another chimpanzee seeking a full frontal hug, turning his back toward someone and asking for a hug from behind, breathing mouth to mouth, or sticking a finger or hand in another's mouth; Goodall, 1986). However, he expressed these and other gestures for reassurance toward humans. As a consequence, Billy's social reintegration with chimpanzees was not successful.

The decisive point for Billy's single housing came when a group of five chimpanzees, including his former companion, Sue Ellen, chased and attacked him. Billy ended up prone on the ground to protect himself, while the group assaulted him, including aiming

Figure 6. Regis with Petra of his chimpanzee peer group. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

Figure 8. Billy's right hand, with his thumb bitten off. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

for his scrotum, a potentially fatal form of attack. By the time caregivers could intervene, Billy's finger was bitten off. For the next 5 weeks, he behaved fearfully such as screaming when his door to other enclosures was opened and refusing to go into the communal play area. Symptoms suggestive of unease and distress including sleep disorders persisted. He would, or could, not sleep until he had assured himself that the door to his enclosure was securely locked, and he himself had pulled down the vertical door between his enclosure and the common play area, first listening for the click indicating the door was locked, and, lastly, checking its security by attempting to raise the door himself.

Billy's aversion to and fear of other chimpanzees was matched by his attraction to and trust of humans. He developed close relationships with the sanctuary director and showed consistent interest in human females, spending hours playing with or grooming them. In these contexts, he was considered very sociable and charming. When humans were unavailable to him, he routinely chose to look at pictures of women in magazines and television shows. In contrast, his relationships with human males were conflicted and more cautious to the point of aggression. Anxiety and fear of new human males led to what might have appeared to be hostility but was in fact deep fear. In these contexts, though he displayed (e.g., rocking, swaggering), his behavior was neither violent nor empowered: The "displays" consistently ended in a submissive retreat. For example, in the midst of his pseudodisplay, he looked to familiar humans for reassurance. Other related responses included an accompanied projectile diarrhea, anxious gesturing, and screaming. Often he ended an episode by hitting the wall with his hands, then facing the wall, sliding his hands down it, and staring blankly at it, unable to sustain the confrontation.

Billy showed significant discernment, memory, and preference for any human he had come to know and like. Once, he vigorously gestured to the director to come over (i.e., referential pointing characteristic of cross-fostered chimpanzees; Bjorklund & Rosenberg, 2005). The director walked toward his enclosure and saw that he was gesturing with his hand, screaming and moving his eyes between the director and the television. The director began to look around for what he might be so excited about and saw that Dr. Jane Goodall, whom he had befriended years before when she visited the sanctuary, was featured on a television program he was watching. After the sanctuary director verbally acknowledged Dr. Goodall's presence on the television and turned up the volume for him, Billy sat back down and calmly resumed watching the rest of the program (Figure 9).

In contrast to chimpanzee-dominant-reared individuals, Billy showed little enthusiasm for foods typically selected by chimpanzees (e.g., leaves, branches, hard-shelled nuts) and, without examination as is common with chimpanzees reared in a chimpanzee context, would bite into popcorn, pizza, and other human snack foods that are often refused or seriously assessed before tasting by other chimpanzees. When food was served to him, he would take plastic utensils or ask for them through pointing rather than eating with his hands or directly off the plate, both of which are both more typical of other chimpanzees. He engaged in human-specific gestures such as twirling his spaghetti on his plastic fork (Figure 10), finishing each meal by taking a napkin or pointing to ask for someone to bring him one, and wiping off his mouth and chin. Given the choice between a bottled drink or a drink from a cup, he always selected the cup and saved it for future use.[5] Similarly, if someone

Figure 9. Billy greeting Jane Goodall. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

had a cup of coffee, he would request some and gesture for cream, sugar packets, napkins, and a stir stick to mix the ingredients. Upon completion of pouring and stirring the ingredients, he would carefully place the stirrer down and only then drink from the cup. He showed an obsession with washing his hands and face, and after asking for a tissue by pointing to a tissue box, he would carefully lift and use one to blow his nose, displaying mannerisms typical of humans (rituals also absent in or atypical of other chimpanzees); he enjoyed dressing in human clothes, which he donned with attention.

Billy demonstrated an acute sensitivity to human affect and motivation. On one occasion, after sorting through a box of clothes and other items provided for enrichment, he selected a multicolored plastic lei and walked bipedally over to the sanctuary director who was standing near a group of male workers contracted for a specific job. As Billy approached, the director offered him reassurance in the form of a compliment about "how handsome" he was. Billy nodded with his humanlike smile[6] until he heard the male workers laughing at him. Billy then became agitated and bipedally swaggered over to the enclosure bars, lunged, kicked the bars, threw any items he could reach at the men, and finally spit a mouthful of water at them. During his outburst, he ripped the lei off of his neck. Other sources that provoked fear aggression and anxiety were humans in clothing that resembled the uniforms worn by laboratory personnel. During visits by certain previous laboratory caregivers, Billy spit and showed fear, anger, and aggression.

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[5] While bottled and spout water are freely available to the chimpanzees at all times, other beverages, such as fruit and protein smoothies, are often offered as "treats" or as additions to meals.

[6] When humans smile, they typically show their teeth. For a chimpanzee showing teeth co-occurs with what is called a *fear grimace*. When chimpanzees actually smile from happiness, they cover their teeth with their lips. The human version of a smile is taught to chimpanzees by humans, almost always a part of what chimpanzees in entertainment learn to do. This kind of smile is a serious transgression of normal chimpanzee communication. Other chimpanzees would interpret Billy's human teeth-exposed "smile" as fear or anxiety, which would trigger a very different reaction than an actual chimpanzee smile would have.

Figure 10. Billy twirling spaghetti on fork. Photograph courtesy of the Fauna Foundation. Reprinted with permission.

When visited by his last owner, Billy saw him approach yet refused to come out for more than an hour. This reluctance was extremely atypical for Billy who was always eager to see visitors. When he did emerge, he displayed and slammed the fence; only then did he sit, receptive to interaction. However, again unusual for Billy, within a short amount of time, he left the visit and went back into his enclosure—something Billy rarely did.

Discussion

All three chimpanzees showed physical and psychological effects of their traumatic experience at the laboratory but were able to interact positively with humans, though with varying degrees of willingness and apparent enjoyment. However, arriving at the sanctuary, only Regis and Tom, who both had spent a significant portion of infancy with other chimpanzees, showed the desire and capacity to socially engage with conspecifics. Regis exhibits what could be diagnosed as an insecure attachment disorder and a type of *identity fragmentation* (Root, 1996) evidenced by his preference for his former lab mate peers, fear of new situations, and lack of confidence in the presence of older chimpanzee males. On the other hand, Tom's early bonding with his biological mother formed the basis for a resilient self, what Krystal (2004, p. 67) refers to as "adult residuals of infantile omnipotence" that permitted psychological survival after 30 years of traumatizing procedures, including isolated living and other deprivations. Unlike Regis, whose insecurity persists and who had never known older chimpanzees until he came to the sanctuary, Tom is able to interact with adult male and female chimpanzees appropriately. His behavior exemplifies selective acculturation: the ability to live with relative comfort in both cultural contexts (Padilla, 2006).

Notably, and in contrast to Billy who remained conflicted and fearful of both human and chimpanzee males, Tom has formed an especially strong bond with a human male: further evidence of facilitation by early secure attachment experience. Both Tom and Regis were able to mobilize internal resources created during early chimpanzee-dominated context and utilize them for posttrauma

adaptation. The impact of developmental context on posttrauma affective–cognitive state is perhaps clearly illustrated in the extreme case of Billy who was raised nearly exclusively as a human by humans.

While posttraumatic stress disorder (PTSD) is prevalent in many chimpanzee biomedical research survivors in sanctuary (Bradshaw et al., 2008; Brüne et al., 2006), Billy did not exhibit symptoms strongly consistent with a primary diagnosis of PTSD (van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005). Signs of unprovoked reexperiencing of traumatic events, as well as symptoms of dissociation, self-injury, and avoidant behaviors in the form of detachment, were absent (see Bradshaw et al., 2008). Reactions were attributable to external triggers that had been appropriately assessed under the given circumstances. For example, outbursts were always targeted against a specific "offender" as opposed to a more diffuse, seemingly internally prompted hyperarousal. Again, in contrast to many who suffer classic symptoms of PTSD, he was present, empowered in his focused anger, and able to be soothed and "brought back" through human reassurance. He exhibited empathy, caring, and an ability to form and sustain relationships with his human caregivers, and he expressed an active desire to connect with others, albeit not with conspecifics.

Billy's symptoms most closely met criteria satisfying a psychiatric diagnosis of a severe, recurring major depression, which along with general anxiety disorder, obsessive–compulsive disorder, and other disorders are often co-morbid with PTSD, given the complexity of posttraumatic outcomes for the majority of individuals with experiences conforming to serial and sustained trauma (i.e., complex PTSD; American Psychiatric Association, 2000; Herman, 1992; Table 3). Indeed, as Briere & Spinnazola (2003) underscore, a specific diagnostic label is usually inadequate to fully encompass the complexity of symptoms associated with complex PTSD. In terms of *Diagnostic and Statistical Manual of Mental Disorders–IV–TR* (*DSM–IV–TR*; American Psychiatric Association, 2000) Axes III and IV, Billy showed general medical issues relating to complications from years of laboratory experimentation, knockdowns (use of dart guns to anesthetize), surgeries, and self-mutilating sequelae from unsupervised arousal after anesthesia, with accompanying cardiovascular disease and significant psychosocial issues impeding normative chimpanzee socialization. He exhibited a persistent depressed mood, anhedonia, a labile appetite that fluctuated with his mood, and a pronounced sleep disorder that contrasted with the sleeping habits of other sanctuary residents. Cognitively, he exhibited psychomotor retardation and difficulties concentrating unrelated to the intensity of play or activity. Relative to other chimpanzees in sanctuary, Billy was considered indecisive, needing time to "think things out," suggesting ongoing confusion as to his own needs and desires, again in contrast to the others.

Billy also exhibited a form of species identity disorder, akin to descriptions of gender identity disorder (American Psychiatric Association, 2000; Psychodynamic Diagnostic Manual [PDM] Task Force, 2006), where "gender" in this case is replaced by "species." Similar to human gender identity disorders, identification with humans and concomitant exclusion from full participation in his own species culture was associated with his symptoms of negative, depressed affective states, disjunctive relationships among his species of origin, and cognitive disruptions (PDM Task Force, 2006). However, it must be noted that, as in the case of gender identity disorder and what have been described as cultural identity disorders, there is risk of patholo-

Table 3
Diagnostic Evaluation of Billy (Human-Intact Self) Based on Criteria From the American Psychiatric Association's Diagnostic and Statistical Manual (4th ed., Text Revised, 2000)

Multiaxial diagnostic evaluation	Billy's symptoms
Axis I	
296.33 Major depression, recurrent, severe without psychotic features	
Category 1	Persistent depressed mood and anhedonia
	Withdrawn behavior and need to isolate himself from other chimpanzees
	Emotionally unstable; self-injurious, self-destructive behavior
	Loss of motivation
	Sleep disturbances
Category 2	Eating disturbances; appetite affected by moods
	Fatigue/loss of energy
	Psychomotor retardation/agitation
	Difficulty concentrating/indecisiveness
	Low self-esteem
302.6 Gender identity disorder not otherwise specified (modified as "species identity disorder")[a]	Failure to develop age-appropriate same-species peer relationships and skills
	Socially isolated with low self esteem, depression, separation anxiety, and generalized anxiety
	Strong persistent cross-species identification as evidenced by:
	Repeated preference for cross-species affiliation
	Strong and persistent preferences for cross-species roles in play
	Intense desire to participate in the stereotypical games and pastimes of the other species
	Strong preference for playmates of the other species
	Consistent exhibiting of human behaviors and facial expressions
Axis II: 71.09 Personality disorders	Diagnosis deferred
Axis III: General medical conditions	Complications from repeated laboratory experimentation, surgeries, inadequate postsurgical supervision, and captivity that continued to affect his everyday life
Axis IV: Psychosocial and environmental problems	Problems with primary conspecific support group: problems related to the social environment; housing/living environment problems; other psychosocial and environmental problems
Axis V: Global assessment of functioning	Deferred[b]

[a] Due to the difficulty experienced identifying with members of the same species versus identifying with members of the foster parent species (*Homo sapiens*). [b] Global assessment of functioning was deferred because of the complexity involved in quantifying Billy's functioning relative to his behavior in the laboratory or in relation to normative free-living chimpanzee behavior given his cross-fostered development. Instead, qualitative descriptions are provided in previous diagnosis section in the table and Discussion section in the text.

gizing the individual (Padilla, 2006; PDM Task Force, 2006). The purpose is not to associate pathology with Billy's preference for humans over chimpanzees but rather to bring attention to the pathology (used in its definition of *distress-causing*) introduced by human rearing that caused such suffering later in life. Such compromised development shaped his internal representation of self through formative years, simultaneously creating resilience to maintaining and accessing positive *human* introjects (Krystal, 2004) and an impairment to maintaining self coherence in a *chimpanzee* context. It should be noted that much or all of his distress derived *externally* from the social context—chimpanzees who rejected him for who he was and/or his inability to secure a social context commensurate with his own sense of self. The perennial "mismatch" between internal and external contexts resulted in prolonged psychological distress. As Ellemers, Spears, and Doosje (2002) noted, the extent to which the social self mirrors group characteristics and processes depends on the extent to which the individual considers himself or herself to be a member of the group. The degree to which both individual and social context can accommodate each other predicts the potential level of stress or relative discomfort.

Whether chimpanzees who are able to reestablish relationships with conspecifics and yet interact positively with humans regard themselves biculturally as a member of both species or merely retain the capacity to function with humans is difficult, if not impossible, to ascertain. However, it is clear that cultural customs that Billy retained (e.g., twirling spaghetti, preference for human females) were not mere habits that he was trained to learn but rather similar to ethnic identities (Keefe & Padilla, 1987), reflective of his values and beliefs, features that inform resilience. The tenacity with which Billy engaged in human cultural patterns constituted (external) reinforcements of (internal) self-identity and meaning. His near absence of intimate affiliation with chimpanzees early on in life defined a core deficit that impeded full resolution of his self concept within the community he lived that led to his specific psychological disorders.

It is important to acknowledge that the effects of bonds and social identity are perhaps even more powerful in captivity than in other settings because of the significantly restricted, tightly controlled lives chimpanzees have in a laboratory much as noted in cases of human prisoners (Herman, 1992; Krystal, 1988; Lifton, 1999). From this perspective, Billy lived in continual social and emotional ambivalence since the human community with which he identified was both a source of pain/rejection and care/acceptance. Unlike chimpanzee-reared individuals who also live in a bicultural setting, he lacked the

stability of unequivocal membership in any group. Further, the two cultural poles of social identity modeled here, chimpanzee and human, are not identical. In Greenfield et al.'s (2003) and others' classification, the human society in which Billy developed is based on individualistic independent values and sociality, whereas chimpanzee society more closely resembles interdependent collective or ecosocial sustainable living (Cederbald et al., 2003), and, hence, potentially a very different conception of self (Kirmayer, 2007). The evolution or choice of a specific behavior and psychological relationships entail something more complex than a matter of living in two cultures. It also depends on the relationship that the two cultures have with each other and the degree to which they are compatible in terms of values and functions (Padilla, 2006). At the level of the psychobiological self, manifestations of cultural patterns are profound, deeply connected to well-being and function, not cosmetic.

Thus, fidelity to one species or transference of allegiances to another involves more than a simple substitution. To relinquish human social identity and, if even possible, acquire chimpanzee social norms would have constituted a betrayal of the self that was responsible for survival both before and during laboratory confinement. However, the retention of key features of attachment context in all self models indicates that for the individual, the loss of the identified self presents a far greater cost than the attendant psychological distress.

Feral children have similar severe difficulties (and, in many cases, die; Candland, 1995) in the process of reintegrating into human society (Perry, 2007). More broadly, issues of cross-fostering overlap with those encountered by cross-cultural workers engaged in the diagnosis and treatment of individuals in communities experiencing civil war, social transience, and "creolization" (sensu Kirmayer, 2005). Recovery in these cases often occurs in contexts radically different from developmental and ethnic origin and in the absence of social structures traditionally available. Destabilization of traditional social structures and transactions undermines well-being in diverse ways (Sapolsky, 2005). Human victims of war and genocide are, like cross-fostered chimpanzees, faced with the profound task of recreating meaning in a world foreign to the psychological, social, and ecological resources that they acquired from their developmental contexts (Mann, 2007).

The heightened perception of species differences provides a stark example of mechanisms and potential tensions inherent in posttrauma recovery and bicultural settings in general. We may envision the state and function of self in repair to be influenced by three main factors additional to or interactive with heritability (Kanfo & Plomin, 2006): early attachment style and context (which in this case includes species as a variable), traumatic stress, and developmental–recovery context compatibility.

Similar to children separated from their families, chimpanzees in captivity sustain one or more traumatic events: premature separation from biological and cultural context; attachment disruptions; inadequate caregiving; prolonged deprivation; and, in cases of torture or biomedical experimentation, highly invasive psychophysiological insults. Symptoms of trauma are diverse, but Fabrega's (2006) last criterion (i.e. significant behavioral alterations relative to an understood social and cultural space) is pivotal to the evaluation of cross-fostered and bicultural individuals: Primary psychosocial issues were grounded in the nature of developmental context experience.

These impacts cannot be underestimated. Echoing current research findings on mood and anxiety disorders that "there is now compelling evidence that early life stress constitutes a major risk factor for the subsequent development of depression" (Charney & Manji, 2004), Goodall (2000) stated that:

. . . even when captive infant chimps are rejected by their mothers they should be introduced into groups of their own species as soon as possible. Failure to do this results in long term, sometimes permanent, behavioral disorders. . . . This invariably leads to severe depression.

According to Fouts (2000):

. . . regardless of the quality of the cross-fostering, we humans can never be a competent chimpanzee parent. In the end, we (are) responsible for creating a child who will never be integrated into human society, (with) devastating effects on the psychological well-being of the chimpanzees involved when they are abandoned by their human foster parents.

While there are multiple psychological acculturation strategies possible for the individual in recovery and individual responses may show considerable variability, the pervasive influence of early contexts on recovery underscores the need for their consideration in therapeutic intervention design. For the two chimpanzee models of self—intact and fragile—it was feasible to construct adequate posttrauma recovery contexts that permitted, if not complete repair, a type of self "triage." Internal resources were sufficiently compatible with external conditions and resources that they facilitated a sense of normal functioning and the repair of a damaged, but whole, self identity that could be positively reinforced by group members. The environment adequately accommodated the range of coping strategies.

However, in cases in which differences between internal introjects and social contexts are dissonant or too extreme, as in the human intact model, self repair interactions become stressors, thereby setting up the potential for retraumatization and repeated rupture of self coherence. This attachment-mediated intrapsychic destabilization cascades into all aspects of life. As Mann (2007) and others underscore, the chronic inability to reintegrate into one's social community and the disruption to cultural mechanisms (Igreja, 2007) corrode psychological well-being. Behavior is confirmed by what has been observed and studied in humans, namely, developmental neuropsychobiological findings showing that early experiences are critical in shaping right brain processes and patterns involved in communication, facial information, gestures, and emotional prosody. The early psychobiological interactions between human caregivers and Billy failed to provide adequate experiences of interactive repair needed for later right hemispheric, species-specific, chimpanzee-stress-recovery abilities (Schore, 2002; 2005). Trauma survivors are left "refugees entering a new world" (Herman, 1992, p. 196). Developmental experiences set the stage for an identity confusion (or conflict), a particularly severe vulnerability to trauma, and consequent limitations to achieving a fully satisfactory recovery.

It is incumbent on caregivers to design physical and psychosocial treatment plans for trauma patients that provide a bridge between their past and present in order to create meaning making processes permitting not only survival but a revitalization of healthful indigenous cultural contexts in which the patients were reared. This is particularly critical for ecocentric cultures in which the sense of self is built on cultural patterns and values very different than Western models and, because of rapid or traumatic change, traditional environmental structures and processes are not readily available (Bracken, 2002; Yeo, 2003).

This study and those of other cross-fostered individuals underscore the ethical and practical crisis in which human-reared chim-

panzees and other wildlife species in captivity are enmeshed. In addition to severe psychophysiological compromise suffered through biomedical research and testing, cross-fostered chimpanzees must contend with their crisis in identity and their enhanced vulnerability. While Tom and Regis retained ample "chimpanzeeness" to successfully adapt to and derive comfort from all that sanctuary rescue provided, Billy's recovery demanded treatment that had to successfully support an individual straddling two worlds by force of circumstance and psychobiology. More than kin, yet not of humankind, even with all that sanctuary rescue offered, Billy lived and died on a narrow ledge between two worlds—neither of which he could ever really call home.

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