Robot Visions[1]

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Children, AI computer programs, and nonhuman primates: all here embody 'almost minds.' Who or what has fully human status?… What is the end, or telos, of this discourse of approximation, reproduction, and communication, in which the boundaries among and within machines, animals, and humans are exceedingly permeable? Where will this evolutionary, developmental, and historical communicative commerce take us in the techno-bio-politics of difference?

Donna Haraway (1989) *Primate Visions*: 376

The cover of roboticist Steve Grand's (2004) *Growing Up With Lucy: How to Build an Android in Twenty Easy Steps* sports the image of a torso and arms made of metal, wires, black boxes and bolts, powered by a chunky rechargeable battery held in place by rubber bands, and topped by two bulging eyes staring out at the viewer from a sparsely orange-haired yellowish rubber mask. Lucy, a.k.a 'Lucy the Orangutan Robot' is the first prototype in a Cyberlife-Research Ltd. project, and the corporealization of Grand's long-term endeavor to create an artificial life form with a mind of its own. Corporealization, as Donna Haraway explains it, is a process through which new bodies, both human and nonhuman (e.g. the gene, or the machine) are brought into being. She reminds us that:

> The bodies are perfectly 'real', and nothing about corporealization is 'merely' fiction. But corporealization is tropic, and historically specific at every layer of its tissues…Corporealization involves institutions, narratives, legal structures, power-

[1] Draft submitted for publication in *Thinking with Haraway*, Sharon Ghamari-Tabrizi (ed.), MIT Press.

differentiated human labor, technical practice, analytic apparatus, and more (1997: 142).

We adopt Lucy, figured as "a robot with the mind of a baby, who looks vaguely like an orang-utan" (http://www.cyberlife-research.com/), as our model organism for exploring the resonating figures of robot, child and primate in contemporary technoscientific corporealizations of 'almost minds'. The evidentiary materials for our account are a layered strata set down for us by Grand, in the form of a periodically updated hypertext of stories and images, conveyed through web pages, popular and technical publications, media representations, and public lectures.[2] How does Grand materialize assumptions about nature – and in particular human nature – in robots? What *kinds* of bodies are being imagined, and what limits and possibilities does the robot embody in turn?

In a move that identifies Lucy as part of the primate-hominid 'great chain of being', Grand has named his novel robot creation after the fossil Lucy *Australopithecus afarensis*, established in the 1970s as the earliest known human ancestor. This naming links Lucy the robot to a second primate namesake, Lucy the chimpanzee who was raised from infancy to adulthood in the home of a primatologist named Maurice Temerlin and his wife Jane, alongside their son Steven.[3] Lucy the robot baby orangutan is similarly figured as daughter to Grand and his wife Ann, and by extension as kin to other child-apes who have approximated humans in scientific research on the origins and essence of

[2] As of this writing The 'Lucy' project has been discontinued for lack of funds. The web pages referred to in this paper were accessed through the site that Grand has maintained at http://www.cyberlife-research.com/ (last updated in 2004), and in earlier versions through the Internet Archives WayBack Machine at http://www.archive.org/index.php.

[3] See *Primate Visions* pp. 59, 129-32, 39.

human nature. Grand's knowing, if playful, identification of Lucy the robot as a primate, coupled with her characterization as a child and daughter whom he is "growing up" as part of his own family, provides a suggestive set of linkages to the wider cultural and historical nexus of Lucy's creation. We read Grand's Lucy project through the diffracting lens[4] of Donna Haraway's writings on the quasi-integrated circuits of humans, animals and machines to elucidate and expand Lucy's status as a 'situated' robot. Haraway's generative critique of primatology and robotics helps us to recover from the singular bodies of Grand and Lucy the complex histories and imaginaries that give them life.

In *Primate Visions* (1989) Haraway explores the proposition that the primate has served as a powerful resource for figuring the human within 20th century scientific discourse and popular imaginaries. Her analysis offers a reading of the tropes through which this figuring takes place in post-World War II culture and politics as these are played out in the sciences of primatology. The primate as a *natural-technical object of knowledge* functions as a key figure for Haraway's analysis since it has provided the raw material for knowledge making about gender, race, and (human) nature. The term 'natural-technical' refers among other things to the ways in which the primate is positioned such that both nature and culture can be investigated through its body. At the opening of the 21st century, nature is under reconstruction not only as the object of a knowledge-making gaze, but in the form of artificial creatures naturalized through

[4] Diffraction, a term borrowed from optics, is Haraway's metaphor for the bending, spreading or splitting effected by the reading of one thing through or against another. See Haraway 2000: 103, and for an extensive discussion see Barad 2007, chapter 2.

rhetorics of species (phylogenic) evolution and individual (ontogenic) development. The project of Lucy the orangutan robot provides a particularly vivid case in point.[5]

As the epigraph from Haraway suggests, just *how* Lucy has been corporealized – what kind of body she is, and what kinds of values she embodies – becomes significant insofar as it contributes to establishing the pasts that inform contemporary imaginaries, and the future worlds that we may come to inhabit. In the discussion that follows we suggest that while AI creations like Lucy tend to be figured in terms of the timeless and placeless universality so familiar to scientific discourses of 'the human,' they rely upon a range of cultural resources that locate them in more historically and culturally specific imaginaries. Haraway's work has been devoted to articulating the means by which scientific objectivity is asserted, while challenging its totalizing power by locating scientific practices in particular histories and cultures. This process does not undermine scientific knowledge production but rather re-grounds its value in different, more contingent and still powerfully consequential terms: partiality rather than totality, situatedness rather than universalism, effective stories rather than established truths. Nor does this process diminish the world-making power of science. Instead, science becomes more contestable, as the resulting worlds are made evident through their building, rather than simply received as truth.

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[5] Grand's work and worldview are explored at length in Kember 2003. While her study makes only brief mention of Lucy, Kember's analysis is a central resource for our own.

A natural-technical history

Grand characterizes Lucy as a "research platform" designed to help develop ideas about how the human brain may work, animated by her creator's "curiosity about the nature of life and mind."[6] Grand's personal web page lists his job as "Digital god,"[7] and this motif of ironic and culturally saturated metaphor permeates his prose (compare Helmreich 1998). As a research platform for experiments in artificial life, Lucy sits at the intersection of laboratory science, where organisms are engineered to be model subjects; and robotics, where the virtual subject is constructed out of inorganic materials. In the case of the primate laboratory, Haraway observes that by the 1950s the aim was not simply to study the animal as it was, but to simultaneously demonstrate the plasticity of primate (and by extension human) nature, and model the directions that progressive human engineering should take (1989: 64). This marriage of observational science and engineering mirrored the promise of its natural-technical object:

> The laboratory animal in general possessed the highest value for human beings precisely because it was *designed* and standardized, in short, engineered, to answer human queries. But the animal's epistemological status was also as a *natural* object yielding objective understandings (ibid.: 62, original emphasis).

Like laboratory animals, robots are a kind of model organism, but within a regime of invention rather than discovery. As the next logical step in life's evolution, however, Lucy's story is told as a natural history. We can read the 'Lucy' web pages, accordingly,

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[6] http://web.archive.org/web/20030604111509/cyberlife-research.com/about/faq.htm

[7] http://web.archive.org/web/20020811051339/www.cyberlife-research.com/people/steve/index.htm

as a kind of internet-based diorama (Haraway 1989: 30) presenting her history and habitats through a series of carefully arranged scenes.

The earliest announcement of Lucy's birth appears on the Cyberlife-Research website update for August 25, 2000, which lists the date of her 'conception' as May of that year.[8] Grand traces Lucy's ancestry to an autonomously piloted glider project,[9] from which she inherited the servomotor technology that serves as her 'musculature', and projects her life as a baby orangutan robot forward across successive versions named Lucy MKI and MKII. Her kinship network is drawn on a web page titled 'Lucy Links,' with pointers to her "cousins in the wild and captivity," a collection of primate research and conservation sites, along with websites detailing research on artificial brains, humanoid robots, artificial life and adaptive systems. Lucy's first photo album, of November 6, 2000, offers a series of images of Steve at work on Lucy's 'brain' in his home workshop in Somerset, England; his wife Ann Grand preparing Lucy's early 'monkey suit'[10]; Grand's students; BBC Channel Four photographers arrived to document Lucy's birth; and a staged 'tea' party with the first prototype Lucy and her

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[8] http://web.archive.org/web/20001003233743/www.cyberlife-research.com/Lucy/index.htm. Relations of conception and birth become ever more imploded in the case of artificial life forms.

[9] Like many of her predecessors, Lucy's origins trace back to military roots. Kember (2003) reports that in 1998 CyberLife signed a contract with the Ministry of Defense's 'Defense Evaluation Research Agency' "to construct an artificial pilot capable of flying a simulated military aircraft" (107).

[10] Like taxidermy, robotics is organized around the construction of simulacra, realistic restorations out of heterogeneous materials including parts of original flesh in the former case, synthesis out of predominately electronic materials in the latter (see Haraway 1989: 38). The original plan for Lucy involved the 'skinning' of a stuffed toy orangutan purchased at Toys'R Us, which would become the epidermis for the hardware and circuit boards of Lucy's body. Various practical problems undermined this plan, however, as the necessity of additional circuit boards meant that Lucy 'outgrew' her skin, and an appropriate replacement proved hard to find. These practical problems contributed to a policy of making Lucy's inner workings evident, leaving her a more unapologetically hybrid mix of simulated simian and 'visible robot'. Her kinship with toys is meant to signal as well her lack of utility or instrumentality, a sign of basic versus applied research, the general versus the particular.

'soft' companion, an orangutan toy, on the lawn of the Grand's home. Reproductive kinship is complicated as the Grand's son, identified as Lucy's "half brother," is shown at the workbench as well, contributing to his sister's creation.

At the end of 2001, Lucy is given her own website, in the form of a first person Diary.[11] She introduces herself and locates this moment as pivotal in her ontogenic progress and her prospects for future autonomy:

> I was conceived in May 2000, and my dad has steadily been developing my body and the less tricky parts of my brain ever since. Now he's at last about ready to start building the important part - the very large neural network that ties my vision, hearing, voice, muscles and proprioceptors together to make me into a complete organism. After that it's up to me.

A row of snapshots of Lucy 'paper clipped' to the side of the main page suggests that she has made her way out into the world (or at least to the local shopping mall). She's now assumed her most widely circulating appearance, the unapologetically robotic torso and a rubber mask head, with synthetic orange 'orangutan' hair, and inset 'eyes'.[12]

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[11] http://web.archive.org/web/20011127034024mwww.cyberlife-research.com/.

[12] Lucy's Diary reports an early encounter with the press, before she had outgrown her body suit: "There was a funny thing about the photographers. They asked mum if she could take off my body skin, so they could see my insides. Artistically, I have to agree they were quite right - when I'm still, I look like just any old stuffed toy. But when mum offered to take off my head skin, they went all squeamish - 'ah god no!' they said. Odd people, humans - naked bodies are OK, but naked heads aren't!"

In April of 2002 a new set of pages, in Grand's voice, explains that Lucy has allowed them to take over her diary, in order to report on a setback in the project.[13] This page includes a classically posed 'family portrait' of Ann and Steve Grand, both looking quite severe, with a somewhat demonically countenanced Lucy:

The text explains that while the project is progressing well, perhaps even on the edge of breakthroughs in "demonstrating many of the major engineering principles that may lie behind the function of mammalian cerebral cortex" the money is running out. In November of that year, however, Grand receives a NESTA DreamTime Fellowship for Technology[14], and as Lucy reports in her diary:

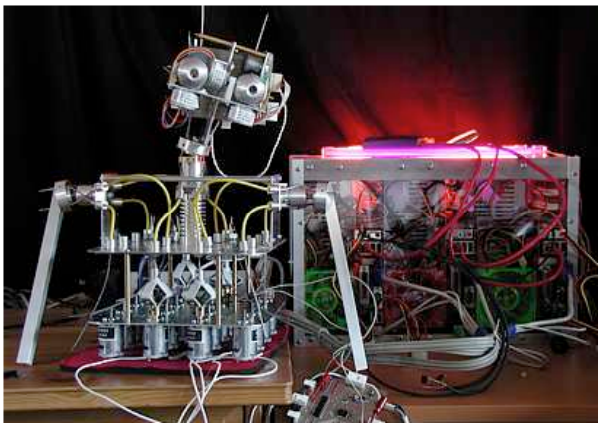
> This means he gets a year's (modest) income, to give him time and space to come up with a whole new me. And there's money for my development – my new body and the tools to make it. I'm going to have my own bank account – he'll have to give me

[13] http://web.archive.org/web/20021020103414/www.cyberlife-research.com/diary/0204.htm.

[14] NESTA is the UK's National Endowment for Science, Technology and the Arts.

hands this time, so I can sign the cheques! See you when I have new eyes to see you with![15]

The site remains largely unchanged over the following year, until in 2004 the Diary is replaced by a new more conventional website format, reporting on Lucy's development but again in the voice of Grand. Lucy MKI has been replaced by Lucy MKII, a more elegantly engineered, but also unadornedly robotic figure.



Despite the added resources of new tools, however (a lathe, a small CAD-CAM machine, a better soldering iron), Grand reports that the project has temporarily foundered on the problem of Lucy's 'musculature', a system of servomotors extended – and complicated – with springs that would approximate both the demands and the possibilities of human muscle control. "This, combined with a lot of bugs in the very expensive CAD software I'd bought for designing her many circuit boards, meant that the end of the year came and went far too soon."[16] The money has once again run out, but a popular book about the

[15] http://web.archive.org/web/20030206184256/www.cyberlife-research.com/diary/0211.ht
[16] http://www.cyberlife-research.com/

project (Grand 2003) sustains the hope of its revival.

Assembling origin stories

With these brief scenes of Grand's designs and desires for Lucy as a backdrop we return to the question of just how the Lucy project corporealizes a particular conception of human nature. One of Haraway's central observations is that scientific investigations have invested primates with significance as humans' evolutionary antecedents, through whom both the past and potential future of humanity might be observed. Inspired by this argument, we suggest that at the same time that the project of robotics aims at advancing the artificial, the object of that advance is a reconstruction of the natural, in the sense of an evolutionary humanism that progresses from primate pasts to machinic futures.

Haraway observes that naming "is a key rhetorical device bestowing a particular kind of individuality in the form of an apparently timeless, universal selfhood," which accrues to the named entity in the absence of a more particularized history (Haraway 1989: 146). Lucy the robot's naming 'after' Lucy *Australopithecus* lays claim to the robot's place in a particular kind of history: not the very immediate conditions that markLucy's present time in the early 21st century,[17] but the long evolutionary history of humanity. As Lucy *Australopithecus'* namesake, moreover, Lucy the robot is linked to a wider scientific and cultural project aimed at establishing the value of the human above other life forms through the truth of its extended, evolutionary history. In the case of

[17] Grand does refer to the events of September 11, 2001, but only to defend his right to build Lucy against fears that doing so might lead to the creation of a hyper-intelligent master race. Grand further characterizes the perpetrators of the events as unthinking humans who are the antithesis of his model of intelligence. See Grand (2003: 193-196).

paleoanthropology, the stuff of human history is the fossil, the matter from which scientists generate and continually amend the story of evolution. The Lucy *Australopithecus* fossils were unearthed in 1974, and paleoanthropologists constructed the *Australopithecus* skeleton by piecing fragments found at the main site together with others dug from an entirely different site. From the created fact of the resulting skeletal form, scientists generated a specific question that was to be answered in a variety of ways in the years to come: What was the significance of Lucy's erect bipedal structure and small brain casing (Haraway 1989: 190-193)?

One answer to the question was offered by Owen Lovejoy, who read into Lucy's bones a story of female limitation, male capacity, and the dawn of the nuclear family. Lovejoy argued that in bipedal form, females could not simultaneously reproduce and care for their offspring efficiently enough to sustain the species within a matrifocal grouping, where all the responsibilities for gestation and care fell on the mother. Females now required the help of male counterparts, who took over providing for the young. For Lovejoy, this transformation of "the matrifocal group into the human bifocal 'primitive nuclear family' constituted…the key evolutionary turn from ape to man" (Lovejoy, in Haraway PV: 192). As in other narratives of the time,[18] Lovejoy's makes Lucy a point of origin for the human within a longer evolutionary trajectory that stretches from before human existence to the present. Grand's naming of Lucy after the *Australopithecus afarensis* skeleton situates Lucy in the same trajectory.

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[18] Haraway notes as well Lucy's changing significance at the hands of sociobiologist E.O. Wilson, for whom Lucy takes on a newly central role. In Wilson's account of social strategy as the motor of evolutionary change, "[t]he key fossil was no longer the hunter australopithecine confidently striding out into history, but the diminutive bipedal Lucy facing a reproductive crisis as her body failed her in difficult ecological times, requiring that she tie herself to her husband at all costs" (1989: 127-8).

Family Ties

However effectively they may work to locate Lucy in the human evolutionary trajectory, dry fragments of bones have their limits. Lucy the robot's association with the live bodies of nonhuman primates – orangutans and other apes – provides further means of balancing her on the almost-human boundary. The orangutan, which Grand identifies as Lucy's prototype in the primate world, has a specific history in the field of primatology. The orangutan has been featured, for example, in the drawing of 19th century racial hierarchies based on skull and facial measurements, and in later 20th century field studies. Haraway excavates popular culture, field photographs, and scientific writings to expose their racialized underpinnings, in particular their unmarked whiteness with its attendant racism. In keeping with Grand's location in early 21st century European and U.S. scientific and cultural circuits, Grand's own family remains unmarked, while Lucy's physical appearance within the family suggests an uncertain provenance. From this point of view, Grand implicitly posits the white, middle class and heterosexual nuclear family as the crucible of humanity, thereby suggesting its universal status while only hinting at possibilities for other, differently marked (by gender, race, class, sexuality, etc.) 'family' groupings. At the very least, Lucy's ambiguously-colored and -featured mask bears an ambivalent, albeit unspoken relation to the contemporary legacies of a range of bodily hierarchies. Does Lucy signify a 'dirtying', or at least rendering more primitive, of the white nuclear family that might be purified through a more successful incarnation of human-like intelligence? Or does she stand as a counter to discourses of purity, including the separation of the natural from the artificial?

A more explicit trope in the association between Grand's robot and living nonhuman primates is not evolutionary time, but ontogenic development. The robot's association with the second Lucy, the chimp who lived as part of Temerlin's family and was herself named after Lucy *Australopithecus*, situates Lucy the robot on the human/animal and adult/child boundary. At this border, the child-primate embodies developmental capacities that mirror those of the human child. These capacities in turn are normatively tied to the heterosexual nuclear family, where they are nurtured into full expression.

It is clear from Haraway's accounts of child-primates reared in their surrogate fathers' family homes that whatever the specific features of the family narrative may be, it brings the nonhuman primate into the realm of human nature (the child's developmental potential) and culture (kinship and love). One primate-child in Haraway's history is Prince Chim, a pygmy chimpanzee raised by primate biologist Robert Means Yerkes in the 1920s. In the carefully controlled space of the Yerkes' laboratory, chimpanzees were Yerkes' model organisms for the human. These apes constituted "pure units of personality," and were therefore "particularly plastic to reason, called engineering, and could be models for control of the productive forces of human life" (1989: 65). Located outside the laboratory, however, in the domestic space of the home, Chim was less a research subject than a "surrogate son" (ibid.: 61). In keeping with this more familial relation, Chim and his female counterpart Panzee traveled with Yerkes to Cuba to visit Mme. Abreu's primate brood, and (like Lucy with the Grands) appeared in a close-up family photograph (58-9).

Yet like the son who must carry on the family name and business, Chim still embodied for Yerkes a potential that would only be fully realized in the lab. As Haraway puts it, Chim's

> noble epistemological and moral status inhered not in his closeness to wilderness and to man as hunter, but in his promise as a bright, lively and docile child in Yerkes' dream of establishing that most modern of institutions—the experimental laboratory (61).

Consistent with a widespread use of the child in Euro-US scientific and popular cultures (see Castañeda 2002), the child's time – childhood – and self ("personality," in Yerkes' terms) function in child-primate histories as sites of possibility from which a later, fully realized project and body will develop. Grand's naming of his robot after Temerlin's Lucy relies on a similar positioning, such that the robot shares the natural-cultural space of the almost human with Lucy the chimp and her child-primate counterparts. Like all primate-children, Lucy's story is cast in the frame of individual human development, from infancy to adulthood. And Lucy the robot's association with these nonhuman primate-children works to install in her the child's developmental potentiality to become fully human.

Conceived by 'Daddy' Steve Grand and cultured in silicon with the aid of her 'Mummy,' Grand's wife Ann, Lucy is explicitly the progeny of her creator. And like Lucy the chimp who learns to speak American Sign Language, robot Lucy is afforded the basic requirements for normal development through her placement in a nuclear family. Haraway reminds us that the key figure in the nuclear family (as compared to the

matrifocal group) is the father-provider. Despite the shadowy presence of the human mother in scientists' stories, it is the father who plays the transformative role in the family drama. In her review of a 1975 *Psychology Today* article on Temerlin and Lucy, Haraway notes that like Yerkes, who mourned the early death of Chim from respiratory illness, Temerlin had an emotionally intense relationship with Lucy, complete with parental love and Freudian desire (1989: 399, fn. 23). While Grand does not claim any such emotional bond, he does complain about his paternal "labour pains," much worse than the "almost effortless process" of natural childbirth. Father-scientists, including Grand, share in the legacy of masculinist birthing, which is almost always 'better' – less messy and more controlled – than female birthing. Taken together, these tropes of developmentalism, kinship, and childhood endow Lucy with social and cultural trappings that make a collection of wires and bolts into the specific proto-human entity of the roboticist's dreams.

Configuring Lucy

While Lucy promises a developmental potential like that of her primate-children counterparts, her specific trajectory is figured differently. As a technical project, Lucy constitutes one of a variety of responses to a lineage of research in artificial intelligence tracing back to the 1950s and associated most closely with founding fathers Allen Newell and Herbert Simon.[19] Named by critics with the acronym GOFAI, or 'Good Old Fashioned AI', the early approaches and their contemporary descendents adhere to a

[19] For critical and contextualizing histories of AI see Dreyfus 1992, Edwards 1996, Adam 1998, and Hayles 1999. For more on Grand's vision of 'New AI' see Kember 2003.

strategy of formal representation that makes stipulation of reasoning procedures and relevant propositions at the outset, or from the ‘top down’, a precondition for intelligent behavior. The increasingly evident problems with this approach have encouraged an alternative movement dedicated to the creation of intelligent life from the ‘bottom up’, requiring the discovery of some primordial mechanism from which intelligence might grow. This latter strategy, to which Grand subscribes, takes its inspiration from biological rather than logical antecedents, and imagines an evolutionary/developmental path through which simple ‘creatures’ endowed with basic mechanisms will emerge as intelligent agents.

The concept of ‘emergence’ is the trope through which proponents of what Grand names the ‘New AI’ “secure a form of digital naturalism in the face of the evident constructivism of 'artificial' life" (Kember 2003: 56). Rather than creationism in the biblical sense, where creatures spring forth fully formed, the aim is to create the basis for life that will then realize itself. This shift involves a change in focus from production of the actualized entity, to creation of the potential for its realization. In this respect ‘New AI’ maintains the natural scientist’s insistence on the independent agency of nature, and the alienable character of the object of knowledge (Shapin and Shaffer 1985: 77, Haraway 1989: 185). Kember sums this as “the paradox of creation which is at the heart of the ALife project: the God-like act of creating life is 'stolen' or appropriated by man and then credited to the computer" (2003: 55). ‘Emergence’ is the key to the bootstrapping process whereby the resulting creatures continue after the hand of their creators is removed.

At the same time, this commitment to 'emergent' intelligence is accompanied by a desire for release from the inexorably slow processes of phylogenic development, and a shift from scientist observer to inventor creator, with not only knowledge of but also mastery and control over the materials and their manipulation. In particular, navigational or 'situated' robots have generated a new set of discontents among their creators.[20] Rodney Brooks, the most prominent early proponent of navigational capabilities as a basis for emergent intelligence, embarked with his students in the early 1990s on another set of projects under the heading of 'humanoid' or 'sociable' robots. Unwilling to leave robotic evolution to time frames beyond the researcher's productive career, Brooks and others have leapfrogged to the other end of the evolutionary order, to explore human-level intelligence more directly. According to Grand, it is the "huge gap in the market … between the biologically tractable but not really very intelligent world of insects and sea slugs, and the far-too-hard, conscious, language-using world of human" that Lucy is aimed to address.[21]

Like many proponents of the 'New AI', Grand maintains that to be called intelligent a creature must be capable of developing through experience and adjusting itself continuously to new situations. In this sense as well he remains true to narratives that constitute the child as the key site of a developmental process that gives rise to the fully formed, or complete human. Grand's hope for Lucy's development is that she should

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[20] With some exceptions, robotics projects have tended either to focus on navigation, with robots figured as 'lower order' insect-like bodies, or to address 'higher order' functions involved in sociality, typically taking the form of stationary human-like robots configured from the waist (or neck) up. In each case, success is projected as progress from an initial set of capabilities to a more and less fully specified range of future competencies. Those capabilities taken to be essential vary, but generally include some combination of navigation, vision, object manipulation, hearing and speech. See Suchman 2007, chpts. 13 and 14.

[21] http://web.archive.org/web/20030604111509/cyberlife-research.com/about/faq.htm

"work her way through nursery school, learning to coordinate her muscles, to form spoken words and eventually to paint pictures." This somewhat eclectic list presages a commitment to new forms of robotic embodiment, sociality and creativity. While the aims are familiar in contemporary robotics, Grand asserts that "a *radically new kind of artificial brain*," will underlie Lucy's accomplishments, one that begins with very few capabilities and generates its own increasing complexity. For Grand, the best chance for engineering this capacity is to create a material substrate for intelligence that functions like a 'mammalian' brain:

> Lucy's brain is designed around a key set of hunches about how such a mechanism can be made using (simulated) neurons and biochemicals, and how something similar might have evolved in nature.[22]

These "hunches" can be located in contemporary neuroscientific understandings of the developing brain, also linked in its scientific figuration to human – and specifically brain – evolution. Just as Grand insists that Lucy requires a body to replicate the development of human-style intelligence, so too contemporary developmental neuroscience has materialized a child-brain whose development proceeds in response to the child-body's interactions with the world. Embedded in this understanding of the developing brain is the possibility of cultural differentiation according to how 'the world' looks, smells, feels, sounds, and tastes. Depending on the nature of the child's culturally specific environment, cognitive capacity is differentially established. But the dominant version of the child's neurological flexibility relies on a universal child-brain that is shaped through

[22] http://web.archive.org/web/20030604111509/cyberlife-research.com/about/faq.htm

its contact with a generic environment of sound, sight, touch, and so on (Castañeda 2002: 77-79).

The ability that Grand proposes will most dramatically distinguish Lucy from her robot predecessors, however, will be her participation in the realm of the imaginary:

> She will not be as smart as a human or ape baby of the same age, but she will learn for herself and she will have something that no robot has ever had before – an *imagination* (original emphasis).[23]

Grand characterizes imagination as "a virtual world inside our heads" that we inhabit and that mediates our active perception of the world outside. While Grand's approach carefully limits claims to human likeness, it nevertheless repeats the assumption that human (or human-like) existence is individual, cognitive, and brain based. And while embodiment is taken as crucial to the development of imagination in the same way that the body is considered critical in developmental neuroscientific accounts of child-brain development, the brain ultimately retains its supremacy over the rest of the body, and imagination is limited to intellectual capacity. Brain, development, imagination, and body also retain their generic figuration, which erases any historical or cultural contingency.

[23] Kember (2002: 114) mentions Lucy as one of Grand's future projects, of which he says: "I'm trying to create a robot that can make plans and rehearse them in her head – i.e. she will have an imagination" (Interview, August 2000).

Refiguring Lucy

How to 'figure' actions and entities nonanthropomorphically and nonreductively is a fundamental theoretical, moral and political problem. Practices of figuration and narration are much more than literary decoration. Kinds of membership and kinds of liveliness … are the issues for all of us (Haraway 1997: note 23, p. 284).

Our interest in this paper has been to compare primatology and robotics as two ongoing projects at the intersection of simian and cyborg figures of the 'almost human', to sketch out the marks of their historical origins and cultural specificity and to articulate both reproductive repetitions and generative possibilities. We share with Grand the premise that imagination is an identifying capacity of the human. Rather than locating that capacity within the cerebral cortex, however, the work of Haraway and others in contemporary science and technology studies directs our attention to *cultural* imaginaries and the material practices that they animate and that give them their life. Claims about universals come always from particularly positioned persons (Haraway 1989: 211), and cultural imaginaries, however long standing and widely circulating, are fundamentally specific. Their tracing is a genealogical and ethnographic inquiry quite different from the search for a holy grail of the human true everywhere and for all time. In this spirit, Haraway's writings about the history of primatology question the assumed innocence of the stories that she reviews, their "rigorous exclusion of contextualizing politics" (1989: 156). Hers is, among other things, a project of restoring marks that have been erased.

Primate Visions provides an historical and cultural template that helps us to anchor Grand's more free-floating account of Lucy, and its attendant claims on the human. Like their counterparts the child and the nonhuman primate, AI robots like Lucy have come to be figured as always already constituted sites of potentiality whose realization and elaboration is the work of technoscience. Their potentiality is temporal in that it allows scientists to reach further backward or forward in time, and material in that it requires the physical construction or re-construction of bodies. For their evolutionary narratives, the central figures are ancestors and progeny, developmental orderings, and teleologies of progress and becoming.

In reading Grand's project through the lens of *Primate Visions* we can trace a kind of 'natural history' joining paleoanthropology to robotics (see Table 1). Like many histories this one suggests a linear progression, where archaeological projects are displaced by increasingly synthetic ones, science by engineering. A central aim of Haraway's work is to complicate any simple linearity, however, showing instead the ongoing traffic that operates across and also within the successive historical 'moments' of the natural and social sciences. That demonstration undermines in turn associated narratives of progressive development from primate to human. Just as Lucy's figuration relies on resonances between children, nonhuman primates, and AI, so too she can be re-located to the historical and cultural nexus Haraway identifies for primate studies, where these resonances were established. At the same time, the lesson that *Primate Visions* teaches is that while each moment in the history of the human sciences is haunted by the still lively

ghosts of its predecessors, it is also intricately entangled with contemporary preoccupations. Lucy's story is no exception.

Paleoanthropology	Proto/early hominids
Field primatology	Naturalism and rehabilitation
Laboratory primate studies	Social engineering and the model organism
Robotics	Synthesis and the post (or other than?) human

Table 1

Writing about the relational shift between nature and artifice in early 21st century technoscience, Haraway suggests that nature has become "a source of certainty and legitimacy for the designed and engineered" (1997: 103). By anchoring Lucy the robot in human evolutionary history through the process of naming, Grand makes a claim to her value as a project that trades on both her actuality (what Grand has achieved to date), and her potentiality (the promise for future incarnation that the Lucy project holds out). The evolutionary story that underwrites these progressions is still there, but now loops back to a new form of creationism for which science and engineering are the invisible hands.

Lucy *Australopithecus* and Lucy the robot both involve the assembly from available materials of a narrative of becoming human: The earliest Lucy from various pieces of organic remains – nature – worked up, as Haraway reminds us, through an array of technoscientific rendering and inscription devices, and the most recent Lucy from a

heterogeneous assembly of servomechanisms, springs, batteries, circuit boards and solder. In both cases the natural-technical objects created are sustained through extensive labors and animated by circulating cultural historical imaginaries. And in both cases their story is founded in an evolutionary narrative of becoming intelligent, though in the latter the machine becomes the universal metaphor for life, the automaton the ancestor of autonomy. Steve Grand's 'Frequently Unanswered Questions' suggest that the great chain of mechanism follows the same ordering as that of organism; that humans are the highest order of machine, for whom the dominion of brain over body is most complete.[24]

The grounds of the 'almost human' differ in the case of primates and of robots, in the sense that one is 'naturally' different from the human, having a different evolutionary and taxonomic place, the other different in material substrate, a simulation. But both share the sense of an approximation to the human with respect to capabilities; that is, the potential of becoming more human-like through various courses of instruction in the one case (e.g. in language use), engineering in the other. More than assembled artifact, Grand's robot child displaces a commitment to life or consciousness as privileged characteristics of the organic, opening the way for the ontogenesis of a "mammal-style intelligence" in the machine (Grand 2003: 37). While inspired by primate/human fantasies, Lucy's abilities are not projected to be simple replicas of primate or human intelligence, but something recognizably intelligent in its own right. As the primate

[24] http://www.cyberlife-research.com/

provides a mirror for the human scientist that observes her, and the child for the adult she is to become, the robot mirrors its inventor but also promises something different.

The questions of how the robot could be other than second term to the human, and how both human and robot could be figured in ways that do not repeat the violence of the generic and the universal, align with the same questions in primatology. Haraway's account of the 'rehabilitation' of the Temerlin's Lucy on Baboon Island in Gambia points in one possible direction. Not at all unproblematic in their colonialist positioning, this and other such camps run by deeply committed, white women scientists in the 1980s nevertheless provided a space for alternative relations between humans and apes. For Haraway, "[t]he people and animals in these stories are *actors* enmeshed in history, not simply objects of knowledge, observers or victims" (1989: 129). Writing poignantly about the relationships between the female primatologist Janis Carter and Lucy, Haraway emphasizes the blurring of key categories such as nature and culture, wild and civilized, so fundamental to the history of primatology she recounts. Rather than recapitulating that history, "Lucy's and Carter's cross-species contact may be read as an allegory of reinventing nature in a world where the cost and the work of the construction can no longer be made invisible" (ibid.: 131).

Unpacking the universal and generic exposes their particularity, and the workings of power that establish certain particulars as the (only) real. At the same time, unpacking is only the first step toward creating alternative figurations and attendant possibilities for a more richly livable future. In the final chapter of *Primate Visions,* Haraway offers a different story, taking as a case in point the text *Primate Societies* (1987) published in the

same year. She reads the latter as a feminist project, still multiply entangled with its disciplinary inheritance, but offering an antidote to more normative uses of the primate in its commitment to "specificity and non-reductive difference":

> When biology is practiced as a radically situational discourse and animals are experienced/constructed as active, non-unitary subjects in complex relation to each other and to writers and observers, the gaps between discourses on nature and culture seem very narrow indeed (1989: 373).

In turning from animals to robots we encounter a different kind of difference, that between the organic and the engineered. In her recent *Companion Species Manifesto* Haraway insists that however imploded the boundaries of nature and culture, organism and artifact "the differences between even the most politically correct cyborg and an ordinary dog matter" (2003; 4; see also Haraway 2008). This proposition stands in tension with the insistence of Grand and other AI researchers that as humans we *are* machines. The literalization of machinic metaphors erases difference in the name of a new form of hyper-humanism (Haraway 1989: 110), replacing an *a priori* commitment to human uniqueness with an equally essentialist investment in fundamental mechanism.

Reading contemporary developments in science and technology is necessary both for an identification of the ways in which emerging technological formations revitalize old ideological agendas, and as a means to discover the spaces available for resistance, intervention and transformation. Read through Haraway's lens, cyborg figures like Lucy might help us to realize not only Cold War legacies of communication and control, but also "lived social and bodily realities in which people are not afraid of their joint kinship

with animals and machines" (1991: 154). What might be needed is a more differentiated set of starting points for the robot, that admits possibilities for multiple kinds of bodies and associated capacities, as well as more various cultural environments: not just the nuclear family, but social groups that more effectively represent and challenge the many forms of relationality that exist both within and outside of U.S. and European cultures; not just the normally developing child, but differently abled bodies; and not just a limited notion of imagination, but varied forms of engagement with the world. Lucy as a cyborg daughter could certainly be part of that re-imagining, as long as she sees beyond the bounds of single, apparently innocent visions of her own ancestry.

Such points of departure are ultimately no more complex than the universalized individual imaginer that Grand is working toward. Nor is his project antithetical to them. Sarah Kember has proposed that "Grand's insistence on an unconventionally holistic view of the organism *in situ* mitigates against an unproblematic autonomy and outlines a form of co-evolutionary dependence between organism/agent and its environment" (2003: 199). AI robots' necessary embodiment and their co-evolutionary natures only just begin, however, to work against the mind/body split and individualist autonomy so familiar to Western technoscientific imaginaries, including more traditional AI. The directions robotic AI takes remains a question to be answered by the ongoing practices of borrowing and re-tooling already evident in both primate studies and AI. Framed not as the importation of mind into matter, but as the rematerialization of bodies and subjectivities in ways that challenge familiar assumptions about the naturalness of normative forms, primates, robots and robot-primates might become sites for

transformation rather than further reiteration. This requires stories that are non-innocent, however, aware of the 'circuits' between the discursive and the material, and animated by imaginaries that remember their own histories.

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