BECOMING HUMAN

A THEORY *of* ONTOGENY

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Preface

In this book I propose a theoretical framework for organizing and explaining the research that my colleagues and I did from 1998 to 2017 in the Department of Developmental and Comparative Psychology of the Max Planck Institute of Evolutionary Anthropology in Leipzig, Germany. It is presented as a more or less coherent story, but the story line was not there from the beginning. It emerged only through the work. The theoretical framework owes much to my colleagues, although, needless to say, they do not all agree with all of it.

My main acknowledgment is thus to the Leipzig team as a whole for their exceptional work and dedication to the scientific enterprise. Many of their studies are cited here. Of my numerous colleagues over the years, I would like to single out my senior partners who were there for the duration. Elena Lieven was my one age-mate throughout, serving as a constant reminder that nothing says human uniqueness like language (and often serving as my social conscience as well). Josep Call *was* the ape house, from designing its testing rooms to designing brilliant experiments, and the ape work simply could not have been done without him. Malinda Carpenter was my main partner in crime when we first began thinking at our almost daily lunches for several years about human uniqueness in terms of shared intentionality (although we still disagree about some points). Crucial to the enterprise as well were Katharina Haberl, who created and supervised our incomparable child laboratory, and Henriette Zeidler, who was the organizational hub through whom, and because of whom, everything worked.

I also would like to express my deepest gratitude to the Max Planck Society, without doubt the best scientific organization in the world, and to my colleagues in the other four departments of the Max Planck Institute for Evolutionary Anthropology, without doubt the best institute of its kind in the world. The working atmosphere for those nineteen years was, in a word, inspirational. It was a privilege to work in the society and at the institute.

In terms of this book in particular, I would like to thank first and foremost my wife, Rita Svetlova, for providing numerous helpful comments on many ideas and phrasings in various parts of the book. In addition, I thank Jan Engelmann, who read the entire manuscript and gave helpful feedback, particularly on the second chapter. And finally, I thank Andrew Kinney at Harvard University Press as well as HUP's three anonymous reviewers for helpful feedback on the penultimate draft.

Note that many of the studies cited in this book have videos of the children or the apes performing in (usually) one condition in the task. They can be viewed by scientists and educators (for scientific and educational purposes) at:

http://www.becoming-human.org/
Username: developmental
Password: psychology

Becoming Human

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In Search of Human Uniqueness

In his 1871 book *The Descent of Man* Charles Darwin proposed, in effect, that humans were just another branch on the evolutionary tree. Victorian Englanders, many with significant scientific training, were incredulous. Humans' closest living relatives, the great apes, still lived in forests and jungles "red in tooth and claw," but humans lived in a world of telescopes and steam engines, symphony orchestras and the British Parliament, and morning prayer followed by afternoon tea. It was a puzzle, to say the least, how just another branch on the evolutionary tree could live a life so utterly different from that of other animals.

Today this puzzle is essentially solved. At some point in human history a new evolutionary process arose. A telltale sign of this new process is that not all humans live amid telescopes, symphony orchestras, and the British Parliament but instead live among their own distinctive artifacts, symbols, and institutions. And because children, whatever their genetics, adopt the particular artifacts, symbols, and institutions into which they are born, it is clear that this societal variation cannot be coming from the genes but rather is socially created. The full puzzle is thus that humans are not only a species of unprecedented cognitive and social achievements but also, at the same time, one that displays a novel kind of socially created, group-level diversity.

The solution to the puzzle—the new evolutionary process—is of course human culture. But the traditional notion of culture as something apart from biology and evolution will not do. Human culture is the form of social organization that arose in the human lineage in response to specific adaptive challenges. Its most distinctive characteristic is its high degree (and new forms) of cooperation. Synchronically, the members of a cultural group coordinate with one another in the context of self-created

cooperative structures such as conventions (including linguistic conventions), norms, and institutions, and they relate to one another based on cooperative motives such as trust, commitment, and fairness. Call this the coordinative dimension of culture. Diachronically, the members of a cultural group pass along skills and knowledge to succeeding generations via cooperative processes of cultural learning, such as active instruction and conformist learning, resulting in a kind of "ratchet effect" in which cultural practices and products (including conventions, norms, and institutions) evolve, perhaps "improve," over historical time. Call this the transmitive dimension of culture. The outcome is that virtually all of humans' most remarkable achievements—from steam engines to higher mathematics—are based on the unique ways in which individuals are able to coordinate with one another cooperatively, both in the moment and over cultural-historical time.

But this explanation of human uniqueness in terms of cultural processes creates another puzzle, and this one is not yet solved. In this case the focus is not on the level of the species and its achievements, but rather on the level of the individual and its psychology: how do human individuals come to the species-unique cognitive and social abilities necessary for participating in cultural coordination and transmission? To answer this question the obvious first step is to establish exactly how human psychology differs from that of other primates—precisely how humans as individuals are unique. The difficulty is that over the past few decades empirical research has established that humans' nearest living relatives, the great apes, possess cognitive and social skills highly similar to those of humans, including many that are seemingly relevant to cultural processes. For example, there is recent research demonstrating that at least some great apes (1) make and use tools, (2) communicate intentionally (or even "linguistically"), (3) have a kind of "theory of mind," (4) acquire some behaviors via social learning (leading to "culture"), (5) hunt together in groups, (6) have "friends" with whom they preferentially groom and form alliances, (7) actively help others, and (8) evaluate and reciprocate one another's social actions.

But do apes do these things in the same way as humans? To make this determination in particular cases we must look beneath the sweeping claims that both apes and humans "have *x*" or "do *y*," even though such claims may be true on a general level. To penetrate beneath such generalities, we need to make more fine-grained comparisons by performing

comparative experiments in which humans and great apes (especially chimpanzees and bonobos, as humans' nearest living relatives) are observed in as-similar-as-possible circumstances. Such controlled experimental comparisons make it possible to detect subtle differences of behavior and, ideally, the cognitive and motivational processes underlying them. In this way we seek to identify the differences on the individual psychological level that ultimately lead to humans' unique forms of cultural coordination and transmission (and so to telescopes and parliaments).

Given a description of the key differences between humans and their nearest great ape relatives, the next task is to explain those differences. In an evolutionary framework, the axiomatic explanation is, of course, natural selection: the human individuals alive today have been naturally selected to meet certain species-unique ecological or socioecological challenges. For example, one proposal is that humans evolved many of their unique cognitive and social capacities in response to ecological challenges that first forced them to collaborate with one another in acquiring food, and then later prompted them to form larger cultural groups to defend their resources from other groups (Tomasello 2014, 2016). Under these conditions, individuals who could best cooperate with others—individuals who were both capable and motivated to put their heads together with others to collaborate or form a culture—were at an adaptive advantage and so proliferated.

But natural selection creates nothing. Natural selection is only a sieve that sorts, after the fact, viable from nonviable organisms. Evolutionary novelties originate not from natural selection but rather from the other main dimension of the evolutionary process: inherited variation. Classically, inherited variation in evolution emanates from genetic mutation or recombination, which produce, via ontogenetic processes, novel traits. But recent advances in evolutionary developmental biology (so-called Evo-Devo) suggest that the constructive role of these ontogenetic processes has not been fully recognized. Not only do new traits always come into existence via ontogenetic processes—which direct and constrain genetic expression—but by far the most frequent source of new traits is changes in the timing and manner in which already existing genes are expressed and transact with the environment. Thus, even relatively modest changes in the way that regulatory genes orchestrate ontogenetic timing and plasticity can have enormous and cascading phenotypic effects—not encoded directly in the genes—as developing systems interact with one another and

with the environment in unexpected ways. The implication is that if we wish to explain how uniquely human psychology is created, we must focus our attention on ontogeny, and especially on how great ape ontogeny in general has been transformed into human ontogeny in particular.

And that is my goal here. I wish to describe and explain the ontogeny of uniquely human psychology, using as a starting point great ape ontogeny. Great apes engage in basic processes of perception, memory, and categorization, as well as more complex processes of intentional communication, prosocial behavior, and social learning. From this starting point, we may then attempt to identify the unique aspects of human psychology as they emerge ontogenetically over the first years of life. A natural end point for this investigation is children of six to seven years of age. In the eyes of many cultural institutions and traditions, across many centuries and societies, children's sixth or seventh birthday heralds their entry into the "age of reason." In British common law, this is the first age at which a child may commit a crime. In the Catholic Church, this is the age at which a child may first take communion. In cultures requiring formal education, this is the age at which a child is ready for serious instruction in literacy and numeracy. And in traditional societies, this is the age at which a child is first given important independent tasks such as tending a flock, gathering firewood, or delivering a message (Rogoff et al. 1975). Overall, children of this age have become, from a cognitive point of view, mostly *reasonable*—beings with whom one may reason, and expect a reasonable response in return—and they have become, from a social point of view, mostly *responsible*—beings whom one may hold accountable, and expect to hold themselves accountable, for their beliefs and actions. The result is nascent "persons," who have taken a giant first step toward internalizing the culture's norms of rationality and morality, making them for the first time capable of and indeed responsible for normatively self-regulating their own beliefs and actions.

Our working hypothesis to explain the ontogeny of uniquely human psychology is Vygotskian: uniquely human forms of cognition and sociality emerge in human ontogeny through, and only through, species-unique forms of sociocultural activity. But the theory we develop updates and modifies Vygotsky—it is *Neo*-Vygotskian—in placing human sociocultural activity within the framework of modern evolutionary theory. This means that we begin by seeking to identify the ways in which humans are biologically prepared for engaging in their unique forms of

sociocultural activity; indeed, we may argue that it is precisely this biological preparation—in the form of maturationally expressed capacities—that makes uniquely human sociocultural activities and experiences possible in the first place. This does not contradict Vygotsky's argument for the key role of sociocultural context in human psychological development. Modern evolutionary theory emphasizes that organisms inherit their environments as much as they inherit their genes: a fish inherits not only fins but also water. Human children inherit a sociocultural context replete with cultural artifacts, symbols, and institutions, and their unique maturational capacities would be inert without a sociocultural context within which to develop (Richerson and Boyd 2005). Normal human ontogeny thus requires *both* the maturation of species-unique cognitive and social capacities and also individual experience in such things as collaborative and communicative interactions with others, structured by cultural artifacts such as linguistic conventions and social norms.

The account of human evolution on which we rely is that of Tomasello et al. (2012; see also Tomasello 2014, 2016), which focused on the evolution of human cooperation and how it enables species-unique processes of cultural coordination and transmission. For precision, the account borrows theoretical tools from philosophical accounts of shared intentionality (Bratman 1992, 2014; Searle 1995, 2010; Gilbert 1989, 2014). In this view, humans' abilities to cooperate with one another take unique forms because individuals are able to create with one another a shared agent "we," operating with shared intentions, shared knowledge, and shared sociomoral values. The claim is that these abilities emerged first in human evolution between collaborative partners operating dyadically in acts of joint intentionality, and then later among individuals as members of a cultural group in acts of collective intentionality. In contrast to Vygotsky's almost exclusive focus on the transmitive dimension of culture—how the culture's practices with symbols and other artifacts are passed along across generations and thereby restructure human psychological functioning—we focus more on the coordinative dimension of culture: how humans, including children, collaborate and communicate in the moment (how they *co*-operate) as they engage with others in sociocultural activities. Indeed, the argument will be that it is the coordinative dimension of uniquely human cognition and sociality—including its motivational aspects and the new social relationships that these engender—that makes possible the cooperative cultural practices of teaching and

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Evolutionary Foundations

The most basic cognitive and social processes that can be observed in developing children today all have evolutionary histories. Understanding these histories is important because it tells us what these psychological processes are, in the sense of what they are "designed" to do (Tooby and Cosmides 2005).*

In general, great apes have evolved cognitive and social skills for doing such individual things as foraging for food and competing with groupmates for dominance status. Humans in addition have evolved a suite of species-unique cognitive and social skills for coordinating with others in various novel forms of cooperative interaction. These uniquely human adaptations for cooperation evolved in two key steps (Tomasello et al. 2012). The first step comprised adaptations enabling early human individuals to cooperate with one another dyadically in obligate collaborative foraging (with partner choice); these are the skills and motivations of joint intentionality. The second step comprised adaptations enabling modern human individuals to cooperate with one another in the larger collaborative enterprise known as culture; these are the skills and motivations of collective intentionality. These two steps constitute the evolutionary foundations of uniquely human cognitive and social ontogeny.

The emergence of early humans' collaborative and cultural ways of life also instigated important changes in the general course and context

* "If creatures from outer space came across a complex human artifact such as a traffic light, idling, they could dissect it and analyze its structure forever and not understand why it behaves in the way that it does. The wires and lights by themselves could never reveal (not even with the help of an fMRI) why the red light on one side activates only when the green light on the other side activates. To understand these actions we must first understand traffic, and how the traffic light was designed to solve the specific problems created by traffic" (Tomasello 2014, 151).

of human ontogeny. Of special importance, as humans became ever more cooperative they began investing more time and resources into the development of their children, and this effort included adults other than the mother (in the so-called cooperative breeding pattern). Adults provisioning children with food and information well into adolescence slowed down ontogeny, freeing up time and resources that enabled children to appropriate more efficiently the massive amounts of cultural information required to become proficient in the ways of the group.

In this chapter, then, we set the stage for the specific ontogenetic analyses in the main body of the book. We do this, first, by explicating the evolutionary foundations of uniquely human psychology, and, second, by specifying how this uniquely human psychology led to several novel features of human ontogeny as a whole. We conclude with some methodological considerations that, in the chapters that follow, will structure how we go about describing and explaining uniquely human ontogenetic pathways.

Human Evolution

Our story begins with humans' last common ancestor (LCA) with other apes, about 6 million years ago. By all accounts this LCA was much more similar to contemporary chimpanzees and bonobos than to contemporary humans, so we use modern-day chimpanzees and bonobos as models for its psychology. From there we posit two new "environments of evolutionary adaptedness" that selected for humans' ultra-cooperativeness: one focused on face-to-face collaboration in early humans from around 400,000 years ago, and the other focused on culture in modern humans from around 100,000 years ago. Contemporary human psychological ontogeny comprises adaptations shared with the LCA as well as uniquely human adaptations grounded in these two subsequent evolutionary periods.

Great Ape Individual Intentionality

Obviously, we have no direct evidence for the nature of the LCA's psychology. But we know quite a bit about the psychology of chimpanzees and bonobos, as models. Because our goals here are general, our account of their cognition and sociality is general as well. For more detailed

accounts with fuller citations of the relevant research, see Tomasello and Call (1997), Call and Tomasello (2008), and Tomasello (2014, 2016). In addition, in the eight chapters that follow this one we discuss in detail many studies in which chimpanzees and / or bonobos are directly compared with human children.

Cognition Chimpanzees and bonobos spend the better part of their day foraging for food. In this context, they have evolved cognitive skills for understanding the workings of the physical world (Tomasello and Call 1997). They understand (1) space, for finding food; (2) object categories, for identifying food; and (3) quantities, for maximizing food intake. In other words, chimpanzees and bonobos possess the same "core knowledge" of the physical world that human infants begin to display early in ontogeny (Spelke 2009). In addition, in procuring and extracting food—especially when tools are involved—these apes make causal inferences in ways that can only be called thinking. For example, if an ape sees a cognitive problem in one location, then goes to a different location to examine a row of tools, she can, just by looking, choose the tool that fits the problem's causal structure (though the problem is out of sight at the moment). The ape can do this because she has the ability to cognitively represent the problem and mentally simulate using the available tools within that represented problem. In all, based on studies of modern-day great apes, we may say that the LCA had very sophisticated skills of cognition and thinking about the physical world.

A somewhat similar story may be told about social cognition. Great apes, and therefore the LCA, possess and possessed an understanding of others as intentional agents. It is likely that apes' understanding of intentional agency also evolved in the context of foraging—that is, competitive foraging—because identifying others' goals and perceptions is crucial for predicting their behavior when in competition with them. For example, if a subordinate chimpanzee sees two pieces of food and sees a dominant chimpanzee looking in the direction of one of them, she will then choose to pursue the piece that the dominant cannot see. She does this based on an understanding that the dominant has the goal of food and that he can pursue that goal only if he can perceive it. Thus, based on studies with great apes we may hypothesize that the LCA had an understanding of others as intentional agents (another piece of core knowledge) and that they used this understanding in mental simulations to predict what others

would do in various novel competitive situations. Based on other studies with apes, we may infer that the LCA's skills of communication and social learning were likewise sophisticated because they too were underlain by the basic social-cognitive skill of understanding others as intentional agents.

Overall, in comparing the cognitive skills of chimpanzees and bonobos to those of human children, I have characterized our nearest great ape relatives as operating with skills of individual intentionality (Tomasello 2014). They possess complex skills of cognition and social cognition for understanding, predicting, and manipulating their physical and social worlds. What they do not possess is humanlike skills of shared intentionality, such as the ability to participate in the thinking of others through joint attention, conventional communication, and pedagogy. Chimpanzees and bonobos—and thus the LCA—are and were very clever, but mainly or only as individuals.

Sociality Like most primates, the LCA had more or less long-lasting social relationships with selected groupmates. In addition to kinship, their relationships were based mainly on (1) competition and dominance, and (2) cooperation and "friendship." Like many mammals, they combined these two types of relationships as they cooperated with a partner to fight for dominance with a competitor. To cultivate good partners for these conflicts, they did various things to make friends (such as grooming and sharing food). They also helped one another do such things as retrieving an object or obtaining food when they themselves were not competing for it. In general, the LCAs very likely had a special sympathy for kin and friends—especially those who supported them in competitive interactions—and thus cooperated with them in various ways. Their cooperation was grounded in competition.

The one apparent exception is no exception at all. Chimpanzees (and perhaps bonobos) hunt in small groups for monkeys and other small mammals, and so presumably did the LCA. In terms of coordination, in some cases the hunt resembles a kind of helter-skelter chase; but in other cases individuals surround a small prey in order to capture it. Based on experimental studies, we may infer that it is a kind of individualistic coordination in that each hunter is attempting to capture the monkey for itself (because the captor gets the most meat) and they take account of the actions and intentions of others in order to do so. The participants are not

working together so much as they are using one another as "social tools" to maximize their own gains. This is also evident in the fact that the captor will steal away with the carcass whenever he can. But typically he cannot, so all the participants (and many bystanders) get at least some of the meat by begging and harassing the captor. We may thus infer that the LCA had some basic skills of collaboration, but these did not include working together toward a shared goal or voluntarily sharing the spoils at the end.

Overall, as paradoxical as it may sound, our best guess is that LCA individuals had rich social lives with long-lasting relationships, but—as compared with humans—their sociality was still somewhat individualistic. When hunting, they could not put their heads together with others to form the shared goal of working together, and they had no tendency to share resources fairly among all relevant parties. Chimpanzees and bonobos, and so the LCA, are and were very social, but only in a kind of instrumental way.

Executive Regulation In both the physical and social domains, individuals of the LCA also likely had the ability to self-monitor their own actions and thinking. Thus, based on studies with great apes, we may infer that they could make decisions based on an assessment of what they did and did not know; for example, if they were uncertain about the location of something (or whether they could win a fight), they could opt out and pursue another goal rather than risk high-cost failure. This suggests that when they were thinking about a problem they in some sense knew what they were doing.

Furthermore, one large-scale study of chimpanzees (and orangutans) suggested that if the occasion called for it the LCA could self-regulate its behavior in various adaptive ways. For example, it could (1) delay in taking a smaller reward now so as to get a larger reward later, (2) inhibit a previously successful response in favor of a new one demanded by a changed situation, and (3) make itself do something unpleasant for a desired reward at the end (Herrmann et al. 2015). In short, LCAs had a variety of skills of cognitive self-monitoring and motivational self-regulation. What they did not do, that even human children do, is to monitor their actions and thinking based on the perspectives and evaluations of others in their social group.

within another—enable individuals in addition to reflect on their own mental states: to think about their own thinking. The cognitive outcome of early humans' adaptations for obligate collaborative foraging was skills of joint intentionality: skills for putting one's head together with a partner to form a joint goal with joint attention, creating the possibility of thinking about things in terms of perspectival cognitive representations and socially recursive inferences.

Sociality Early human individuals who were socially selected for collaborative foraging related to others in some new ways. Most important, they had strong cooperative motives, both to work together with others toward cooperative goals and to feel sympathy for and to help others who were, or might be, their partners. If an individual depended on a partner for foraging success, then it made good evolutionary sense to help him whenever necessary to make sure he was in good shape for future outings.

Moreover, early human individuals who were socially selected for collaborative foraging also developed a new kind of cooperative rationality that led them to treat others as equally deserving partners—that is, not just with a sense of sympathy but also with a sense of fairness. Partners understood that either of them could, in principle, play either role in a collaboration and that both of them were necessary for joint success. Moreover, as two individuals collaborated repeatedly with one another in a particular foraging context, they developed a common-ground understanding of the way that each role needed to be played for joint success, what we may call role-specific ideals (for example, in hunting antelopes the chaser must do *x*, and the spearer must do *y*). These ideals were impartial in the sense that they specified what either of us must do to fulfill the role "properly," in a way that ensured our joint success. All of these things together led to a collaborative attitude: because we both are needed for success, and we are interchangeable in our roles (each of which have mutually known and impartial standards of performance), we are equally deserving of the spoils. This is in contrast to cheats or free riders, who are not deserving of the spoils.

In choosing a partner for a collaborative effort, early human individuals wanted to choose someone who would live up to role-specific ideals and who would divide the spoils fairly. To reduce the risk inherent in partner choice, individuals who were about to become partners could use their newfound skills of cooperative communication to make a joint

commitment, pledging to one another to live up to their role ideals, including a fair division of the spoils. As part of this joint commitment, the would-be partners also could pledge, implicitly, that whichever of them might renege on the commitment would be deserving of censure; so the deviant, if she wanted to stay in good cooperative standing, would actually join with the partner in condemning herself (internalized into a sense of guilt), in a kind of we > me morality.

Thus, the social outcome of early humans' adaptations for obligate collaborative foraging was a second-personal morality: the tendency to relate to others, face to face, with a heightened sense of sympathy for (potential) partners and a sense of fairness based on a genuine assessment of both self and other as equally deserving partners in the collaborative enterprise (self–other equivalence).

Executive Regulation Based on studies comparing apes and human children, we may infer that early humans not only engaged in individual self-regulation (as did the LCA), but also a kind of social self-regulation. Cognitively they were able to executively regulate their own thinking by anticipating how others would understand and evaluate this thinking—typically as it was expressed in some overt act of cooperative communication. This constitutes a kind of social self-monitoring of their individual thinking (to later become self-regulation via norms of rationality). Socially, especially in the context of partner choice, they could simulate how others were evaluating their cooperativeness, and they cared about this enormously (to become, later and in combination with their we > me morality, self-regulation via norms of morality).

Modern Human Culture and Collective Intentionality

The small-scale collaborative foraging characteristic of early humans was eventually destabilized by two demographic factors that ushered in modern humans (*Homo sapiens sapiens*) some 150,000 years ago. First was competition with other human groups. Competition with other groups meant that a loosely structured population of collaborators had to turn into a more tightly knit social group to protect its way of life from invaders. The result was the sense that our entire social group was one big collaborative activity aimed at group success. Second was increasing population size. As human populations grew, they tended to split into smaller groups, leading to so-called tribal organization in which a number of different

social groups were still a single super-group or "culture." This meant that recognizing others from one's cultural group became essential; in the context of sometimes hostile group competition, one also needed to be recognized by others in one's group oneself. Such recognition in both directions was important because only members of one's cultural group could be counted on to share one's skills and values and so be good and trustworthy collaborative partners, including for group defense. The dependence of individuals on the group thus led to a sense of group identity and loyalty, and a failure to display this group identity and loyalty could be lethal.

Contemporary humans have many diverse ways of marking group identity, but the original ways were mainly behavioral: people who talk like me, prepare food like me, and otherwise share my cultural practices are likely members of my cultural group. And so emerged modern humans' tendency toward active conformity to the group and its conventional cultural practices. Teaching one's children to do things in the conventional way thus became mandatory for their survival. Teaching and conformity generated cumulative cultural evolution characterized by the "ratchet effect"—and thus cultural organization in the form of the group's specific set of conventions, norms, and institutions. Individuals were born into these supraindividual social structures and had no choice but to conform to them. The key characteristic of individuals adapted for cultural life was thus a kind of group-mindedness, both in taking the perspective of the group cognitively and in caring about the group's welfare.

Cognition The cognitive skills needed for functioning in a cultural group were not just skills of joint intentionality but skills of collective intentionality. Individuals had not just personal common ground with other individuals but also cultural common ground—even with individuals they had never before met—because they knew together that they had all had many of the same experiences as a result of growing up in the same cultural group. The individual also had to take the perspective of the group in many situations, especially with respect to the culture's conventions, norms, and institutions. There were right and wrong ways to perform the roles in them: this is the way we do things. This new kind of perspective was thus a kind of "objective" perspective, independent of any individual. Institutions further fortified this sense of objectivity because essential parts of the cultural world were institutional realities such as chiefs, marriages,

and shells-as-money, which were in actuality regular people and things that attained a new status—with new deontic powers—because and only because everyone recognized in their cultural common ground that they did in fact have this status.

In many ways the most important conventions in a cultural group are its linguistic conventions used to coordinate social activities. In addition, language is key to the way that humans think in many different ways, perhaps especially in the way that it conventionalizes perspectives (for example, *dog* versus *pet*) and enables individuals to jointly attend to one another's ideas as they exchange them via their shared linguistic conventions. Language additionally contributes to the sense of an objective perspective on things, as it enables one to express generic propositions about the world in general. Thus, to teach their children, modern human individuals began using generic forms of language in which it is not just that a particular leopard is dangerous, but "Leopards are dangerous" represents an objective fact about the world. The teacher is not communicating her personal opinion to the child but rather representing the culture's objective view of things.

Moreover, modern humans used their linguistic skills to argue with one another cooperatively about some belief or action. In doing so, they provided reasons for why others should agree with them (for example, we should go this way, not that way, because there are antelope tracks down this path, not that path). The individuals who could participate meaningfully in this process were those who behaved cooperatively by subordinating themselves to "good" reasons: my personal preference does not matter, but I will agree and go along with whatever decision is supported by the most and best reasons, using criteria on which we all agree. By engaging in this process individuals' thinking became organized in a much wider and more reason-based "web of beliefs," structured by the group's normative standards of rationality.

Sociality Living in a modern human cultural group meant, above everything else, conforming. One had to conform to coordinate with others in conventional cultural practices, to advertise one's identity with the cultural group's way of doing things, and to be in line with the group's social norms. Some social norms were only about conformity and group identity, but others touched on humans' senses of sympathy and fairness (inherited from early humans), and these became moral norms. And so

just as conventional norms codified the right and wrong way of doing things in instrumental activities, moral norms codified the right and wrong way of treating other people morally. Because the collective intentionality and cultural common ground of modern humans created a kind of "objective" perspective on things, modern human morality came to be characterized as objective right and wrong.

Of course one could act against moral norms. But when called to task by other group members, the options were limited: one could ignore their criticism and censure, and so place oneself outside the norms and values shared by the cultural group (perhaps leading to exclusion from the group), or one could accept it as legitimate and deserved. And indeed modern humans did think of the cultural norms into which they were born as a legitimate means by which "we" regulate "us," and it was part of their group identity to think in this way. This meant that when one deviated from the group's social norms, it was important to justify this deviation to others in terms of the shared values of the group (for example, I neglected my duties because I needed to save a child in trouble). In this way, modern humans internalized not only moral actions but moral justifications, and so created a reason-based moral identity within the moral community.

Executive Regulation And so modern humans self-regulated their thoughts and actions not just based on what they imagined other individuals to be thinking about them, as did early humans, but also based on the normative standards of the group. They began self-regulating their thoughts via the group's publicly accepted norms of rationality, and their actions via the group's publicly accepted norms of morality: they observed not just social self-regulation but normative self-governance. They asked themselves, What ought I to think? And what ought I to do?

Summary and Implications for Ontogeny

Figure 2.1 presents a schematic summary of the three steps in human evolution just explicated. Our ontogenetic hypothesis is that these three sets of adaptations—great ape individual intentionality, early human joint intentionality, and modern human collective intentionality—form the maturational bases for human psychological development, the latter two accounting for its species-unique aspects. Our working hypothesis is that the skills and motivations of joint intentionality (for example, joint attention

way of looking at things is often referred to as developmental systems theory (for example, Gottlieb 1997). When the focus is on human behavior and psychology in particular, it is often referred to as evolutionary developmental psychology (for example, Bjorklund 2015; Barrett 2015). This epigenetic approach to human psychological development contrasts sharply with many so-called nativist approaches, which invoke evolution simply to claim "It's innate!" and be done with it (what I have previously called "simplistic nativism"; Tomasello 1999). A more thoroughgoing evolutionary approach to human psychological development will describe and explain the dynamic processes that construct particular ontogenetic pathways.

The Human Ontogenetic Niche

The individuals of all great ape species go through relatively protracted ontogenies, spending a large portion of their lives in immature form. This long period of immaturity is dangerous for the fledgling because it depends on others for food and protection from predation. Providing all this care is also costly and risky for adult caregivers in a variety of ways. The large costs and risks of this "extended immaturity" life history pattern—for both offspring and caregivers—suggest that it must have at least some adaptive advantages. Most basically, a long period of immaturity means that many cognitive and social competencies, and their associated skills of learning, will develop gradually as the organism interacts with its environment. This extra time, as it were, gives the individual the opportunity to construct its own flexible and cognitively controlled ways of dealing with its own individual adaptive challenges (Bruner 1972).

The human version of this extended immaturity life history pattern has some special characteristics adapted to humans' ultra-cooperative lifeways. Most importantly, human ontogeny unfolds within a highly cooperative social group (a culture), whose members collaborate and help one another in myriad ways, including in raising the young. In this cooperative ontogenetic niche, children depend on many more adults in many more ways and for a much longer period of time than do other apes.

The most basic way is in obtaining food. Great ape mothers wean their youngsters at around four to five years of age, and from then on they are on their own in obtaining food. Great ape mothers allow their offspring to scavenge the detritus of their feeding behavior—the peels, husks, and shells—but they do not actively provision them (see Ueno and Matsuzawa

2004, for an experimental demonstration). In sharp contrast, after human children wean at around three years of age, they are provisioned with food by mothers and other adults until well into adolescence. In a study of hunter-gatherers, Hill et al. (2009) found that children typically do not provide their own food at a level sufficient for survival until mid-adolescence. This same pattern would seem to hold, perhaps even more strongly, for the children in modern industrialized societies.

In a similar fashion, great ape youngsters are pretty much on their own for gathering information about the world around them. They may learn things from others, but adults do not actively provision them with needed information via teaching or instruction (Thornton and Raihani 2008). Once again in sharp contrast, human children gain much information from intentional adult instruction, and this is true in societies of all types, including in hunter-gatherer groups where adults instruct children in less verbal ways (Kruger and Tomasello 1986; Hewlett and Roulette 2016). Indeed, for human children to acquire the local cultural skills on which their survival depends—and to develop normally in all kinds of other ways cognitively and socially—adult instruction is absolutely essential.

All this cooperative provisioning of food and information is done not just by mothers but by a plethora of other adults. For all four nonhuman ape species, basically 100 percent of the care of offspring is provided by the mother, and youngsters stay in close proximity to their mothers for some time, typically in bodily contact. In sharp contrast, human adults form pair bonds, so children are raised in nuclear families with childcare also provided by other relatives and friends. The outcome is that in human societies of all kinds, from hunter-gatherer groups to modern industrialized nations, after early infancy only about 50 percent of the care of offspring is provided by mothers, with the other half provided by fathers, grandmothers, and friends (Hrdy 2006). This pattern of so-called cooperative breeding enables mothers to forage and engage in a variety of other tasks without distraction, and so to have offspring at more closely spaced intervals than other apes. Another important outcome of this pattern of cooperative childcare—which will figure prominently in our account of infancy—is that securing care and attention from an array of different adults presents unique cognitive and social challenges for the infants themselves, perhaps contributing to the development of some of their precocious social and cognitive abilities (Hrdy 2016; Hawkes 2014).

The main point is that this especially cooperative ontogenetic niche makes possible an especially protracted ontogeny. Adults provisioning youngsters with food and information frees them from the costs and risks of sustaining themselves energetically and informationally so that they may take their time developing their cognitive and social skills. The most concrete way to see the overall pattern is to look at brain growth over age in humans and chimpanzees. The adult human brain is roughly three times larger than that of other apes. But even if this enormous size difference at maturity were neutralized, the relative rates at which chimpanzee and human brains reach their respective adult sizes are very different. As can be seen in Figure 2.2, already at birth the brains of chimpanzees are about half of their adult size; they reach 90 percent of their adult size by two years of age. In stark contrast, the brains of humans are only 20 percent of their adult size at birth and do not reach 90 percent of their adult size until eight years of age.

The fact that the human brain is three times larger than that of chimpanzees suggests more complex cognitive functioning in adulthood, and its much slower rate of development suggests that human children need more time to learn and develop their skills in their especially complex cultural environments. Thus, despite some variability in particular developmental pathways, a common pattern for humans is the early emergence of basic skills followed by a long period of development to get to

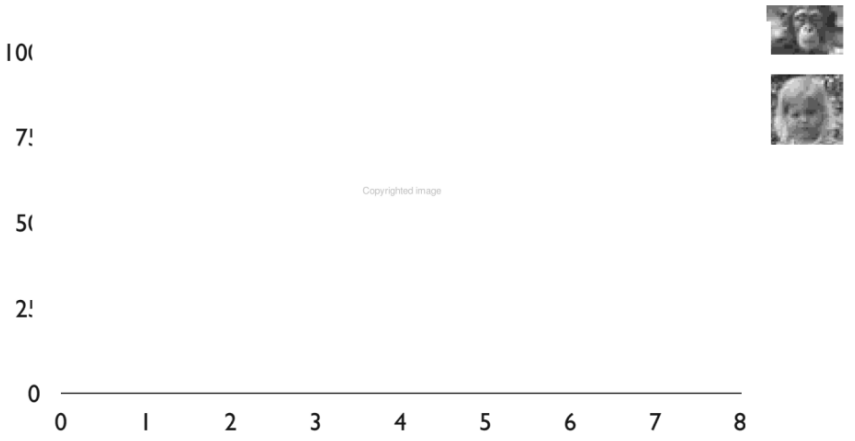

Figure 2.2 Percentage of adult brain size as a function of age (in years) in humans and chimpanzees (based on data from Coqueugniot et al. 2004).

the final, highly complex adult end point—as we shall soon see in much detail.

Human Psychological Life History

It is widely accepted among virtually all students of human evolution that this pattern of a relatively slow ontogeny, including slow brain growth, is at least partly an adaptation to humans' cultural way of life, in which developing children have much to learn and many skills to develop before they can become competent members of their cultural group. And these competencies are not just cultural fads and fashions; early human individuals could not have survived for long on their own without mastering a variety of culturally transmitted subsistence practices and social conventions, including the appropriate use of basic artifacts and symbols. This might lead us to expect that human children should have early emerging skills for becoming competent members of a cultural group.

Evidence for this proposal is provided by Herrmann et al. (2007). They administered a comprehensive battery of cognitive tests to large numbers of chimpanzees ($n = 106$), orangutans ($n = 32$), and two-and-a-half-year-old human children ($n = 105$). The test battery consisted of sixteen different nonverbal tasks assessing all kinds of cognitive abilities involving both physical and social problems relevant to primates in their natural environments. The tests relating to the physical world consisted of problems concerning space, quantities, and tools and causality. The tests relating to the social world consisted of problems requiring the subjects to imitate another's solution to a problem, communicate nonverbally with others, and read the intentions of others from their behavior. If the difference between human and ape cognition is a difference in something like "general intelligence," then the children should have differed from the apes uniformly across all the different tasks. But this was not the case. The finding was that the children and apes had similar cognitive skills for dealing with the physical world; however, the children—old enough to use some language but still years away from reading, counting, or going to school—already had more sophisticated cognitive skills than either ape species for dealing with the social world (see Figure 2.3).

When the correlational structure of individual differences in these cognitive tasks is examined, neither the children nor the chimpanzees revealed a factor of general intelligence (Herrmann et al. 2010). What both species had was a similar factor centered on spatial cognition (likely to be

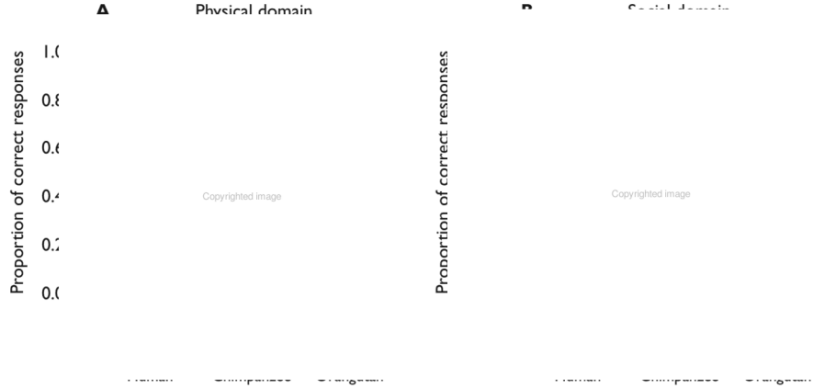

Figure 2.3 Results of tests of cognitive abilities in human children, chimpanzees, and orangutans illustrating their differing rates of development (overall results from Herrmann et al. 2007).

mammalian-wide). The main difference between species was that for the chimpanzees there was only one additional factor comprising various physical and social-cognitive tasks, whereas the children showed distinct, separate factors for physical cognition and social cognition. This species-unique social factor—in combination with children's greater social-cognitive skills on this test battery—suggests that early in ontogeny humans already employ unique adaptations for social cognition, which enable them to master, in a way that other apes cannot, the cultural skills of communication, cooperation, and social learning. What Herrmann et al. called the cultural intelligence hypothesis is that these unique, early developing social-cognitive skills empower human children to culturally learn from others in ways that "bootstrap" their understanding of the physical world through language, instruction, and other cultural and educational interactions so that as adults they will have especially sophisticated cognitive skills across the board.

A key point for current purposes is that humans' specialized social-cognitive skills are not things added onto the end of ontogeny in adulthood, but rather they emerge relatively early—sometime before two-and-a-half years of age, at the least. So all other aspects of human cognitive and social development are built on this unique foundation, leading to unique outcomes. A dramatic demonstration of this proposal comes from the most comprehensive study to date of great ape cognitive ontogeny. Wobber

mother–infant attachment as characteristic of all primates (for example, crying when in need) are no longer sufficient. Instead, according to Hawkes (2014), in this context the infants who do best are those who can discern the thoughts and moods of caregivers and solicit help and care from them via various kinds of interaction and communication. Tomasello and Gonzalez-Cabrera (2017) offer a modified version of this hypothesis, emphasizing that such things as infants' emotion sharing, attention sharing (aka joint attention), and attitude sharing in cooperative communication with adults all tend to align the psychological states of infant and adult; many studies in social psychology show that aligning psychological states—and even behavior in imitation—promotes social bonding (for example, Wolf et al. 2016). Social bonding via the sharing of emotions, attention, actions, and attitudes is an evolutionarily novel phenomenon: individuals feel closer to others as they share experiences with them. This is foundational to virtually all forms of uniquely human cooperation and shared intentionality.

After infancy, early childhood (from three to six years of age) inaugurates what has been called "the two social worlds of childhood." The first world is that of adults, especially with regard to issues of cultural transmission. Thus, although adults in some cultures attempt to teach children from early in ontogeny, it is not until around three years of age that children begin to understand adult pedagogy as, essentially, the "objective" voice of the culture informing them of how "we" do things (see Chapter 5). The second world is that of peers, especially with regard to issues of social and cultural coordination. Again, young children will interact with peers from well before three years of age, but infants' and toddlers' interactions with peers are so thin they are often described as "parallel play" (and their conversations are mostly talking at, not with, one another; see Chapter 4). But after age three, young children begin to interact with peers in ways that evidence a growing competence at social and mental coordination, including an understanding of the culture's conventions and norms, and a growing respect for peers as coequal collaborative and communicative partners. The slow pace of human ontogeny gives young children sufficient time to master both these social worlds.

The developmental capstone of the current account is children at six or seven years of age. As noted above, across all of the world's cultures, children of this age are seen as having reached a new level of functioning that enables them for the first time to perform simple but important cultural tasks independently and reliably (Rogoff et al. 1975). To an important

extent, adults begin to see children of six or seven years as mostly *reasonable:* thinking and acting in ways that they are capable of justifying to others in the culture based on reasons and values we all share. And they have become, from a social point of view, mostly *responsible:* recognizing that others in the culture depend on them to act in accordance with these shared reasons and values—and doing so. Children of this age have thus become, at least to some degree, beings who can normatively self-regulate by asking themselves, What ought I to think? And what ought I to do? They are now ready to begin mastering in earnest the many adult-like skills, practices, and knowledge necessary to become fully fledged members of their cultural group.

Explanation in Developmental Psychology

Our overall goal is to provide a scientific explanation for the main ontogenetic pathways constituting uniquely human psychology. This goal places us squarely in the field of developmental psychology. Explanation in developmental psychology classically comprises two steps: (1) an age-anchored description of some developmental pathway and (2) identification of the factors that affect that pathway's trajectory at various steps along the way, especially in terms of the processes of maturation, experience, and executive self-regulation.

Description does not mean naïve observation. Much of the research in developmental psychology consists of experiments designed to reveal what children are really doing when their naturally occurring behavior could be interpreted in multiple ways. When they use a word do they understand it as a social convention used only by in-group members? When they divide things equally between people are they doing so with a sense of fairness? Describing a developmental pathway means establishing its nature, including its underlying cognitive and socioemotional processes, at each of its steps.

Identifying the factors that affect a developmental pathway calls on correlational research, cross-cultural research, research with special populations, and experiments. In our analyses here, we begin with the developmental pathways already in motion, as it were: we start with the ontogeny of great ape psychology, which has its own trajectory. For current purposes, that existing great ape trajectory is a given, which we do not at-

tempt to explain. What we attempt to explain is how humans have deviated from that relatively ancient trajectory.

Maturation and Experience

There is no doubt that maturation—as the direct expression of human evolution by means of natural selection—plays a key role in structuring human ontogeny, including its unique aspects. However, in complex human competencies, maturation never supplies anything like a finished product, as it can do (to a first approximation) in very basic behavioral skills such as breathing and swallowing. In all of the cases that concern us here, then, what matures is a *capacity,* a readiness to go forward under certain conditions. Actually going forward requires exercising that capacity and experiencing the results.

Given that the ontogeny of complex human competencies is almost never due to maturation alone, we will speak here of the "maturational component" of a developmental pathway—that is, those aspects of a pathway that have been naturally selected at the level of the species as a whole (typically with some plasticity). Importantly, even the aspects of a pathway that are invariant across individuals may still involve much learning if the opportunities for such learning are invariantly available to all individuals. A good example, on the level of sensory-motor development, is walking. The human body has evolved in myriad unique ways for walking bipedally, from the structure of the skeleton, to the structure of the limb muscles, to specialized feet, to specialized mechanisms of balance, and on and on. And all typically developing children in all cultures begin walking within a quite predictable developmental period between about nine and eighteen months of age. Clearly, the developmental course of walking has a large maturational component. But at the same time, children *learn* to walk, and they do so with the support of such generic things as gravity that are invariantly available in all normal human environments. Biological adaptations arise in response to environmental challenges, and the developing organism's actual interactions with those environmental challenges are often a crucial part of their ontogeny.

The nature of children's experience depends on their cognitive and social abilities at a particular developmental level. A great ape, no matter its developmental level or experiences, cannot learn about scoring a goal in soccer because it does not have the capacity to understand the rules that constitute the game. It has no ability to understand culturally constituted

realities that depend on conventional agreements. Children can only understand scoring a goal in soccer (beyond the spatial event of a ball entering a net) when they have the skills for understanding rule games, which depend on cognitive skills of collective intentionality that only develop after age three. One may attempt to teach a two-year-old the rules of soccer and what constitutes a goal, but they will not learn because they are not maturationally ready to have the requisite experiences. On the other hand, two-year-olds can learn many things from their joint attentional and collaborative interactions with others—in ways that great apes cannot—because they have capacities for engaging with others in those ways. We thus advocate a "transactional" causality: maturational capacities create the possibility of new kinds of experiences and learning, and then those learning experiences are the proximate causes of development.

In contrast to such maturationally structured learning, there are, of course, many human skills and much human knowledge for which the individual cannot be biologically prepared in any direct way because they vary across human societies—such things as riding a bicycle, making a bow and arrow, or reading a book. Learning such culturally specific skills depends on a social environment full of other individuals who engage in and even teach the particular cultural practice. We could thus call this culturally structured experience. Of course, it also depends on evolved skills of cultural learning that are universal in the species. Indeed, our focus here is not on culturally specific skills but rather on the ontogeny of children's general skills and motivations of shared intentionality, including cultural learning, that make the acquisition of culturally specific skills possible at all.

Following Vygotsky (1930 / 1978), our basic distinction will be between skills that develop "naturally" through maturationally structured individual learning, and those that develop "culturally" via imitative learning from others in the culture or via adult instruction. It is also possible for children to develop new skills in a process of social co-construction, in which, for example, they learn to view a situation from multiple perspectives simultaneously by assimilating the differing perspectives of peer partners. The result is a typology of four types of learning and experience that play key roles—at different ages in diverse domains—in human cognitive and social ontogeny: (1) *individual learning,* (2) *observational learning*

(imitation and so forth), (3) *pedagogical or instructed learning,* and (4) *social co-construction* (prototypically in peer collaboration).

Who young children are learning from often matters as well. Infants and toddlers before the traditional weaning age (up to three years old) have their most meaningful social interactions and experiences with adults. Adults not only nurture and protect them, but they also engage with them in uniquely human forms of social interaction such as joint attention, cooperative communication, and social imitation. This suggests the possibility, as noted previously, that human infants' early emerging skills of joint intentionality evolved to elicit care and attention from parents and other adults by forming meaningful social relationships with them. In contrast, infants and toddlers do not have an abundance of meaningful social interactions with peers. Of course, they sometimes interact with other infants and toddlers, but their respective actions are often described as "parallel"; they almost never engage with one another in uniquely human forms of social interaction such as joint attention, cooperative communication, and social imitation.

Also as noted previously, beginning at around three years of age, young children enter into what has been called the two social worlds of childhood: adults versus peers. On the one hand, children of this age interact with knowledgeable and authoritative adults, who typically tell them what to do and teach them things, and they typically conform and learn because adults are respected authorities. On the other hand, children of this age interact with peers, who are no more knowledgeable or powerful than they are, which engenders perspective-taking, dialogic thinking, and reciprocity. Of course, there are exceptions to this pattern, when young children engage coordinatively with adults in some situations—perhaps especially in Western, middle-class cultures where it is normal for adults to play with their children as if they were peers. Also young children sometimes are instructed in things by more expert peers. But still there is a huge difference in the nature and the effects of these two different types of social interaction, rooted in the simple fact that adults are adults, and peers are peers.

Our causal model is thus, to repeat, "transactional." Maturational capacities are inert until they are used in transactions with an environment. It is what children experience and learn during these maturationally structured transactions—and, in many cases, how they learn and who they learn from—that actually propels human ontogeny forward.

internalizes this instruction to voluntarily direct her own attention and action strategically (for example, Vygotsky 1930; Winsler 2009).

The general process is thus that the young child imagines how some social interactant is comprehending or evaluating her, and then she uses this to socially self-regulate. Scaling up the sociality involved, children from about three years of age (but, needless to say, not apes) socially self-regulate on the basis of cultural structures—such as, prototypically, conventional and moral norms—that are based in cognitive processes of collective intentionality, what we may call *normative self-governance.* This process operates in much the same way as social self-regulation in a dyadic context, but the social other in this case is more generalized and authoritative. Thus, from sometime during the late preschool period, young children self-regulate both their thinking and actions not just by how efficacious they will be in the current context (as do apes), and not just by how they will affect a particular person's thoughts or evaluations (as do younger children), but also by the perspective of how these will fit with the normative expectations of the social group. This process essentially constitutes the construction of a normative point of view as a self-regulating mechanism, arguably the capstone of the ontogeny of uniquely human cognition (normative rationality) and sociality (normative morality). And, again, engaging in social self-regulation or normative self-governance can lead to developmental change without any additional inputs from either maturation or learning.

All these kinds of executive self-regulation—individual self-regulation (of uniquely human processes), social self-regulation, and normative self-governance—play important roles in leading children to reconfigure things in ways that resolve conflicts between perspectives or values. By internalizing social experiences structured by shared intentionality and using them to executively self-regulate their own thoughts and actions, young children, by the time they are six years of age, will have taken a first big step on the road to becoming normatively reasonable and responsible members of their cultural group.

Methods

We will be attempting in what follows to describe and explain developmental pathways. Obviously, before charting a developmental pathway one must decide what constitutes that pathway. This can be done in different ways depending on one's purposes, including the degree of detail

needed. In general, a developmental pathway may be defined or characterized by the end point one wishes to explain. If one wishes to explain walking, then the pathway includes all of the relevant skills and competencies leading to that end point. However, if one wishes to explain running, then walking is only one step along the way. In most cases, a developmental pathway, as defined by a particular end point, will comprise a number of other, perhaps smaller pathways with their own developmental histories.

In deciding how to describe and explain a developmental pathway we must make some methodological choices. Most basically, an evolutionary perspective on human ontogeny leads to a focus on action as the primary level of analysis. Natural selection can operate directly only on the way organisms interact with the environment overtly. The ability to perceive something, or feel something, or think something can only be "seen" by natural selection if it influences the way the organism acts, in which case these internal processes become, indirectly, targets of natural selection. This is not to say that the underlying psychological processes are somehow unimportant or problematic; to the contrary, they structure everything. But in an ontogenetic analysis, we must view perceptual, cognitive, and emotional processes in their context as components in a developing pathway whose evolutionary *telos* is adaptive action.

To identify the underlying psychological processes involved, experimental methods are needed. In the contemporary field of developmental psychology, there are three main sets of methods (leaving aside the neuroscientific methods, as they are mainly correlational and concerned with a different level of analysis). The first is various kinds of looking measures, which are used most prominently in studies with infants, whose skills of adaptive action are limited. Studies using these methods have uncovered a host of surprising competencies in infants, which have transformed the way that developmentalists view the earliest phases of human ontogeny. But in most cases the competencies revealed are perceptual competencies and represent only a first step toward a fully developed system of adaptive action. The second set of methods, at the other end of the continuum, involve language-based interviews, used mostly with children from about four to five years of age, as younger children are notoriously poor at expressing their knowledge and competencies in language. Third, in contrast to both of those approaches, our focus here is on methods that target children's skills of decision making and adaptive action: how children

interact with and adapt to various behavioral contingencies and problems. This focus is appropriate because most of the developing pathways with which we are concerned unfold during the period of one to five years of age, when children have some significant behavioral competencies but little ability to reflect on them linguistically. For each of the developmental pathways whose course we chart, we will look briefly at any perceptual or motivational competencies that emerge early in the pathway and serve as precursors, but we will not consider our job complete until we have charted the way the child uses these competencies in facing behavioral challenges.

In the next two parts of the book, we describe and explain how human children become reason-based rational and moral creatures over ontogenetic time in particular domains. In Part II the four chapters focus on uniquely human cognition, and in Part III the four chapters focus on uniquely human sociality. The basic procedure for each of the chapters is as follows.

- We begin by recounting what is known about great apes in this domain, and in particular anything known about great ape ontogeny.
- We then describe and explain the species-typical ontogenetic pathway for humans (based mainly on behavioral experiments). In most cases this comprises two interrelated and ordered pathways reflecting, in turn, the capacities of joint intentionality (evolved for early human collaborative foraging) and collective intentionality (evolved for modern human cultural life). For example, the pathway for uniquely human cultural learning has a first phase of imitative learning followed by a second phase of instructed (pedagogical) learning. The explanation is in terms of what we know about the key factors affecting the course of the pathway, as established by developmental studies of biological syndromes (especially autism), individual differences, and cultural differences.
- Finally, we spell out how developments in this domain contribute to the overall structure and ontogeny of children's reason-based rationality and morality.

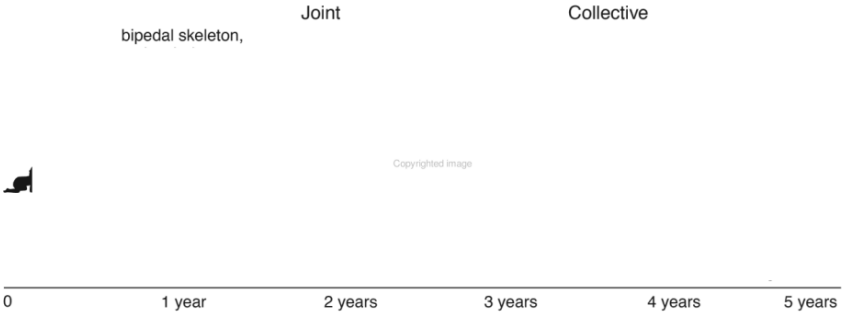

Figure 2.5 Illustration of a developmental diagram: the ontogenetic pathway for learning to dance the tango. Abbreviations: Cog = cognitive capacity; S-R = executive self-regulation.

To help us to describe a particular developmental pathway and to identify the factors that affect its course, we will use what we may call developmental diagrams. The function of these diagrams is to graphically depict a particular developmental pathway across age, including the most important component processes and causal factors involved. As a playful example (intended only as an illustration of the method), in Figure 2.5 we depict the ontogenetic pathway for learning to dance the tango.

Such developmental diagrams comprise four essential components. First, our starting point is great ape ontogeny (in the tube occupied by an infant and juvenile chimpanzee at either end). The key competencies here are knuckle-walking, which emerges in apes at one year, and active participation in group travel, which emerges between two and three years. Second, the focus of our explanatory attention is the middle row of rectangular boxes, flanked by an infant and young child at either end. These depict a path from crawling to walking to taking a walk together to tango dancing, at the ages indicated. Third, in the top lines above the great ape tube are uniquely human maturational capacities of (1) joint intentionality (here: the cognitive capacity for forming a joint goal) and (2) collective intentionality (here: the executive capacity to normatively self-regulate or, in this case, to "follow the rules") that mature at, respectively, about nine months and three years. (Included in this example only are also uniquely human capacities for bipedality.) Fourth, the shading around each box depicts something of the nature of the experiences needed for the individual to bring together these different sources into the designated

developmental outcome, with darker shading indicating that more of particular kinds of experience are needed. In addition, the skills listed below the boxes indicate experiential inputs from other skills with their own complex developmental histories—in this case, the ability to learn from instruction. So, in this example, walking requires experience of a very generic kind, whereas tango dancing requires specific instruction. (In each of the particular accounts that follow, the relevant experiences will be specified more precisely, of course.)

The animating image is thus great ape ontogeny moving forward; then, as uniquely human capacities of shared intentionality mature, they enable new forms of sociocultural experience, which transform great ape psychology into human psychology over developmental time. In general, my explanation for the developmental emergence of the ability labeled by a particular box in a particular diagram always includes (1) great ape ontogeny (in the tube) as the foundation; (2) preceding abilities (to the left), with an arrow to the box as precursors; (3) maturational capacities (above the tube), with arrows to the box as enabling causes (including executive regulation); and (4) relevant experiences (shading around the box) as proximate causes. Thus, "taking a walk together" emerges from individual walking and ape group travel, as the capacity for forming a joint goal with a partner matures and enables new kinds of coordinative social experiences with others. We will be using such developmental diagrams as a way of summarizing both the trajectory of the developmental pathway and the factors that affect it for each of the pathways in each of the eight chapters that follow.

3

Social Cognition

Mature human thinking is structured by the basic distinction, recognized since the ancient Greeks, between subjective and objective (or appearance and reality, belief and truth, opinion and fact). The distinction derives from the insight that a single individual's subjective perspective on a situation at any given moment may or may not match with the objective situation as it exists independent of this or any other particular perspective.

Great apes and other animal species do not bifurcate experience in this way. They take the world as it appears to them, without contrasting it to anything else (objective or otherwise). They are also able to imagine what another individual is experiencing or has experienced, but they do not contrast this with what they or anyone else is experiencing or has experienced either, much less with an objective perspective. Their understanding of the world and their understanding of others' experiencing of the world are simply not integrated in a way that leads to the distinction between subjective and objective.

Great apes do not distinguish subjective and objective, in my view, because this is not an insight that individuals can come to on their own. An individual cannot come to it either by inventing a clever theory or by simulating another's experience, and they cannot come to it by comparing their past to their current experience. To understand the distinction between subjective and objective, an individual must triangulate (to use the term of Davidson 2001) on a shared situation with another individual at the same moment: we both see *X*, but you see it this way, and I see it that way. That is, the participants must come to understand that the two of us are sharing attention to one and the same thing, but at the same time we each have our own perspective on it. This is the basic cognitive

organization of the so-called dual-level structure of shared intentionality (Tomasello 2014).

Human infants begin engaging others in this dual-level manner from around nine months of age. They are able to do this because they have inherited this way of engaging others from their early human forebears, for whom it enabled novel and unique forms of social and mental coordination. Initially, infants engage with adults in joint attention, within which they learn about their individual perspectives. In communicating, child and adult attempt to align their perspectives, and later in ontogeny to exchange and coordinate perspectives in conversation about a common topic. It is through the exchange of perspectives in linguistically mediated discourse—in which partners jointly attend to one another's thinking—that children are forced to coordinate discrepant perspectives (which they do through the use of their developing skills of executive regulation). During the period from three to six years, using their emerging skills of collective intentionality, children construct from this admixture of sharedness and individuality an "objective" world independent of their own or anyone else's way of construing it, but about which, nonetheless, individuals may have various subjective perspectives, attitudes, and beliefs, including false beliefs.

In this chapter we focus on the ontogeny of uniquely human social cognition. We begin with the ontogeny of great ape social cognition, especially their ability to imagine (nonperspectivally) what others perceive and know. We then look in turn at young children's skills of joint attention and at their ability to coordinate multiple perspectives on the same entity. These unique skills set the stage for three- to four-year-old children's ability to coordinate conflicting perspectives on the executive level—for example, two contrasting beliefs or an object's appearance as compared with reality—and thereby to construct new understandings of the world.

From Apes: Imagining What Others Perceive

For all our analyses of uniquely human ontogenetic pathways, we begin with great apes. In the current case of social cognition, the analysis focuses on multiple skills—namely, following gaze direction, imagining what another sees or hears or infers, and imagining what another knows or believes.

Great Ape Social Cognition

From the point of view of social cognition, gaze following is a fairly low-level process. But there are some differences between the way that great apes and human infants follow the gaze direction of others that might be related to, or even fundamental to, more complex processes of social cognition. The main issue is developmental timing. In the simplest gaze-following tasks, when the looker and the target are in the same visual field (and so peripheral vision may come into play), two studies have found gaze following in seventeen-month-old human-raised chimpanzees (Okamoto et al. 2004; Tomasello and Carpenter 2005a). Gaze following to more distant targets comes only several years later, however:

- In a test in which a human looked up to the sky, three chimpanzees below three years of age did not systematically follow the looker's gaze direction whereas five individuals older than three years of age did (Tomasello et al. 2001).
- In a longitudinal study, chimpanzees and bonobos first began following the gaze direction of humans between two and three years of age (Wobber et al. 2013).
- In an experiment, chimpanzees under four years of age continued following the gaze direction of a demonstrator who continually looked at nothing whereas older individuals soon quit (Tomasello et al. 2001).
- In another experiment, chimpanzees over five years of age, but not younger, performed "double looks" as they checked back with a demonstrator who was looking at nothing to see whether they got it right (Bräuer et al. 2005).
- In two final experiments, chimpanzees over four years of age (younger juveniles were not tested) locomoted to follow a human's gaze direction to a location behind a barrier (Tomasello et al. 1999), and they could tell when a barrier blocked a looker's visual access to a target (Okamoto-Barth et al. 2007).

These are all much older ages than human infants in the same tasks, as we shall soon see (see also Lucca et al. 2017).

Beyond simple gaze following, a number of studies have attempted to assess whether chimpanzees can imagine the actual content of what others see. In a series of studies, Hare et al. (2000; see also Bräuer et al.

2007) had a dominant and subordinate chimpanzee compete for food in novel situations in which one piece of food was out in the open and one piece of food was on the subordinate's side of a barrier where only she could see it. When their door was opened (slightly before the dominant's), the subordinates chose to pursue the food on their side of the barrier only; they knew that the dominant could not see this food (whereas he could see the food out in the open). In an important variation, Hare et al. (2001) hid only one piece of food on the subordinate's side of one of two barriers (see also Kaminski et al. 2008; Karg et al. 2015b). The trick was that in some cases the dominant witnessed the hiding process but in other cases he did not. The result was that subordinate chimpanzees avoided going for food that a dominant could not see now but might have seen hidden some moments before; they knew that he *knew* where the hidden food was located. And they assigned this knowledge to this particular individual: if, after one dominant had seen the hiding process, he was switched for another, the subordinate subjects knew that the new individual had not seen the hiding process and so did not know where the food was. Great apes can imagine the actual content of what others perceive and know.

In addition, great apes sometimes attempt to actually manipulate what others see. Hare et al. (2006) and Melis et al. (2006a) had chimpanzees compete with a human (sitting in a booth) for two pieces of food. In some conditions, the human could see the ape equally well if it approached either piece of food (one on each side of the booth). In these cases, the ape had no preference for either piece. But in the key condition, a barrier was in place so that the apes could approach one piece of food without being seen. And this is exactly what they did. They even did this in a variation in which the choice confronting them was to reach for food from behind a barrier (such that the human could not see their body) but either through a clear tunnel (where the human could potentially see their reaching arm) or an opaque tunnel. They imagined what the human could see of their reaching arm. In a follow-up study, these same individuals preferentially chose to pursue food that they could approach silently—so that a distracted human competitor could not hear them—as opposed to food that involved making noise en route. This generalization to a completely different perceptual modality—audition versus vision—speaks to the power and flexibility of the cognitive skills involved. In still another impressive skill of social cognition, in a find-the-food game, chimpanzees

knew that their competitor would choose a board that was lying slanted on a table (as if some food were underneath) rather than a flat board (under which there could be nothing); they knew what kind of inference he would make from the perceptual situation (Schmelz et al. 2011). Great apes' skills of social cognition are extremely flexible.

A final step in the process is the understanding of false beliefs. In five different studies modeled on classic tasks passed by four- to five-year-old children, great apes have failed (see Tomasello 2014, for a review). But recently great apes have performed well in two different false-belief tasks passed by human infants at around eighteen to twenty-four months of age. In an anticipatory looking task modeled on that of Southgate et al. (2007), Krupenye et al. (2016) had great apes watch an actor observe something being hidden; then, after the actor had left the scene, it was moved. When the actor returned, great apes looked first and most often to the location where the actor was likely to search (where he observed it being hidden), even though the object was no longer there. Great apes also passed another infant false-belief test based on the helping task of Buttelmann et al. (2009, 2017).

We return to this issue in more detail later, but for now we simply state our view that in these ape studies—as well as the corresponding infant studies—individuals are anticipating what others will do based on what those others see or have seen, and the individual's own knowledge of the situation is not salient to them in any way (much less any objective situation). We would thus assimilate these studies to those showing that great apes know what others know, with the fact that the ape herself knows something different being basically irrelevant. One could call this an "implicit" understanding of false belief in the sense that apes can predict what another will do based on what it has seen, even if this differs from what they themselves see or have seen (as their own experience is irrelevant to their prediction of the other's actions).

Taken together, these various studies show that chimpanzees know that others see things, hear things, know things, and make inferences about things. Beyond the studies of gaze following, these more demanding studies clearly demonstrate that chimpanzees can imagine the actual psychological content of what others are seeing, hearing, knowing, and inferring, and what this means for their impending actions. These more demanding studies were carried out mostly with adult apes, almost none below four years of age.