Gisela Labouvie-Vief

Integrating Emotions and Cognition Throughout the Lifespan

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Preface

The major purpose of this book is to offer a single and coherent core of common concepts and parameters about the development of emotions—a set of concepts that applies to emotional development over the total span of life, "from womb to tomb." These concepts/parameters are proposed as theoretical bridges across diverse developmental periods or stages, and that can be consistently applied throughout the *total* of the life span. At the same time, these concepts carry unique implications for different periods of life, such as infancy, childhood, adolescence, early and middle adulthood, and late life/aging.

The unifying concept that ties together these diverse periods of the life span is an extension of Piaget's notion that the process of development follows laws or equilibrium and homeostasis. Each level of development, according to Piaget, is characterized by a balance of opposing forces—one oriented towards stability of cognitive skills and called *assimilation*, the other characterized by an expansion of cognitive skills called *accommodation*. These two forces, working together but in alternation, ultimately assure a dynamic of equilibrium/homeostasis.

Piaget used the concept of equilibrium primarily in the cognitive sense, but in this book, I propose to expand this concept of purely cognitive equilibriums to ones that directly imply organismic/physiological processes typical of equilibrium or homeostasis—concepts of excitation, activation, arousal, and tension that imply successions of moments of stability and reorganization that alternate and complement each other. The equilibrium concept is particularly crucial for emotional well-being and thriving: Experiences that secure sufficient equilibrium foster balance and well-being, since they ward off excessive tension related to overstimulation/arousal and excessive stress. During the course of development, the capacity to maintain such balance grows in such a way that over time, individuals can deal with stimulation characterized by higher levels of discrepancy, complexity, and tension by still maintaining stability rather than being overwhelmed and fragmented.

The theory proposes that at first, such necessary balance is precarious, since the range of experiences over which equilibrium can be maintained is narrow and fragile. But with the growth of cognitive skills during the first half of life and later on, and given sensitive guidance by caretakers, individuals come to comfortably master

feelings that, at early junctures of development, are too strong and disturbing. As a consequence, they experience such feelings as comfortable and interesting—they even enjoy them for a slight burst of excitement and seek them out intentionally.

The core premise of the book is that as development progresses, this shift in equilibrium results in an enlargement of the complexity and range of situations over which stability and comfort can be maintained. Following Sroufe (1995), this process is referred to as a *raising of tension thresholds*—i.e., stress and discomfort no longer occur at relatively low thresholds but only at rather high ones.

Although positive emotional development is characterized by such synchronized emotional–cognitive expansion with an elevation of tension thresholds, less positive outcomes can result in a lowering of tension thresholds, a process that implies difficulties in modulating tension. Such emotional–cognitive restriction is a typical outcome if early development is characterized by problematic caretaking and socialization processes. Its effects can continue and permeate later portions of the life span.

In contrast to the raising of tension thresholds in early development, later life brings a variety of problems in cognition and emotion regulation. The book proposes that these can best be characterized by a tendency for tension thresholds to become lowered as a consequence of processes of normal emotional–cognitive aging. As a result, problems of emotion regulation that are not already handled in well-routinized ways become apparent at lower levels of tension. Nevertheless, the difficulties in later life can be held in check, to a considerable extent, by the lifelong formation and strengthening of emotion regulation skills that can set off some of the general aging declines.

Throughout the book, detailed attention is given to the cognitive and neurobiological mechanisms that are at the base of expansions or restrictions of emotional equilibrium mechanisms. Equal attention is given to those biological and social factors that may reroute positive expansion into negative pathways characterized by dysregulation and emotional disequilibria that may characterize a large portion of individuals' life spans.

The book targets a wide audience of social, behavioral, and biological scientists; it will also be of interest to their students, including postdoctoral, doctoral, and graduate and undergraduate students. It will aim at enlivening presentation through the provision of real-life examples. Thus it will be likely to be read, as well, by educated readers interested in questions of and information about emotional development throughout the different stages of life.

Geneva, Switzerland Gisela Labouvie-Vief

Acknowledgements

This book represents the fruit of some three-and-a-half decades of my research and theoretical work that recently has come to fruition, just at the point of transitioning from my position as Full Professor of Social-Emotional Development across the Life Span at the University of Geneva into that of Professor Emerita.

The preparation of the book has been greatly helped by the support and enthusiasm of many friends, colleagues, and collaborators over the course of the years. This enthusiasm has sparked and helped sustain my interest in my research and writing about emotions from a life span perspective. I want to thank warmly, first of all, my former teachers Warner Schaie and the late Paul Baltes who sparked my interest in issue of life span development. Once embarked on my own on an academic career of examining issues of development "from womb to tomb," I encountered many colleagues who supported my work through encouragement and continued interest and who offered generous comments that found their way in my conceptions. I am especially grateful to the late Klaus Riegel for his inspiration. Frequent discussions with Ravenna Helson were a further source of inspiration as well as valuable critique. Former colleagues and collaborators who always were ready to help figure out complexities of theory included Manfred Diehl, Mark Lumley, and Lee Wurm while I held the position of distinguished professor at Wayne State University. Ursula Staudinger and Anik de Ribeaupierre were instrumental in the call I received, in 2005, to the University of Geneva—a move that allowed me to work in the environment rich with the concepts of the late Jean Piaget, whose important contributions had stimulated my interests and thinking in developmental transitions in the domains of intellectual and emotional development. I was most fortunate to obtain support of my early inspiration to proposing a theory of life span emotional development through a 5-year Research Career Development Award, of the National Institute on Aging, from 1978 to 1983. It gave me the pleasure to read a wise collection of Piaget's work, which has deeply formed my thinking on processes of development.

Once in Geneva, I had the fortune to work with a number of research assistants who enthusiastically shared my own interest in emotional development: Daniel Grühn, Harold Mouras, Anne-Laure Gilet, Nathalie Barraco, and Joseph Studer all

were collaborators who contributed enormously to the research program of our social–emotional development group. I am proud they all went on to their own academic careers, and pleased to be observe they ably continue discussions to research and theory on emotional functioning and its development at different stages of life.

Once determined to write a book of my own on codevelopment of cognition and emotions, preparation of this book was greatly aided by my 10-month stay as a Fellow of the Hanse Wissenschaftskolleg (HWK), a Center for Advanced Study in Delmenhorst, Germany. This Center allowed me to make the acquaintance of worldwide prominent experts in the area of neuroscience who helped spur my interest in and refine my understanding of this important field. Of the persons who were ready to give me advice and answers on difficult topics when asked for, I am especially grateful to Dorothy Poggel and Illana Gozes for discussions about the neurobiological side of my interest in emotion–cognition relations. John Bye commented on several chapters and with great expertise suggested corrections where needed; both he and his wife Helene extended constant warm friendship during my stay. I also thank the Direction of the HWK, which provided an ideally equipped context facilitating academic research; without the Center's aid, and the constantly helpful support of its staff, I am not certain I would have outlasted the rigors of bookwriting. Last but not least, I was fortunate to be able to spend this productive stay close to family near Bremen, and I am especially grateful for the love and support I received from Hedda, Selma, and Lisa, Brigitte, and Georg.

Contents

Chapter 1
Emotions and Cognition: From Myth and Philosophy to Modern Psychology and Neuroscience

This chapter begins with the presentation of some prescientific and philosophical views of the nature of emotions and cognition/rationality—views that often implied a dualism that devalued emotions and idealized reason. This dualistic view was challenged by Charles Darwin who, in the wake of his "Origin of Species" (1859), wrote a further book (Darwin, 1872) proposing that emotions in humans and animals alike were evolved adaptive systems, highly automated since they were aimed at securing a sense of equilibrium and survival in urgent situations of danger. Darwin's proposal prepared a turn towards biology. It not only forms the base of modern theories of emotions; it also had profound influences on philosophical and psychological thinking on the importance and function of emotions in adaptation. This effect is briefly exemplified by the theories of Freud and Piaget. The chapter ends up detailing how this "biological turn" is evident in recent theories of emotions as "ancestral equilibrium systems" of the brain, as evidenced by the latest writings of Panksepp and Biven (2012) and Damasio (2010).

1.1 Reason and Emotions as Polarity

Human experience of and relationship to reality often is felt and discussed in terms of a dualism. On the one hand is the world of thinking and rational decisions—a highly structured reality analyzed by philosophers and held to yield verifiable, even certain insights into the nature of reality and human nature. On the other hand is that of more emotive and intuitive processes that often defy the structured and sober language of reason, and that yet enliven that language with the richness and sensuality of felt experience. Our intellectual history often has polarized these languages and placed them in stark opposition. Accordingly, the language of reason and thought was held to be superior and trustworthy, whereas that of emotion and intuition was judged to be worthy of suspicion.

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The separation of these two modes of experience has often been discussed by referring to them as two different "languages." In *Psyche and Eros* I (Labouvie-Vief, 1994) followed Carl Gustav Jung (1933) in calling those two modes *logos* and *mythos. Logos* means "word," but it refers particularly to the conceptual aspects of words and, more generally, of reality. It connotes such activities as counting, reckoning, explaining, and refers to such aspects as rule, principle, and reason. It thus designates knowledge that is arguable, demonstrable, and carries clear connotations—thus can be defined with precision and agreement. Bruner has referred to this as a "paradigmatic" mode of thought (Bruner, 1986).

The word *mythos* also refers to language and speech, but in contrast to *logos*, it designates a way of approaching and experiencing reality that is less readily arguable, demonstrable, or formalized than is true of *logos. Mythos* language is connotative rather than denotative, and its meanings are conveyed in the context of narrative performance such as retelling a myth. Plato termed this mode *mimetic* and said of the reciter of Homeric poetry:

> I think you know that the very best of us, when we hear Homer or some other of the makers of tragedy imitating one of the heroes who is in grief, and is delivering a long tirade in his lamentations of chanting and beating his breast, feel pleasure, and abandon ourselves and accompany the representation with sympathy and eagerness, and we praise as an excellent poet the one who most strongly affects us in this way (Plato, 1961a; c.f. Labouvie-Vief, 1994, p. 34).

This "narrative" mode of thought (Bruner, 1986) thus is one in which meanings are conveyed through social participation. It aims at conveying to the situation a sense that is organically felt and pregnant with emotive significance, rather than making claims to "objective evidence." It is a language inherently subjective, rather than being rational and aimed at objective proof. It implies a language and a mode of thinking in which we are carried away by emotions, imagination, and fantasy—a language utilized in poetry, story telling, and myth.

Throughout our intellectual history, there has been an ongoing debate about how these two modes are to be ordered. One of the first philosophers to discuss the relative merit of these two modes was Plato, who concerned himself with the effects of writing on thought (see Donald, 1991; Scribner & Cole, 1981). Prior to written language, information was related through oral transmission—a mode that is inherently interpersonal and imparts knowledge through a sense of participation and immersion, or emotional directness and the identification of the listener with the orator.

More recently, the philosopher Cassirer also remarked on the fact that in the mythos mode, individuals do not take an analytical and distancing attitude towards information; rather

> Mythical thinking does not dispose freely over the data … . In order to relate and compare them to each other, but is captivated and enthralled by the intuition, which suddenly confronts is. It comes to rest in the immediate experience; the sensible present is so great that everything else dwindles before it. For a person whose apprehension is under the spell of this … attitude, it is as though the whole world were simply annihilated; the immediate content, whatever it is, commands his … interest so completely that nothing else can exist beside and apart from it. The ego is spending all its energy in this single object, lives in it, loses itself in it (Cassirer, 1946, pp. 32–33).

The invention of writing, by contrast, encouraged an entirely different attitude towards information, which was no longer conveyed by the quasi-contagion encouraged by intense emotional involvement that listeners were likely to experience as if by contagion. Instead, it afforded the listener a greater measure of distance. For example, written messages can be uncoupled from their context, and the reader can inspect them, disconnect them and transpose them in space or time, and systematically compare and critique them. This is a mode of thought, then, that lends itself ideally to rational debate oriented towards proof and establishing "truths" (see Scribner & Cole, 1981).

1.2 Plato and the Idealization of Rationality

The Greek philosopher Plato was one of the first individuals to call this new mode of thought *reason,* and he claimed that reason is a mode of thinking and knowing that is more advanced than *mimesis* or *mythos.* The polarity between the two modes of thought was put, then, into a hierarchical, vertical relationship: accordingly reason was to dominate and suppress the imaginative and emotive, and the core conviction was that by such suppression, the objective laws of logos would reveal ultimate truths that were completely universal, neutral, and untainted by human subjectivity and the failings of organismic existence. Thus, admonished Plato, in Phaedo (1961b), the philosopher should aim at avoiding paying attention to the body's clamoring, since "…The mind or psyche can best reflect when it is free of all distractions such as hearing or sight or pain or pleasure of any kind—that is, when it ignores the body and becomes as far as possible independent, avoiding all physical contacts and associations as much as it can, in its search for reality (Plato, 1961b, p. 48)."

As the philosopher Lakatos pointed out, for about two millennia the laws of thought were essentially identified with laws of logic, and the history of logic was "essentially the history of criticizing and improving the deductive channels and destroying the inductive channels by making logic formal (Lakatos, 1970, pp. 8–9)."

1.3 The Deconstruction of the Myth of Rationality

The early twentieth century, in contrast, was witness to a radical deconstruction of that myth of the superiority of reason unfettered by human subjectivity. Such a deconstruction was spurred on by the critique of romantic philosophers such as Nietzsche and Schopenhauer (see also Nozick, 1981, p. 4; Lakoff & Johnson, 1980). These philosophers argued that rational discourse is replete with subjective elements, as evident in a language of competitive concern with the pursuit of power and contempt of human fallibility and subjectivity. Indeed, for a rational discourse to claim universal validity, it needed to make use of the very subjective language it

hoped to ban from the scene. This claim was offered in the form of the so-called *limitative theorems* of, among others, the mathematicians Skolem, Goedel, and Church (see Smith, 2007). These theorems pointed out that only relatively basic and trivial axioms (such as the mathematical axioms of Euclid) could be framed in the closed deductive form that had been the hope of past philosophers. Once more general issues were addressed, however, it was necessary to accept less formal, less deductive, and more uncertain propositions. In general, these theorems were interpreted as stating that truth is not a static and universal matter, but that it is best understood as a dynamic process: something that evolves, that is being constructed, and that is continually being redefined. Truth has, therefore, an explicit historical and developmental perspective, and it is moved out of the realm of axioms and ideals into the very context of human practice (Labouvie-Vief, 1994). Thus, if by purging the language of rationality of all the elements of the language of mythos, subjectivity, and desire, philosophers had hoped to assure inevitable progress and enlightenment, that hope itself was built on a language of desire: "Just as Freud had pointed out that rationality, if used in excess turns into its opposite, irrationality, so the roots of the fervent idealization of logos were revealed to speak a language of desire. This is so because the prohibition of desire is itself an act of desire and the belief in the inevitable emancipative power of logos is itself a myth (Labouvie-Vief, 1994, p. 174)."

1.4 Darwin's Upgrading of the Organic and Emotions

The early twentieth century reevaluation of the lofty role of reason had, in fact, been anticipated by Charles Darwin's book "The Origin of Species" (Darwin, 1859). Darwin had been exposed to the thinking of the geologist Lyell whose work implied that the time frame of the earth's creation as shown in geological deposits must have by far exceeded religious accounts. Darwin had collected an enormous amount of evidence in support of the conclusion that life on earth had evolved over a then unimaginably long time frame—and that it had done so in equivalent ways for different species from animals to man. He knew that pronouncing the very kinship and genesis of humans to that of the animals was an explosive proposition, and he agonized over its publication (Gruber, 1981), delaying until Wallace (2007) was about to publish his own highly similar ideas on patterns of evolution before him. In the climate of the times, as is well known,

Darwin's proposal of a continuity in the evolution of animals and humans was nothing but shocking, even heretical, and it was thunderously criticized as an assault on religious accounts of creation that dethroned and ridiculed the dignified status of the conceptions of man and reason. Nevertheless, Darwin soon followed "Origin of Species" with his work "On the Expression of the Emotions in Man and Animals" (Darwin, 1872). In this book, Darwin suggested that emotions serve extremely important adaptive purposes, secured by evolutionary processes so as to optimize

survival in situations of high urgency. Emotions thus are highly automated, with the result that they are able to deliver rapid responses not possible with the slower processes of rational analysis—and in that sense, adaptively superior in many situations to reason:

> … certain actions, which we recognize as expressive of certain states of mind, are the direct result of the constitution of the nervous system, and have been from the first independent of the will, and to a large extent, of habit … Our present subject is very obscure, but, from its importance, must be discussed at some length; and it always is advisable to perceive clearly our ignorance (Darwin, 1872, as quoted by Panksepp & Biven, 2012, p. 1).

To bring home the power and importance of that *wired-in* type of automaticity, Darwin related an "experiment" he performed on himself 1 day as he visited the Zoological Gardens:

> I put my face close to the thick glass-plate in front of a puff-adder … , with the determination of not starting back if the snake struck at me; but, as soon as the blow was struck, my resolution went for nothing, and I jumped a yard or two backwards with astonishing rapidity. My will and reason were powerless against the imagination of a danger which had never been experienced (Darwin, 1872/1965, p. 38).

1.5 Emotion Theories After Darwin

Darwin's work was to revolutionize views about the function of emotions. Indeed, it was to provide a basis not only for a reevaluation of their importance, but offered a scientific foundation of how to study them. In his book he detailed a number of emotions such as rage, shame, fear, or joy. Each class of emotions was characterized by a particular event that set it off or *activated* it. Activation was evident by typical gross motor gestures such as defense or attack, as well as characteristic facial expressions which were shared by humans and animals alike). For example, just as animals may puff themselves up and raise their hair when attempting to ward off an attack, humans speak of "hair raising events" when struck with a sense of horror. Darwin's book provided detailed images of the facial musculature that produced various emotional movements, as well as photographs (a first in the history of book writing) of different emotional expressions of children and adults (see Fig. 1.1). His proposals were revived by Tomkins (e.g., 1962, 1984, 1999) who analyzed emotions in terms of distinct patterns of expressive gestures and physiological responses. His suggestions were further developed by his students Paul Ekman (1973), Ekman and Rosenberg (2005) and Carroll Izard (1979, 1990) who further developed Darwin's theory by providing precise, anatomically based methods of scoring facial movements. These movement patterns are generally organized by about seven basic *affects*, or core emotions, each related to distinct expressive movements and physiological patterns. Thus the notion that there are basic emotional patterns fixed by biological heritage has received wide-ranging support and has come to be accepted as a well-established finding on research on emotions.

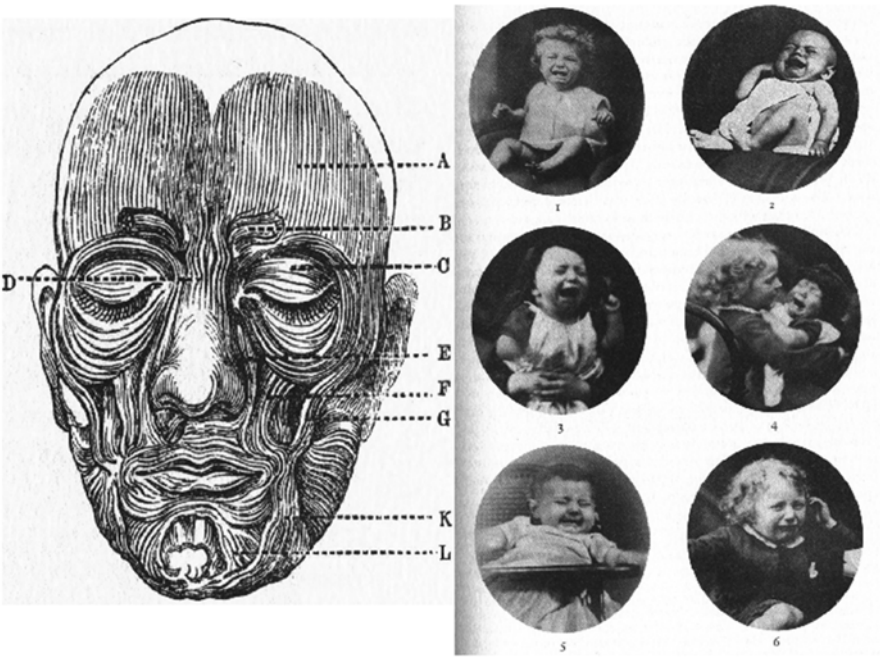

Fig. 1.1 Facial expressions of emotions according to Darwin**.** Darwin meticulously documented the muscles of the face and their functions in facial expressions such as frowning, wrinkling the nose, clinching the eyes, and raising the corners of the lips, all in various ways involved in the distinct expressions of distraught babies (Reproduced with permission from Darwin, C. (1998, 3rd Ed.), The Expression of the Emotions in Man and Animals. Introduction, Afterword, and Commentaries by Paul Ekman. London, Harper & Collins, p. 29)

1.6 Freud and the Unconscious

Darwin's writings reevaluating the importance of highly automated emotions as compared to rational processes have had a profound influence on more modern views of emotion. One precursor of these modernized views was Sigmund Freud (1823/1957, 1900/1953) the founder of psychoanalysis, whose work also began with a rejection of the rationalist dogma. Thus he proposed that rational processes were undergirded by a way of being in which an *inner* world of desires and wishes prevails. This inner world of *primary process* is highly unconscious and identified as the "ID"—a kind of biological heritage in terms of drives that have their own intentionality—an intentionality, however, that is not rational, but aimed at the satisfaction of wishes and urges, rather than the optimization of rationality. Freud was particularly interested in the development of sexuality and introduced the notion of infantile libidinal wishes towards their parents as one of the predominant drives—a

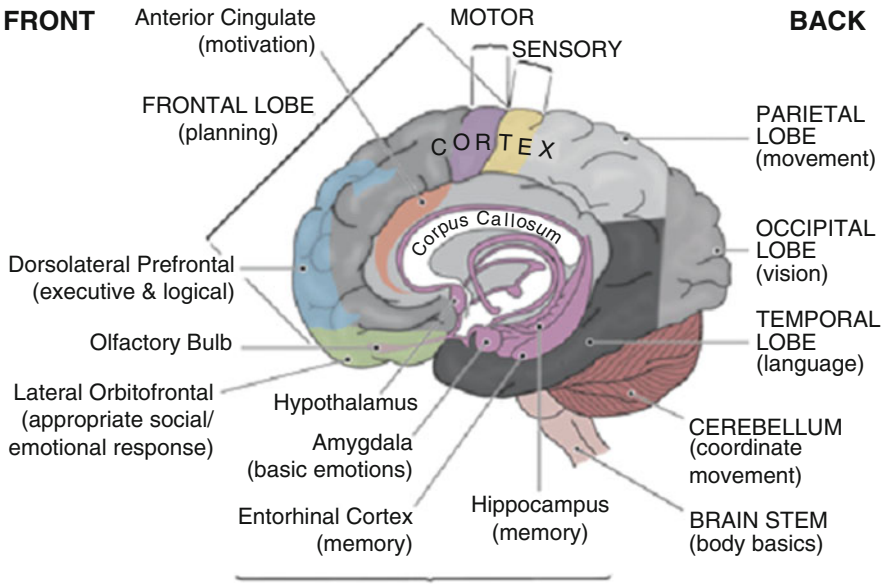

Fig. 1.2 The Brain and what it does. Reproduced with permission from, www.brainwaves.com. For explanation, see text

fact which somewhat scandalizing Victorian attitudes of the time and earned his theory the name of "psychosexual theory." [1]He held that the ID is dominated, by the pleasure–pain principle—that is, it aims at the optimization of pleasure and the avoidance of pain—in contrast to the EGO, which is orientated towards the demands of external reality. The EGO is ruled by *secondary process*, a way of being that is no longer directed merely by the ID's demand for achieving pleasure and avoiding pain. Rather, it engages rational functions to establish a balance between the demands of the ID and the objective and veridical function of the EGO's orientation towards outer reality. The EGO hence introduces reflection upon and management of primary process rather than the mere living out of the latter (Fig. 1.2).

Freud's theory implied a duality of tension between the ID and the EGO. However, this principle of tension does not reflect a simple dualism between the two poles; rather, it implies that a creative tension may exist among the two. Through this dialectic of tension, it is, in principle, possible for individuals to transcend the sheer dualism between reason and emotions, or EGO and ID processes. Instead they are able (or at least attempt) to evolve a relatively harmonious balance and integration between the two. Ideally, such integration fosters affective spontaneity, while at the same time securing a balance with rational discipline. Such integration is, however, by

[1] Yet at the same time, Freud's acknowledgment that sexuality had its origins already in infancy and early childhood also exposed to the public that sexual abuse of young children constituted a problem not to be hidden.

far not a guaranteed outcome of development, as we will see in chapters to follow. Much of Freud's work, indeed, addressed the problems of adaptation that resulted from a lack of such balance. Imbalance could express itself, for example, by an ID that was over activated, and as a result was flooded due to lacking EGO restraints; alternatively, it could be evident in an EGO whose controls take on tyrannical proportions and fostered maladaptive defenses that, rather than fostering smooth and rewarding emotional experience, could eradicate emotional spontaneity and flexibility altogether. These divergent solutions continue to constitute an important topic in our knowledge about how individuals regulate emotions in more or less adaptive ways, as we will see throughout the book.

1.7 Erik Erikson's Psychosocial Stages of Life

Another theory of emotional development that had its origin in psychoanalyses was that of Erik Erikson. Erikson had received his formation as a psychoanalyst in Vienna, where he underwent psychoanalysis with Anna Freud, the daughter of Sigmund Freud, and was exposed to the circle of psychoanalytically interested individuals that surrounded Freud. But the core theme of his theory of development was not to become sexuality per se; rather, he developed a theory that was oriented to how individuals constructed a sense of identity and self, a process which continued over the total of the life span. In that process of construction, he placed particular emphasis on the social context in which the growing individual began to develop and to construct a sense of self. His theory proposed that this process of construction emerged over a series of Eight stages, each of which poses a particular social challenge and provokes a "developmental crisis" for the individual—"crisis" here is meant not in a catastrophic sense, but in the same sense discussed in Chap. 4, in which the notion is that advances in development often bring disequilibrium and momentary disruption which, ideally, can be resolved in a new equilibrium and psychological advance. As a result of this "crisis," the individual struggles between two poles. Ideally, the individual is able to establish a final equilibrium among these two poles, a process which characterizes his or her "adaptive force." As an example, the first stage characterizes the period between the age of 0 and 2; during this period, the developmental task, supported by positive interactions with the mother (or other caretaker), is to find an equilibrium between the core self qualities of basic trust, as opposed to basic mistrust. This equilibrium, in turn, confers on the child the adaptive force of Hope.

Erikson held that in the process of development, there is a complementarity among generations, since adults, in taking care of the developmental needs of the young, also find in the process of so doing that their own developmental needs are met. In this process of "cogwheeling," of the stages of childhood and adulthood, there is thus a mutually beneficial "system of *generation* and *regeneration*" (Erikson, 1964, p. 152), as quoted from Wolff (1997, p. 375). We will revisit this notion in different chapters to come.

1.8 Piaget's Theory of Assimilation and Accommodation

In the wake of Freud's writings, Jean Piaget (1981) similarly proposed that development arises out of a dialectical tension between two types of processes or orientations. As was true of Freud, Piaget proposed that the reality to which we adapt is not merely an external given "out there." Rather as infants we are, through our biological heritage, furnished with an "inner" reality that provides us with automatic reflexes and actions adapted for survival—actions (such as ones related to nursing, preferring the sight of human faces, and reflex like protective gestures when experiencing a sudden drop) that constitute automated means of preserving equilibrium and, therefore, life. What we come to understand as "reality" evolves from this organismic ground of our inner, biological, and psychological being. To this inner reality, the self assimilates external experience at first. With repeated encounters with external reality, however, children gradually begin to actively turn outward to accommodate to new experiences; through this process of accommodation and learning they modify their inner tendencies, which become more and more adapted for dealing with the external world. Hence for both Freud and Piaget, positive development implies being able to work creatively with the tension between the internal and the external pole. Piaget proposed, indeed, that this process of the gradual expansion of experience was the driving force of all future cognitive development, as we will further discuss in the next chapter.

Although Piaget's theory was primarily a theory of *cognitive/rational* development, it is particularly noteworthy that he was one of the first theorists to completely reject a dualism between reason/cognition and emotion. Rather, he suggested that reason and emotion are completely intertwined systems: emotions constitute the energetic side of cognition in that they activate and motivate the organism. Cognition, on its side, provides order and structure to the energetic processes of cognition. In that way, the two systems support and work with each other. Indeed, Piaget (1981) held that cognitive development did not only drive the advancement of rational processes throughout different stages of life, but it equally also worked to gradually transform emotions. In helping us to foresee events and, if necessary, to forestall them, cognition is a powerful tool that extends our ability to maintain necessary equilibrium. His theory thus held that, as cognition grew in complexity and sophistication, so emotional life also was transformed over time. As a result, the advance of cognitive development provides successively more powerful means of preserving equilibrium in complex and challenging situations. We will return to this process and detail it in Chap. 4.

1.9 Emotions as Ancestral Equilibrium Systems: Neurobiological Views

The proposals of Darwin, Freud, and Piaget more recently have been echoed by neurobiologically oriented emotion theorists who also underscore the continuity with automated processes such as emotions on one hand, and more complex

cognitive, and sometimes conscious ones, on the other. These differences are widely thought of as forming a hierarchy that to an extent is reflected in the very physical structure of the brain. Figure 1.2 displays one version of that structure. Stretching from the front (frontal lobe) to the back (occipital lobe) one finds the largest structure of the brain, the *cerebrum*. It is associated with higher order cognitive functions such as logical thinking, language, and planning and voluntary behaviors—"executive processes" that can guide more automatic forms of behavior, planning, and understanding language. It consists of two hemispheres, the right and the left hemispheres. These two hemispheres are connected by a bundle of nerves, the corpus callosum, which permits communication across the two hemispheres. Below the extension of this part of the brain, one finds an area referred to as the Limbic System. Here are located a number of systems whose role in the activation of emotions is paramount. For example, the amygdala is a structure that indicates the "value" of an emotion from pleasant to unpleasant and even dangerous, and it relates this information to higher order centers such as specific areas frontal lobe. The amygdala has been especially widely studied in relation to the activation of fear (LeDoux, Panksepp); we will return to this fact in later chapters.

Part of the limbic system is the brain stem, which builds a bridge to the spinal cord. The brain stem is a prime site of the type of innate behavioral knowledge of ancestral equilibrium systems: It incorporates basic instinctual tendencies related to respiration, alimentation, reproduction, domination, and exploration—all functions on whom survival critically depends and that therefore are highly automated.

The various theoretical outlines just discussed propose that the brain is built as a hierarchical structure, with relatively more primordial structures featuring automatic instinctual tendencies at a lower level, in contrast to ones related to more cognitive and voluntary and aware processes on higher levels. This corresponds to an original proposal of MacLean (1990), a neuroscientist who proposed a tripartite Model of the brain. According to this "Triune Brain" Model, these levels corresponded to different evolutionary stages of the brain from amphibia to humans, as shown in Fig. 1.3.

The equation of different layers of the brain with "remnants" of different evolutionary stages has been proven problematic, however; layers of the brain do not necessarily perform functions and tasks as coherently organized subsystems, but rather participate in complex processes of communication with each other. More modern views, therefore, explore the specific linkages of communication in which the different components of the brain engage. Nevertheless, LeDoux (2003), suggests that, even though the Limbic System, in particular, does not constitute one coherent system emotion systems per se, the concept of such a system is useful, because it expresses MacLean's insight that emotions involve relatively primitive circuits that have been conserved and passed on in Mammalian evolution. In turn, the total brain is built in a hierarchical fashion along an axis from relatively "primitive" and automatic to relatively advanced and complex cognitive forms of emotion processing. As for the Limbic System, it does indeed feature a number of structures and processes that are important in the automatic activation of emotions. Of those structures, the Amygdala (which receives its name from its almond-like shape) is

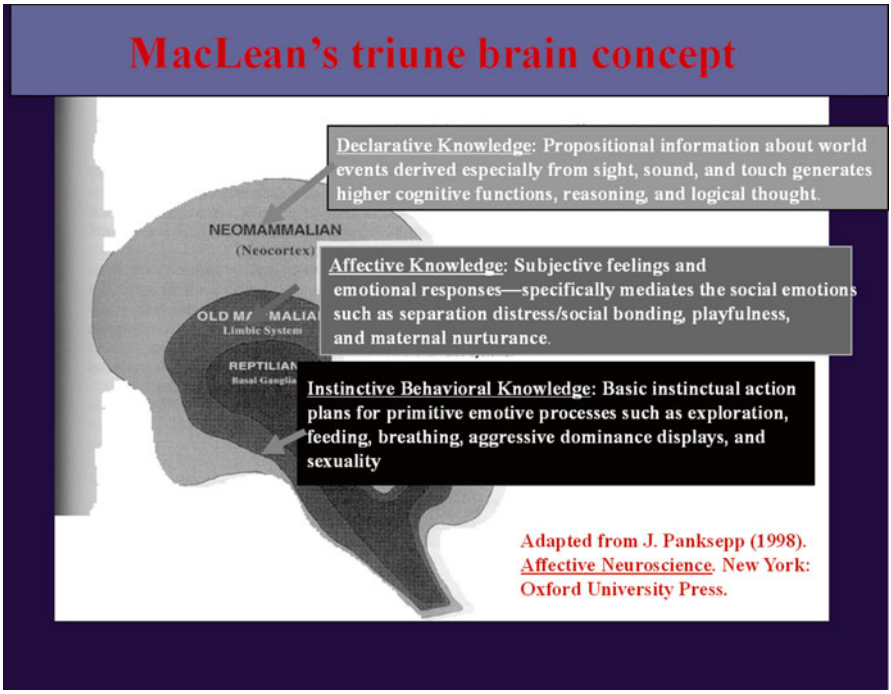

Fig. 1.3 The Triune Brain. MacLeans' proposal that the brain is structured in three layers that evolved from instinctive to cognitive forms of knowledge in the course of evolution (Adapted and reproduced with permission from Panksepp (1998), *Affective Neuroscience.* New York: Oxford University Press)

regarded as the paramount processing system of emotions. It evaluates the emotional value of a stimulus and reports this value in terms of intensity of activation. Indeed, LeDoux proposes that the computation by which the brain determines the value of an emotional stimulus constitutes the very nature of emotion. From this initial determination of value, he states,

> Other aspects of emotion then flow from this computation. First, emotional reactions Oscar. These covert Bodil Responses and associated changes in internal body physiology are the advance guard of emotional responsitivity. Subsequently … a feeling emerges as we become aware that our brain has determined that something important is present and we are reacting to it. In addition, given that we are in an emotionally arousing situation, we often take action. That is, we do things to cope with, or capitalize on the event that is causing us to be emotionally aroused (LeDoux, 2003, p. 206).

Figure 1.4 gives an example of the complex information flow that results from such an interplay. The sequence of events, according to le Doux, further, illustrates that emotion processes are largely independent from aspects of conscious processing—as indicated so well in the earlier cited quote of Darwin's observation of this "irrational" reaction to a snake that attempted to strike from behind a thick glass pane! Emotions are initiated (or "activated") by some initial event, and activation

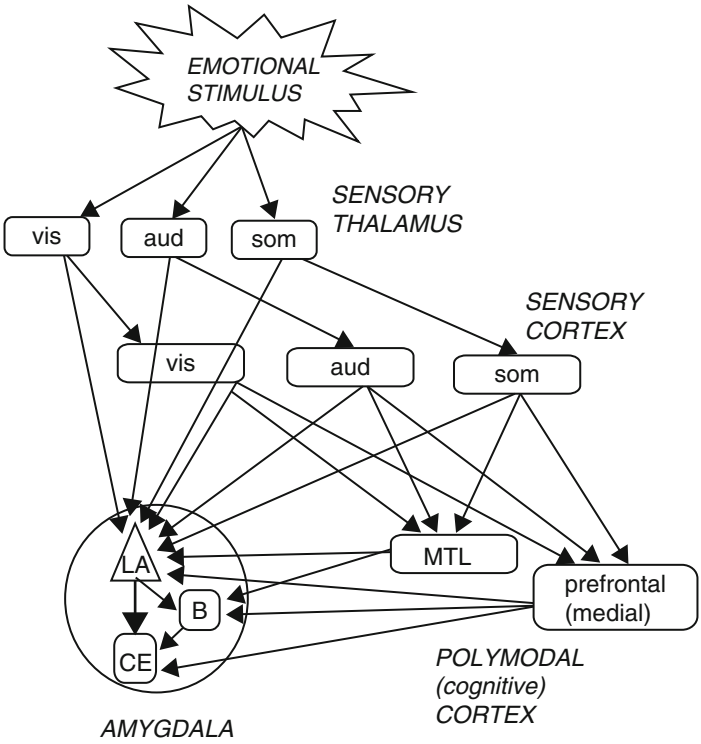

Fig. 1.4 Information flow following emotional stimulation. The amygdala receives low-level information about objects and events from sensory-processing regions of the thalamus, and more complex information from sensory-processing areas of the cortex. *Vis* visual, *aud* auditory, *som* somatosensory, *MTL* medial temporal lobe memory system, *LA* lateral amygdala, *B* basal amygdala, *CE* central amygdala (Reproduced with permission from LeDoux, J. (2003), Synaptic Self. Penguin Books, Figure 8.1, p. 207)

then proceeds as emotionally relevant information which is received by the amygdala; the amygdala, in turn, relays that information from sensory-processing regions of the thalamus, as well as more complex information received from sensory-processing areas of the cortex.

Other recent neuroscientists propose somewhat similar, "layer type" models. One example is Panksepp and Biven (2012) who also formulate a three-layer model in which emotion-related processes are ordered from most automatic to those that are most cognitively elaborated and imbued with awareness and consciousness. Nevertheless, basic forms of emotional awareness already are evident at the most primordial first level. Accordingly, "our most powerful emotional feelings—the primal emotional affects—arise from ancient neural networks situated in brain regions below the neocortical 'thinking cap.'" The neo-cortex (so-called because it evolved relatively late in evolutionary time), in its turn, is associated with complex processes of perception, learning, and cognition. The neo-cortex hence is responsible for all

the heritage of learning and culture. Yet Panksepp and Biven (p. x) note that the cortex intimately needs to correspond with the more primal structures, since …

> … the cortex could achieve nothing without an evolved foundational mind deeper in the brain. Those ancient neural territories below the neocortex constitute our ancestral mind—the affective mind, which is evolutionarily specialized and that we share with many other animals.

A quite similar model is proposed by Damasio in his book *Descartes' Error* (Damasio, 1994). In this book, Damasio argued that Descartes went wrong in claiming that rational processes were superior to, and could exist without, the "wisdom of the body"—the functions that are part of the more ancient layers and encoded as our genetic heritage. In his recent book "Self comes to Mind" (2010), he proposed that at the base of complex forms of cognition and consciousness lies a kind of entirely unconscious or *preconscious intention*: that of preserving life. We already noted that Freud had maintained that an orientation towards pleasure and pain constitutes a first and relatively primitive layer, considered from a historical–evolutionary perspective of existence. In a similar fashion, Damasio proposes that states of pleasure and pain are an integral aspect of processes of life management: these processes signal success or failure of the regulation of inner states. Thus life management at first is entirely nonconscious; if it were not, in fact, the exquisite and delicate regulation of important body states could not function. Furthermore, he suggests that optimal ranges of stimulation express themselves in the conscious mind as pleasurable feelings; dangerous ranges, as not so pleasant or even painful feelings (Damasio, 2010). Thus the success or failure of our regulation management is indicated by pleasure or pain—these feelings, in turn, are important markers or signs to consciousness as far as organismic management of well-being or its lack is concerned. They are signs from the unconscious that indicate that those automatic signs of pain or pleasure are not being obeyed, and that equilibrium process thereby is being disregarded, urging us to search for more conscious, reasonable solutions for the crisis.

Damasio proposes, however, that nonconscious processing constitutes only *one* "layer" of experience, and the most basic one. This most basic layer relays the status of more basic functions to more complex activities of the brain, such as the formation of memories, and eventually, a sense of self and consciousness. These memories formed by the brain are not isolated images of the external world, but composites "of the sensory and motor activities related to the interaction between the organisms and the object during a certain period of time (Damasio, 2010, p. 133)." Thus our memories are not at all "objective" … "but prejudiced, in the full sense of the term, by our past history and beliefs. Perfectly faithful memory is a myth, applicable only to trivial objects … The brain holds a memory of what went on during an interaction, and the interaction importantly includes our own past, and often the past of our biological species and of our future (p. 133)."

Memories are hence inherently subjective—they encode information about the self and his or her inner states. Although at first quite nonconscious, with advancing development and greater complexity of thinking, this subjectivity gives rise to yet more complex mental states of consciousness in which individuals can step back and take their own thinking as an object to reflect on. This move towards consciousness,

in turn, can create a great expansion of the power of thinking—thinking now can project into the past and the future, can consider possibilities and reflect on them, and can optimize plans for success. In this way, advances in development will ideally bring ways of regulating that are more powerful and flexible than the nonconscious mechanisms that make up our ancestral equilibrium systems.

Damasio's differentiation between nonconscious and conscious processes in emotional dynamics has been expanded by Panksepp and Biven (2012), who also differentiates between brain regions that are capable of nonconscious, equilibrium-regulating functions, and ones that permit more conscious forms of emotional processing.

The ancient, subcortical structures of the brain can, in situations of danger, generate automatic behaviors such as freezing flight, or fight; they are also known to control core vital instinctive functions such as respiration, alimentation, reproduction, exploration, and domination. But despite their high level of automaticity, Panksepp and Biven propose that they also are associated with raw emotional feelings and that they present a primal kind of *affective consciousness* of important adaptive significance:

> Primal feelings are not intrinsically bright and intelligent, but they were built into our brains because they are remarkably useful for immediately dealing with the worlds and leaning about its potential. There are many ways these ancient brain networks can make us feel—experiences we sometimes call *core emotional affects* and *raw emotional feeling* (Panksepp & Biven, 2012, p. 13).

The notion of such a primal, nonconscious layer of feelings is reminiscent of Freud's notion of the unconscious with its primary processes. Panksepp (1998) indeed suggests such a parallel, and in doing so proposes that this primal layer is organized into about seven distinct subcortical systems—those for SEEKING, FEAR, RAGE, LUST, CARE, PANIC/GRIEF, AND PLAY. The SEEKING (or expectancy) system is characterized by exploratory inquisitiveness and engenders exploration that is pursued with heightened interest verging on euphoria. The RAGE system causes animals to attack offenders by biting, scratching, and pounding the offender. The FEAR system reflects a frequent response to attack: the animal responds with immobility and freezing, or else patterns of vigorous and dramatic flight. The LUST system is characterized by courting activities with the aim of interesting and pairing with a partner. The CARE system comprises tender feelings and impulses oriented towards nurturing others, such as taking care of the young. It is related to the PANIC/GRIEF system, which engenders intense distress, and even despair in the face of separation. The PLAY system, finally, is expressed in movements of bounding lightness which sometimes have playfully aggressive aspects such as poking or ribbing—although the system may also be related to establishing dominance hierarchies if the encounters are not so much playful as aimed at domination. All of these systems, according to Panksepp (1998) provide primal but highly organized systems that "were built into the brain by evolution: They are ancestral memories (Panksepp & Biven, 2012, p. 20)." In some sense, these ancestral memories add substance and depth to some of Freud's proposals about drives and instincts, at the same time, they permit us to link up those terms with a rich body of

behavioral and modern neuroscientific findings and insights. We will return to some of these systems in later chapters.

Although Panksepp proposes that these core affective and motivational structures are built into the brain and are not dependent on individual learning histories, he nevertheless notes that over the course of development, more complex structures *do* mature as a function of the process of learning. These more complex structures eventually permit more conscious forms of emotional regulation and expression. They even permit more complex social emotions, that is, emotions that incorporate interpersonal and cultural rules. We will return to these levels of emotional complexity in the next chapter.

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Chapter 2
Equilibrium and Disequilibrium in Development

2.1 Introduction

As we have seen in Chap. 3, emotions were, throughout the course of history, mostly held in low esteem, because they do not necessarily agree with demands of logical thinking. In fact, they follow laws of their own that can be at variance with logical reasoning. Nevertheless, since well over a century, the low regard in which emotions have been held has gradually given way to a thorough vindication. It is now widely acknowledged that the unique importance and strength of emotional systems does not lie in their rational power; rather it resides exactly in their automaticity that carries on an extremely important biological function—to take care that vital parameters of organisms are held within critical ranges within which adaptive and efficient functioning is upheld. In addition, should danger threaten of too much fluctuation from these critical ranges, emotional systems provide ready-made mechanisms of coping and repair.

The process of maintaining sufficient levels of necessary constancy is referred to as homeostasis. The constancy achieved by this process of homeostasis, in turn, is termed "equilibrium." Thus the goal of homeostatic processes is reached when equilibrium systems signal to the brain that all is well—or to the contrary, when situations of danger arise that disturb equilibrium, to signal that repair processes must be set in motion to restore equilibrium. We have also seen that theoreticians, such as Piaget (1985), Damasio (2010) and Panksepp and Biven (2012) who are interested in equilibrium mechanisms, all propose that over the course of the development of individuals, our capacities of maintaining equilibrium at first comprise mechanisms that are purely unconscious. But with advancing development, these authors propose, equilibrium mechanisms can increase in their efficacy, as capacities of reflection and consciousness join with the more basic automatic mechanisms. As a result, organisms are able to develop more powerful ways of regulating themselves. In this chapter, we discuss how more automatic processes of equilibrium regulation function, and also how they can transform into more powerful ones that combine with and integrate more conscious processes. We begin with very basic

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biological equilibrium processes such as those discussed by the physiologist Walter Cannon (1932). Such biological equilibriums are aimed at the regulation of fairly fixed parameters (such as for example, body temperature) that must be kept within a specific range of values to secure survival. In contrast to such relatively fixed systems, psychological theories, such as those of Freud and Piaget, postulated equilibrium systems that can change over the course of development. From the more behavior-oriented cognitive proposals of Jean Piaget we will proceed to those of modern neuroscientists who, like Piaget, proposed increasing levels of complexity in how we come to regulate our emotional experience (see Labouvie-Vief, 2009).

2.2 Homeostasis/Equilibrium and Tension Reduction

In 1932, the Physiologist Walter Cannon published a book entitled *The Wisdom of the Body*. In it, Cannon adopted work of the French physiologist and Professor of Medicine Claude Bernard (1865), who suggested that for organisms to live with a certain independence from the fluctuations of outer environments, they had to be able to maintain a degree of constancy of their inner environment, or *milieu intérieur*. It was Cannon who termed the process by which such constancy is maintained *homeostasis*—the core mechanism by which living systems regulate themselves. To maintain a sufficiently constant inner state, Cannon proposed that mechanisms of self-regulation-created balance or *equilibrium* by responding to any change with actions that resisted such change; in this way, they restored the parameters required for healthy functioning. Cannon's theory quickly gained great popularity in psychological theories (e.g., Brent, 1978; Carver & Schaier, 1998; Helson, 1964). Cannon, to be sure, was primarily interested in the way in which the body regulates important parameters, such as body temperature or levels of blood sugar, that are critical for survival. Take, for example, body temperature. In that case, the system aims at preserving a "normal" body temperature of about 98.7 °F or 36 °C at rest. If significant deviations from that value occur in either upward or downward direction, temperature either rises to dangerously high, or falls to dangerously low levels, both of which threaten and even disrupt integrated functioning. In actuality, however, there can be small variations from these ideal values. These values are not punctuate, but form a *steady state* with fluctuations. If temperature falls below or climbs above that steady-state range, the body then initiates restorative actions in proportion to the deviation from the ideal state. If such restoration is not possible and deviations from the end state are driven to the extreme, then the survival of the organism is threatened. At the extreme, the very equilibrium mechanism may break down.

A model like this is referred to as a "tension reduction model." It is described thus because in the words of Walker (1965, p. 63) it is a model "which through the operation of a mechanism restores a certain end-state unless and until the point of breakdown is reached." The aim of the model hence is to keep the discrepancy between ideal and actual state at a minimum, and success is indicated if it can manage to minimize that discrepancy.

Figure 2.1 offers a representation of such a tension reduction model. You could think of a mechanical model such as a thermostat, which is set at regulating a particular

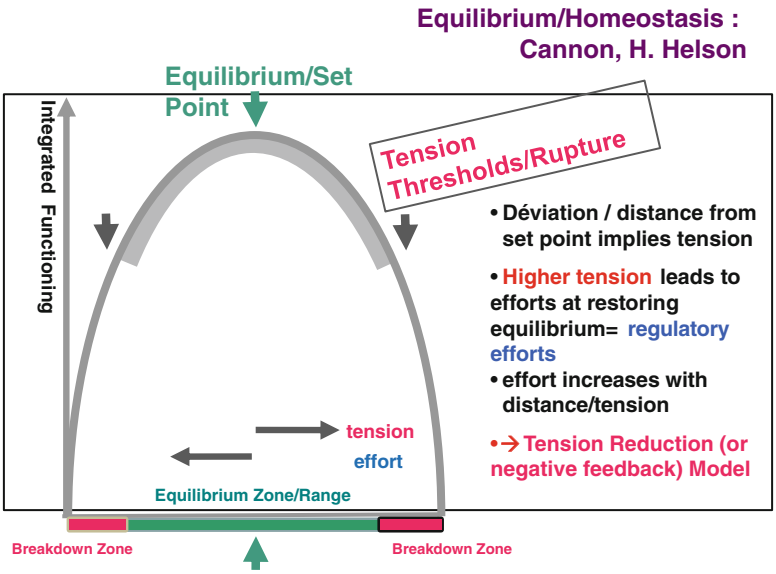

Fig. 2.1 Representation of an equilibrium mechanism as described by Cannon and Helson. The set point shows the ideal value to be maintained by the equilibrium mechanism, and the inverted-U function indicates that with increasing deviation from the set point, integrated functioning of the organism decreases. Increasing deviations are experienced as tension, which results in effortful reactions aimed at tension reduction and re-establishment of equilibrium. The model further indicates that with too extreme variations, the thresholds of tension are exceeded, resulting in "rupture" and breakdown of regulation. For further explanation, see text (Original design by the author)

desired room temperature. Such a thermostat notes deviations from the target temperature and, if that deviation exceeds a certain quantity, sets in motion the heat source it regulates. In this book we will, however, consider biological equilibrium systems, of which biological mechanisms of temperature regulation are a frequent example. Specifically, however, we will primarily deal with the efficacy of regulating *emotion*s throughout this book. In this case of emotion regulation, the parameter being regulated is the degree to which the organism experiences emotional arousal (as could be indicated, for example, by rises in heart rate and blood pressure).

Figure 2.1 shows, first, an inverted-U-relationship between two parameters. The *x*-axis is labeled "equilibrium or tension range"; it indicates whether the organism is currently at equilibrium or deviates from an ideal equilibrium value by a given amount. Presence or absence of equilibrium can be indexed, for example, by the degree to which the range of the critical parameter that requires regulation deviates from an "ideal" value: that value is called the *equilibrium point* or *set point.* Let us assume, for the moment, that we are interested in variations in body temperature around an ideal "normal" body temperature of about 98.7 °F or 36 °C. At such an ideal temperature, the body functions in a healthy, well-integrated fashion, since at the set point, an ideal equilibrium is achieved, which means that the organism functions in the most integrated way. Integration here means that he or she functions at their most competent and feels a sense of well-being. If, on the contrary, the body temperature were to rise significantly above this ideal value—or, on the contrary,

if it were to significantly fall below that value—the resulting deviations could disturb healthy organismic functioning. Hence Fig. 2.1 indicates that as deviations from the set point increase in either direction, integration of functioning and sense of well-being deteriorate gradually.

Figure 2.1 also indicates that despite deviations, the organism nevertheless is able to maintain sufficient equilibrium; the curved light gray zone extending under the inverted-U curve indicates this. How is such an equilibrium that extends beyond the set point properly maintained? As noted in the Walker quote above, the system notes any deviation from the set point; these deviations are experienced as tension, indicated by the right-pointing arrow. This tension, in turn, causes the system to initiate an effortful compensatory response (or a series of such responses) indicated by the left pointing arrow. This effort is aimed at reducing the tension (for example, in the case of rising body temperature, expending effort to be able to cool down, or taking a fever-reducing medication). Hence despite deviations from the set point, equilibrium remains in a range sufficiently narrow to forestall catastrophic disorganization and disintegration.

The vigor of such corrective compensatory responses as well as the effort required for their performance, become greater as the deviation from the set point increases. However, deviations eventually can reach so high a level that compensatory efforts are no longer possible. The very equilibrium mechanism now is overwhelmed, and the system experiences a state of disintegration. In other words, the system has reached a breakdown point at which it can no longer engage in self-repair. In the case of rising body temperature, for example, the person might experience convulsions with actual danger to life, or even death.

How does this mechanism of breakdown of the capacity for compensation of deviations work in the case of emotions? Let us assume, a person's anger is aroused and in fact, escalates to a crisis situation. In that case, rather than being successful at regulating or controlling anger, she or he might become more and more aroused until all efforts at self-control fail and he or she falls into a state of uncontrolled rage. In other words, the equilibrium system has reached a point of breakdown because the thresholds of tolerable tension have been exceeded. This state of affairs is indicated by the dark zones at either end of the curved light gray zone—the breakdown zones of the system.

2.3 Equilibrium and Tension Amplification

Despite its importance in maintaining coherence and integration of the organism, Cannon's theory had a limitation as far as psychological processes are concerned. Psychological systems do not *always* aim for the *reduction* of tension, but at times engage in *the amplification* of deviation and tension. For example, humans and animals alike often, when confronted with a new and challenging situation, are intrigued with its novelty and attempt to explore and master it. That is, they do not attempt to reduce the tension of novelty, but rather are fascinated and attracted and try to figure out the situation. Indeed, theoreticians such as Freud and Piaget pointed out that progress in development required not only stability and integration of functions, but that it also at times demanded the capacity to work creatively with moment's disintegration

and disequilibrium. Because such moments of temporary disequilibrium often are in the service of eventual growth (as we will detail later in this chapter when discussing Piaget's approach), the Polish psychologist Dabrowski et al. (1970) coined the paradoxical but apt term of "positive disintegration." That is, momentary deviations from integration and equilibrium can define opportunities for growth, and eventually result in more powerful means by which homeostasis and equilibrium can be assured (Brent, 1978; Labouvie-Vief, 2008, 2009; Lewis, 2005). Indeed, processes of development of the individual over the course of life are prime examples of such sequences of *disorganization*, *which* leads to *reorganization* at a higher and better-integrated level.

One of the first psychologists to propose an equilibrium model that integrated features of tension amplification was Harry Helson (1964), who termed his theory Adaptation Level (AL) theory. Whereas Cannon had assumed relatively fixed steady-state parameters, Helson described systems that adapt to changes by establishing *new* steady-state ranges. As an example, he discussed visual adaptation to change in light conditions: in that situation, the organism first responds with increased rapid firing, but eventually establishes a new steady state that is characterized by reduced sensitivity and response. Hence complex forms of adaptation often require that the system *establish a new set point* that differs from the original one. In the case of our example of visual sensitivity, the tension threshold, or breakdown point of the system, has been raised, thus enlarging the range over which the organism can maintain equilibrium.

Helson also proposed that the system's ideal point is not reached when it notes no deviation from the set point at all—that is, when it is at rest. Rather he suggested that functioning of the system often does not occur precisely at the AL. Rather the organism functions at its best—that is, with most efficiency and most positive affect—at an optimal range that slightly *exceeds* AL. This is evident in the fact that humans and animals alike are intensely attracted to novel stimulation that occurs at points *away from* neutrality or equilibrium. Hence the ideal state of living organisms at times implies activity and a degree of tension.

The notion of an optimal range of tension that slightly exceeds the point of neutrality is consistent with Piaget's theory (as detailed in the following section) as well as with Neo-Piagetian extensions of it. These views propose that interesting things happen in equilibrium systems at a distance away, *yet not too far away*, from steady state (Prigogine & Stengers, 1984; Smith & Thelen, 1993, 2003). It is also consistent with theories that propose a facilitative relationship between off-equilibrium stress conditions and cognitive processes. For example, Selye (1956) already proposed that adaptive changes, such as focusing attention and effort, often are initiated at slight levels of physiological stress, as detailed somewhat later in this chapter.

2.4 Disequilibrium and Reorganization in Development: A Cognitive View

A particularly important example of a theory that proposes that *functioning away from equilibrium* can drive important positive developmental changes—even is necessary for such changes to occur—is the cognitive-developmental theory of Piaget

(see also Chapman, 1988). Piaget proposed that children move through relatively restful phases characterized by equilibrium, phases in which they assimilated their experience to knowledge (representations) already acquired. Such phases of *assimilation* alternate, however, with phases that are focused on expansion of already existing knowledge, along with attempts to orient themselves to new experiences through *accommodation*. How such expansion happens has been described in Piaget's less-read later works (e.g., Piaget, 1976, 1981) that provide astute and detailed observations of how children resolve the tensions that arise as they discover that their already-formed representations do not give an adequate and conflict-free account.

During phases of assimilation, we perceive events and objects simply in terms of the accustomed patterns, or representations, we have already formed of them. These representations are already highly automatic, and such automatization implies that we see what we expect. That is, variations from the expected are dampened out automatically, without our noting our doing so. Hence we "deform" reality according to our expectations, rather than changing our expectations to better accord to reality—a process that happens without awareness.

However, a shift in focus from feedback dampening to amplification occurs as children begin to note inconsistencies between their responses—inconsistencies that are a result of the sheer automaticity of their responses. At this moment, they turn their awareness towards those inconsistencies. Piaget (1976) calls this moment, "the grasp of consciousness"—a moment that brings about a dramatic change in their behavior: they direct their attention to the inconsistencies they discover; these inconsistencies become problems, which they begin to explore and attempt to resolve. In so doing, they try out different possible solutions, experiment with them, and generally engage in a sustained and effortful search of a solution to the puzzling inconsistencies.

This phase of conscious and critical examination marks the move away from *automatic assimilation* to *deliberate accommodation*. Such periods of accommodation constitute a shift from feedback reduction to tension amplification. This shift of attentional focus is fraught with increasing confusion, conflict, and instability (see also Lewis, 2005). In this way, children shift back between positive and negative feedback, a high-tension activity that displays signs of high frustration. Nevertheless, that frustration eventually is resolved as the child eventually arrives at a new integration.

As an example of such a process, take the case of the child who is given play dough and asked to roll it out into a "sausage." She or he is then asked to continue to roll, so that the "sausage" that first is short and thick, gradually becomes longer and thinner. To the adult observer, the overall volume of the sausage does not at all change in this transformation of short-and-thick to long-and-thin. He or she understands immediately that increases in the length of the sausage have been compensated for by its becoming thinner—and vice versa. Hence they see that the overall volume has remained constant, since the compensatory changes in length and thickness imply constancy of the volume.

In contrast to adults, young children do not note the inconsistencies of their responses. They simply tend to note a single dimension at a time—a focus that is not directed by cognitive understanding, but by purely perceptual and automatic processes. Although, to an adult perspective, they express constant contradictions, they are not at all aware of their contradictory responses, nor do these contradictions bother them.

However, as the child's cognitive understanding of the situation improves, she or he eventually notices the gaps in his or her knowledge and the inconsistencies in their responses. It is at this juncture that she or he begins to engage in a conscious attempt to resolve the inconsistencies.

As a result of the deliberate acceptance of tension and even the curiosity that comes with it, children engage in more systematic efforts to comprehend the situation. Eventually, these efforts are rewarded as they come to integrate the difficulties, the understanding comes to them that changes in length and thickness work in a compensatory fashion. As a result, they arrive at a more complex representation, one that is evident, for example, in the fact that the child no longer is astonished or frustrated at the apparent incoherence of the display. Instead, in a moment of joyous insight he or she exclaims that "Ah, well, it is still the same because it has become longer, but at the same time, also thinner."

Figures 2.2 and 2.3 expand on Fig. 2.1 to represent this process of deliberate search for a solution to the problem. For this purpose, Fig. 4.1 now shows, under the apex of the inverted-U-curve, curved arrows that successively expand outward from the set point and reach towards the zones of greater tension. At the innermost arrow closest to the set point, this range remains quite directly in the zone of comfort and ease; indeed, this is the zone of automation in which responses are easy. We call this zone the "zone of assimilation," indicating that here functioning is smooth and unproblematic. From this zone of assimilation, we see that the child begins to move outward towards the tension thresholds; this is evident in the increasing concentra-

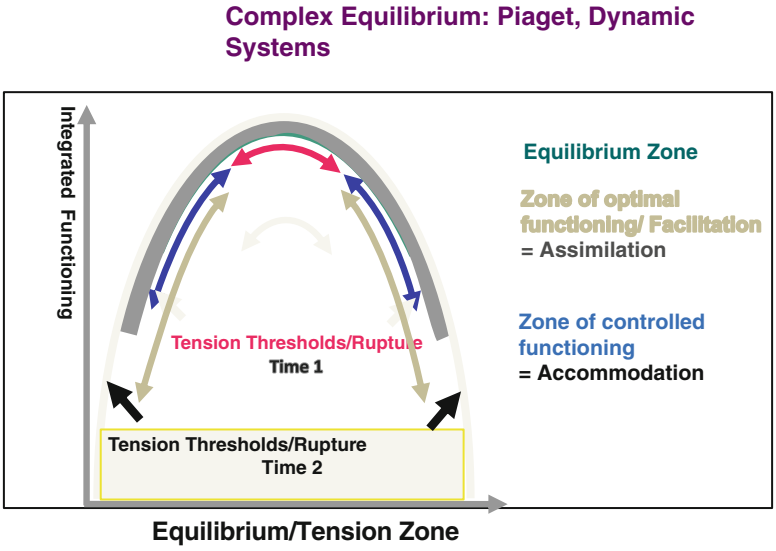

Fig. 2.2 A complex equilibrium system as conceived by Piaget is one able to grow by expansion of the equilibrium range. This happens as individuals work with the tension resulting from deviations, a process which results in pushing outward of the thresholds of tension. This implies that the individuals are able to work constructively at higher levels of tension, and thus avoid rupture of tension thresholds (Original design by the author)

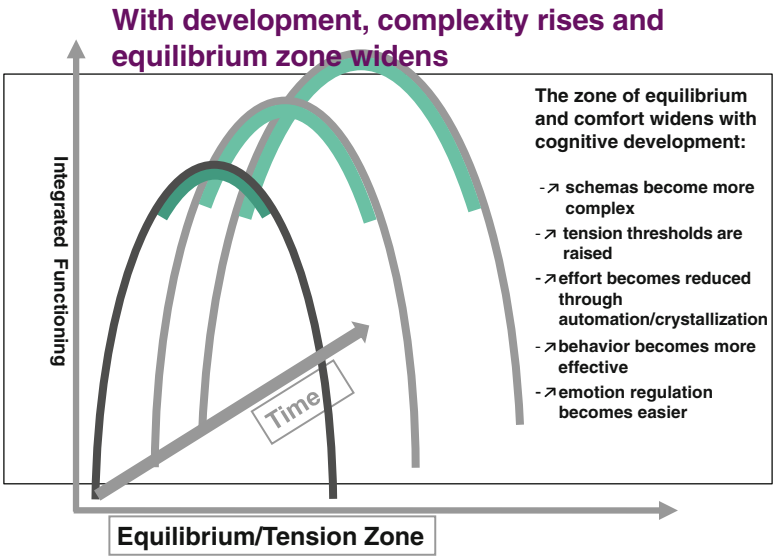

Fig. 2.3 Widening of equilibrium zones and raising of complexity with successive development. Over the course of development and as a result of the raising of tension thresholds, individuals are able to enlarge the ranges over which equilibrium can be maintained. At the same time, their level of integrated functioning raises (Original design by the author)

tion and effort he or she expends, combined with obvious signs of tension and even frustration at his or her difficulty of comprehension.

Now we already noted that a degree of disequilibrium and tension can facilitate processes of learning. Indeed, neuroscientific evidence shows that the effort and the attention that follows from such tension states can have a facilitative effect on the brain: they activate the firing of neurons and enable them to form new connections with other neurons. Such effort-enabled growth of the brain implies that the brain is a modifiable organ, a quality referred to as *neuroplasticity* (for discussion see Siegel, 1999; Goldberg, 2007). As a result of such learning, the process to construe constancy in the face of change becomes well learned and quite automatic, as neurons combine into networks and fire together. This process is referred to as "automatization" and, sometimes, "crystallization." Crystallization has been quite widely documented in the domain of cognitive-intellectual development (e.g., Craik & Bialystok, 2006; Horn, 1970; Horn & Cattell, 1966). It implies that even complex representations come to be activated in a way that is quite automatic and no longer involves the effort that was typical of the learning phase. As a result, events that at one time have been difficult and frustrating are marked by a sense of pride and joy of mastery—just as Helson (1964) proposed that arriving at the set point of equilibrium is marked by a sense of competence and positive feelings.

Piaget called this final phase following equilibrium and disequilibration "re-equilibration." What is important to note here, is that this new equilibrium involves an expansion of the former one—indeed, and expansion in two ways. First, by tolerating tension and operating constructively with it, the child has altered the critical threshold

of tension that previously was associated with rupture of the equilibrium. That level of tension has been pushed outward, and thus the threshold associated with rupture has been raised. Second, and directly related to the raising of the tension threshold, the child's conception of the situation also has increased in complexity. This is indicated in Fig. 4.3 by adding to the original inverted-U-curve a second on—which indicates a higher level of integrated functioning at the same time as a widening of its range of equilibrium. Indeed, a third inverted-U-curve has been added to show that with continuing development, the next curve will show a further rise of level of complexity, along with further widening of the equilibrium zone as the tension threshold raises further. We see, as a consequence, that progression in development is identical to changes in both parameters simultaneously—the level of integrated complexity on one hand, and the raising of the tension threshold, on the other, as indicated by Fig. 4.3.

2.5 Disequilibrium and Reorganization in Development: Neurobiological Mechanisms

Here modify the below and repeat that different functions and levels are represented by the brain as indicated in Fig. (1.2, MacLean, 1990). Lowest level=brainstem, not yet integrated. But integration depends on personal experience and learning: "experience-dependent maturation of the brain."

In support, recent neurohormonal theories of stress detail the facilitative effect of *slight* elevations of glucocorticoids on facilitating cognitive functioning; in contrast, high elevations are known to be related to deleterious effects (e.g., de Kloet et al., 1999; Lupien et al., 2005; see Labouvie-Vief, 2009, for review).

See previous section on how this happens through mechanisms of neuroplasticity: at first, automatic excitation at automatic level initiates excitation. This is responded (spreads to the prefrontal area) to with effort and attention expended in the interest of regulation (dampening, inhibition, "downregulation") create activation of neurons of prefrontal cortex, initiating processes of growth. The growing neurons seek connections with other neurons from lower "layers" of the brain: dampening or inhibiting effect. This process becomes more and more efficient and automated, and eventually is executed with apparent ease. Indicators of lower effort are decreased metabolism, etc. Eventually, an elaborate network of connections responds in a highly efficient way—the notion of crystallized representations or emotional–cognitive schemas.

How are the expansion of equilibrium and the lowering of tension effected on a biological level? From a biological view, regulatory functions are processed along three core systems: the brainstem, and the limbic and cortical systems. At first, integration is lacking since automatic processes predominate and cortical controls are not yet established. Eventually, these systems are vertically integrated (e.g., Panksepp, 1998). This developing hierarchical system draws on brainstem-related homeostatic systems that provide the original physiological foundation for the regulation of state, attention, and emotional reactivity. With cortical growth and developing connectivity between these diverse systems, high-order self-regulatory abilities are built on these automatic forms of regulation. A first milestone is the development of attention modulation capacities,

after the age of 3 months, which affords the adaptive coordination of vigilance and distress during information processing (e.g., Eckerman, Oehler, Hannan, & Molitor, 1995). The second relevant milestone is the growing connectivity between limbic and cortical systems during childhood. For example, the transition to self-regulatory behaviors during the second year of life often draws on higher control systems, reflecting the integration of the anterior cingulate gyrus that is implicated in the coordination of distress and attention. The functional connectivity to prefrontal regions marks the final steps in the development of this system by exerting inhibitory control (Diamond, 1990). The maturation of top-down frontolimbic connections then enables a better regulation of tension generated by stressful events. This emotion-regulation system—which is intimately tied to emotion processing systems—continues integrating during childhood and only achieves maturity after late adolescence (e.g., Steinberg, 2008).

Overall, the formation of connections between "automatic" centers and those that are related to effortful control processes leads to growing regulatory abilities from infancy to young adulthood. Language is a prime example of such regulation, involving as it does the emergence of representations (e.g., Hariri, Bookheimer, & Mazziotta, 2000; Lieberman, Eisenberger, Crockett, Tom, Pfeifer, & Way, 2007; Luria, 1932). For example, Luria demonstrated that the use of language acted to dampen peripheral arousal and motor excitation (Luria, 1932); more recently, research has established that the use of linguistic labels functions to downregulate activation of brain regions involved in emotional processing, such as amygdala (e.g., Hariri et al., 2000; Lieberman et al., 2007). Thus, using functional magnetic resonance imaging (fMRI), Hariri et al. (2000) showed that merely labeling emotional faces decreased activity in the amygdala while increasing prefrontal activation, thus indicating the inhibitory function of cortical regions on emotional processing.

In early childhood, the interconnection between cognitive and emotional processes grows in complexity and allows a better prediction of the social environment. More complex cognitive–emotional representations will allow more precise expectations about the world, thus widening the range of the equilibrium zone as the child matures. For example, the growing ability of the child to recognize and make predictions about the mental states of self and other (Theory of Mind capacities) increasingly equips the child with a cognitive behavioral repertoire that offers increasing capacity to deal with tension and perturbation.

In early adolescence, increasing metacognitive and emotion regulation skills are sustained by the growing complexity of prefrontal and limbic connectivity. Hence, increasingly skillful emotion regulation and tension tolerance are expected with the passage from childhood to adolescence. Using event-related potentials (ERPs), Lewis and Steben (2004) isolated the processes underlying the cognitive control of emotional outcomes. These authors tested children from 6 to 16 years in a go/no-go paradigm and showed that medial prefrontal ERP amplitudes diminish with age. At the same time, the ERP amplitudes become more sensitive to anxiety, and internalizing children showed higher amplitudes than noninternalizing children, especially when anxious. According to the authors, younger children expend more effort controlling their response in general, whereas older children recruit more effortful self-control more specifically under anxious conditions (Lewis & Steben, 2004). Supporting developmental differences in cognitive processes dedicated to the regulation of

negative emotion, this study suggests that tension reduction with increasing age is based on an automatization of processes that require effort at younger ages. Another ERP study examined changes in the form and amplitude of error-related negativity (ERN), a wave associated with cognitive control, in participants aged 7–20 years (Davies, Segalowitz, & Gavin, 2004). These authors found that the amplitude of the ERN increased with age, with the increase most evident at 17–20 years. According to the authors, this trend reflects a developing capacity for the cognitive control of impulsive action. In the same vein, neuroimaging research shows less prefrontal activation in adults than in children (Casey et al., 1997; Durston, Thomas, Yang, Ulug, Zimmerman, & Casey, 2002) and adolescents (Luna et al., 2001) during tasks requiring inhibition or directed attention, suggesting that inhibition is achieved with less effort in adults, as attested to by less prefrontal engagement. All these studies suggest that increasing cognitive–emotional integration and improved emotion regulation with age is based on the development of well-automated networks between the respective functions of the brain (Casey et al., 1997; Luna et al., 2001).

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Chapter 3
Expansion and Reorganization in Development: Neurobiological Mechanisms

In Chap. 2, we introduced mechanisms of equilibrium maintenance in cognition and emotion. We noted that, although equilibrium-maintaining functions are essential for survival. Nevertheless, movements away from equilibrium are of essence, as well. The resulting states far away from equilibrium make possible transitions in which the parameters of equilibrium regulation themselves can be altered. We discussed the example of expansions of equilibrium, whose result is that tension thresholds are raised as a result of a transition towards higher and more complex levels of functioning.

The question that will occupy us in the current chapter is: how do such processes of expansive development function if viewed not from a purely behavioral level, but from the perspective of modern neurobiological theories—that is, from the perspective of the functioning of the brain? As we will see, a focus on disequilibrium is important in neurobiological theories, as well; now, however, new questions and emphases are added, that deal with the exact neurobiological processes that are involved—and that further show, how these neurobiological processes, in concert with experience, can alter brain structures to support more complex representations and more powerful strategies of equilibrium regulation.

3.1 Building the Brain Through Experience

We already noted in Chap. 4, when discussing Piagetian processes of disequilibration and re-equilibration, that a degree of disequilibrium and tension can facilitate processes of learning and expansion of knowledge. Indeed, neuroscientific evidence supports those more behavioral analyses: like the latter it, too, shows that the effort and attention that result as individuals turn with interest and awareness to a new problem, can have a facilitative effect on the brain: the tension or arousal with which they are associated activate the firing of neurons, and enable them, at the same time, to form new connections with other neurons. *Such effort-enabled* growth of the

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brain implies that the brain is a *modifiable* organ capable of learning, and this capacity of the brain for modification as a result of experience is referred to as *neuroplasticity* (for discussion see Siegel, 1999; Goldberg, 2007). As a result of effortful engagement, hence, aspects of the brain are altered in such a way, that future encounters with situations identical or highly similar to those already experienced are greatly facilitated, and often, dealt with at a higher level of complexity and awareness. But how does the brain achieve such growth? To answer that question, we next turn to the main actors in such experience-dependent modifications of the brain: the neurons.

3.2 The Brain and Neurons

The brain serves several interrelated functions: it takes in sensory information, processes information conveyed in this way, and reacts in some fashion by delivering some output, mostly in the form of some response (Annenberg Learner, Unit 10; Annenberg & Annenberg Foundation, 2003). The main performers in these various tasks are the neurons, building blocks, and working units of the brain and Central Nervous System (CNS). Neurons are a special type of cells typical of the brain and Central Nervous System. They are not the only cells of the brain, however—in fact, they constitute only a small fraction of the brain's cells. They are outnumbered, at a rate of about 1–10 or 50, by the so-called *glial* cells—a name which implies they serve as a "glue" to the brain and nervous system, since they serve a supporting function to neurons (Kandel, Schwartz, Jessell, & Siegelbaum, 2012/1996).

Neurons generally have a "bipolar" structure. At one end, they consist of a cell body or *soma*, from which extend many projections called "dendrites" which are specialized for receiving information. At the other end of the soma, it has a single projection termed *axon,* as shown in Fig. 3.1. The axon ends in "synaptic terminals" which send information to the dendrites of adjacent neurons via a structure called *synapse* that joins the two neurons. Axons can vary immensely in length: they can be as short as a few centimeters, but as long as about one meter in the case of an axon that extends from the spinal cord to the big toe and that is involved in the highly automated *knee jerk response*.

Neurons come in a variety of types, but most of them possess four regions that perform different functions (Kandel et al., 2012/1996). These are indicated in the prototype of a neuron in Fig. 5.1: *first* is an input region (a), *second* a region that triggers a nerve impulse (b); *third*, the nerve impulse is then propagated along a projection serving impulse conduction called *axon* (c); this region of conductibility is subdivided into different subregions by the *nodes of ranvier*. The impulse created at the input region is electric and travels along the axon until it reaches the axon's terminal (d). At this point, the output signal causes the release of a chemical substance in the form a neurotransmitter.

Neurons are specialized to perform one of the various functions listed previously. *Information intake* is accomplished by *sensory neurons*, which respond to a variety of stimuli that impinge from the outside or inside of the body—stimuli such as heat or

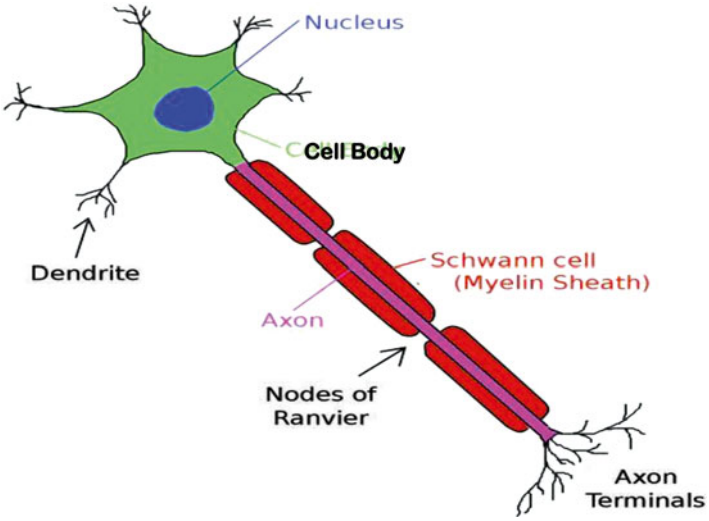

Fig. 3.1 Schematic image of a neuron with nucleus and dendrites, axon with nodes of ranvier and myelin sheath and axon terminals receiving excitation

cold, chemicals, sound, and its vibrations, and so on. *Processing in the brain* implies a chain of responses initiated by neurons to transmit information to other nerve, muscle, or gland cells; such chains of processing can range from relatively simple automatic communication between neurons and various centers of the brain to quite complex strategic processes that imply "cognition" and "thinking." The *output* of this chain most often consists of some motor response initiated by a *motor neuron.*

A thin sheath of fatty substance called myelin, the sheath indicated in Fig. 3.1, covers many axons. Produced by the adjacent Swann cells, this sheath serves as a protective layer of insulation via a fatty substance that aids in the efficacy of transmission—allowing transmission speeds of about 100 m per second. Whitish in color, this myelin sheath is the reason for differentiating between *white* and *grey* matter of the brain—i.e., myelinated neurons and non-myelinated neurons and other substance (Goldberg, 2007). Some degenerative diseases are related to the destruction of myelin in neurons—the best known of those probably is multiple sclerosis.

3.3 Neuronal Transmission: Resting Potentials and Action Potentials

Neurons are experts in communicating with each other and transferring information throughout the nervous system. For each of the regions (a–d) described above, "Messages" consist of a particular signal typical of that region. The signals related to input, trigger, and conduction regions of the axon in general are electrical in

nature. Communication and information transfer between cells also happen as the dendrites of neurons receive messages from other neurons by means of contact points. These contact points or *synapses* are separated by a small gap called the *synaptic cleft*. Messages are sent and received by means of electrical charges from input to conductive regions, but at the output region, they consist, as already stated, of the chemical release of a Neurotransmitter. Generally, messages are initiated by the *presynaptic neuron* and received by the *postsynaptic neuron*.

Electrical transmission happens by means of electrical impulses that result from voltage differentials inside and outside the cell membrane. These differentials create local electrical charges, or potentials. These charges result from differentials in electrical charges between inside and outside the cell membrane. Of those potentials, the *resting potential* is approximately −60 mV. The charge can, however, vary from cell to cell: in the case of nerve cells, it can vary between −40 and −80 mV; for muscle cells, it can be even more negative with −90 mV (Kandel et al., 2012/1996). This negative potential implies a polarized charge that remains constant unless and until the axons receive stimulation.

Excitable cells such as nerve and muscle cells are able to change their resting potential dramatically—and such changes, in turn, are the cause of a signal. Once stimulated, a de-polarization of the resting potential occurs, with a reduction of the membrane potential of the cell by 10 mV (i.e., to −55 mV). This reduction initiates an *action potential* and results in an action potential—a spike or impulse with a positive charge of about +40 mV. The elicitation of an impulse is a very brief event that happens in an all-or-none fashion—but its power can be summated if many sources of stimulation converge and create a series of rapid firings—a sign of a particularly strong activation. The English physiologist Edgar Dougals Adrian in 1928 first formulated this all-or-none fashion of signal transmission:

> all impulses are very similar to one to another, whether the message is aimed at calling forth sensations of light, touch, or pain. If they follow one another in quick succession, the sensation is intense, but if they are separated by long intervals, the sensation is correspondingly weak (c.f. Kandel et al., 2012/1996, p. 36; author's translation from the German).

Kandel et al. further note that, since neural transmission hence has a quite stereotypical character, one might well wonder how neural messages are differentiated from one another?! The reason is that the nature and function of the message is not determined by the signal itself, but rather by the pathway along which it is transmitted. For example, "messages originating from the light-sensitive retina cells are completely different from those that are activated by the touch-sensitive cells of the skin (Kandel et al., 2012/1996, p. 36)."

3.4 Neurotransmitters and Neurotransmission

Once electrical charges reach the end of the axon, they result in the release of neurotransmitters—the brain's chemical messengers. Released at the nerve terminals, neurotransmitters diffuse across the synapse and bind, in a precise key-and-lock

fashion, to receptors of the target cell—often, another neuron. When in place, the transmitter triggers a response from the target cell. Of the considerable variety of neurotransmitters, each has a specific action that promotes a particular response, generally, by facilitating or inhibiting a particular pattern of behaviors (Brain, 2012) provides an excellent summary of some important neurotransmitters and gives a sense of their enormous functional variety.

One important class of neurotransmitters, and the one first identified, are the *acetylcholines* (ACh), which are important in the *activation* of voluntary muscles as well as the control of heartbeat. Antibodies that block a type of ACh are a cause of myasthenia gravis, a disease characterized by fatigue and muscle weakness.

Another important class of neurotransmitters are *amino acids* which, in addition to being the material base of the brain, also function as neurotransmitters. The neurotransmitters *glycine and gamma-aminobutyrid acid* (*GABA*), in contrast to activating action of the acetylcholines, *inhibit* the firing of neurons. The inhibiting function of GABA activity can be utilized through administration of drugs such as Valium or that have an anticonvulsant action. Degeneration of GABA-producing neurons in later life can be the cause of Huntington's disease. Finally, *glutamate* and *aspartate* act in an excitatory manner *n-methyl*-d-*aspartate (NMDA) receptors*, stimulation of these receptors promote learning and memory and the specification of nerve contacts, of which we will speak more in the next chapter when discussing early brain and neural development; however, overstimulation of these receptors can cause cell damage and death.

A third important group of neurotransmitters are the catecholamines, of which the neurotransmitters *dopamine* and *norepinephrine* are particularly important. Dopamine is part of a brain circuit that controls movement; deficits in this circuit are related to Parkinson's disease, a condition characterized by muscle tremors, rigidity, and movement difficulties. *Dopamine* is also important in cognition and emotion and regulates interest in novelty and excited search and pursuit of any resource that might be important and interesting. According to Panksepp and Biven (2012), dopamine energizes the *SEEK* system, one of the primal, ancestral emotion systems. The *SEEK* system allows animals and humans alike to engage in the search for and acquisition of resources necessary for survival; it motivates approach behavior that is characterized by excited and euphoric anticipation of reward. Abnormalities of the SEEK system can be evident in compulsions and are related to psychotic symptoms; in turn, drugs that block the action of the brain's dopamine receptors are used to decrease these symptoms.

Norepinephrine (*NE*), or *noradrenaline* (*NA*) is another neurotransmitter of the catecholamine group. This transmitter is released in situations of acute stress and functions to regulate heart rate and blood pressure. It is part of the stress hormones and affects all parts of the brain; we will return to the twofold importance of stress hormones later in this chapter. With epinephrine, it controls the fight-or-flight response to stressful situations by triggering the release of glucose from energy stores and increasing blood flow to the skeletal muscles.

3.5 Synaptic Plasticity

In the process of the changes that are activated in the neurons and their projections, the system actually becomes *transformed*. That implies that rather than being fixed and inflexible, the nervous system displays a degree of plasticity, which is the base of learning and memory formation and thus the *capacity to remember*. The presence of such plasticity was already suspected since the late nineteenth century, when neuroscientists such as Santiago Ramon y Cajal, speculated that "the ability of neurons to grow in an adult and their power to create new connections can explain learning"—that is, can create permanent changes that reflect a form of memory that has been preserved. Cajal, together with Camillo Golgi, shared a Nobel Prize in Physiology or Medicine for their work in 1906 "in recognition of their work on the structure of the nervous system." "Santiago Ramón y Cajal—Facts" (*Nobelprize.org*. Nobel Media AB 2013. Web. 1 Jun 2014; http://www.nobelprize.org/nobel_prizes/medicine/laureates/1906/cajal-facts.htmon).

Already in the mid-1700s, the philosopher David Hartley suggested that the memories result from mental associations that are "the result of vibrations between nerves" (c.f. LeDoux, 2002, p. 134). The notion of such an association was made famous by Donald O. Hebb who proposed, in what came to be known as the Hebbian Law, stating that "When an axon of cell A is near enough to excite cell B or repeatedly and consistently takes part in firing it, some growth processes or metabolic changes take place in one or both cells such that A's efficiency, as one of the cells firing B, is increased (Hebb, 1949, c.f. LeDoux, 2002, p. 79)"; in more popular terms, the law is widely cited as "Neurons that fire together, Wire Together" since, through repeated firing, the neurons form changes at the synapses—changes that form the bases of lasting "memories," and that may comprise the growth of new dendrites, or may effect increases in the amount of neurotransmitters or the receptors at which they dock (Goldberg, 2007; Kandel et al., 2012/1996).

The capacity of synapses to preserve (*remember*) modifications that have occurred in previous firings is referred to as *synaptic plasticity*; in turn, the capacity of the brain and nervous system, generally, to modify themselves over time is referred to as *neuroplasticity*. As a result of such *plasticity* just described, then, new pathways and networks of neurons, and with them new learning, are created. These pathways build upon and enlarge the efficacy of the purely automatic mechanisms by which we are equipped through our ancestral genetic heritage.

A particularly important experimental demonstration of such an "enlargement" through learning was offered by the Russian psychologist Ivan Pavlov (1927), who used one automatic *ancestral* reaction, that of salivating at the encounter of food, to create a novel reaction that reflected the results of learning and experience rather than some genetically coded automatic mechanism. Pavlov, who was interested in the study of digestive processes, noted that the dogs began to salivate whenever an assistant entered the room. Aware that salivation is a reflexive process when presented with the sight or smell of edible items, Pavlov suspected that the dogs had associated the assistants with food presentation. To test this theory, he chose

a stimulus that originally was entirely neutral—the sound of a metronome, which was sounded just after the presentation of food. After several trials of conditioning, the dogs then began salivating after hearing the metronome.

The Pavlovian experiment represents the original example of *classical conditioning*. In this procedure, an experimenter chooses a stimulus that is associated with a completely automatic response, such as salivation when food is presented. This *unconditioned* stimulus is then presented in association with a completely non-related stimulus such as, in this case, the sound of a metronome which is entirely neutral. After several pairings of food and sound, an association then is established: salivation has become a *conditioned response* to the *conditioned stimulus* of sound. In this way, an automatic reaction has been *acquired* through learning. In contrast, if the conditioned stimulus no longer is presented by the unconditioned stimulus, the conditioned response may weaken or disappear over time—in that case, the conditioned response is said to have been *extinguished*.

A second important paradigm of learning by association different from classical conditioning is *operant conditioning*. In operant conditioning, a relationship is established between a particular behavior and its consequences. For example, to be rewarded with food, an animal might need to learn a particular behavior, such as pressing a lever. In general, when an operant behavior is rewarded, it tends to be repeated in the future; on the other hand, it is followed by an aversive event (for example, feeling sick after eating a particular food), it tends to be avoided.

To return to classical conditioning, an important application of, and variation on, classical conditioning is in the conditioning of fear responses. This design has been used in the conditioning of laboratory animals in order to explore the pathways involved in the learning of fear responses, and involves pairing a noxious stimulus such as, for example an electric shock, with a situation that normally would not be associated with fear (see LeDoux, 2002; Panksepp & Biven, 2012). Again, presentation of the unconditioned noxious stimulus eventually becomes associated with a fear reaction, as evident from a number of possible responses such as a startle reflex, verbal and visual-expressive signs of fear, elevations of heart rate, and galvanic skin response, and so forth. Fear conditioning also is a frequent result of traumatic experiences in humans. It can result in a response that is very resistant to extinction, such as post-traumatic stress reactions/disorder (PTSD).

The power of learned fear responses has been studied, among others, by Joseph LeDoux (2002) who showed that fear conditioning bypasses conscious mechanisms that are based on higher-order processing, and instead passes through a "low road pathway" in which the fear signal is transmitted directly from the signal to the thalamus and then amygdala, as shown in Fig. 3.2. The individual may have no awareness at all of the exact nature of the stimulus that caused the fear, although it causes a strong and difficult-to-extinguish fear response. Such powerful and lasting fear responses have been related to clinical anxiety disorders that may be altered only through therapeutic interventions, including the application of medical treatments.

Learning established through classical conditioning is based on the potential of synapses to undergo long lasting changes with experience—the property of *synaptic plasticity* already referred to. That is, the repetition of certain experiences, such as

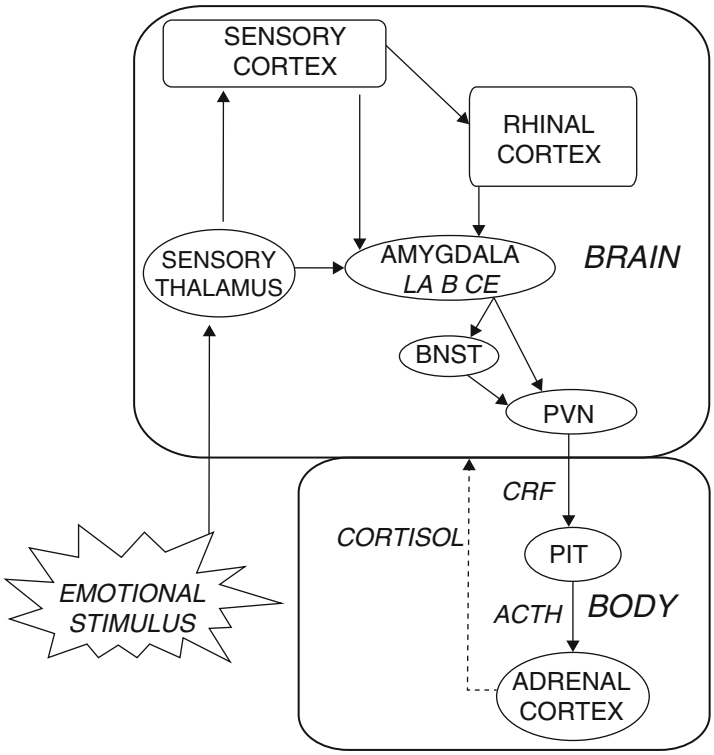

Fig. 3.2 Turning stress on. In the presence of stressful stimuli, the central nucleus of the amygdala activates the paraventricular nucleus of the hypothalamus (PVN), either directly or by way of the bed nucleus of the stria terminalis (BNST). Corticotropin-releasing factor (CRF) is released by axons from the PVN into the pituitary gland (PIT), which in turn releases SCTH into the bloodstream, where it travels to the adrenal cortex. The adrenal cortex then releases cortisol, which travels in the bloodstream to various organs and tissue sites of the body, including the brain (Reproduced with permission from LeDoux, J. (2002), Synaptic Self. Penguin Books, Figure 8.4, p. 223)

being presented with a classical conditioning paradigm, results in synaptic modifications that permit more effective synaptic transmission in subsequent learning trials. Several different kinds of such transmissions are distinguished (see Kandel et al., 2012/1996, pp. 1227–1245). One of those forms is *habituation*, in which the power of a stimulus application decreases over time. Habituation is a very simple form of learning in which an animal is presented with a stimulus that evokes some *orienting response*—that is, some form of interested inquiry into the nature of the stimulus. With repeated presentation of the situation, however, the efficacy of the stimulus decreases and the animals attention weans. This inhibition of the former response involves a weakening and inhibition of the efficiency of the synapse.

In contrast to habituation is *sensitization*, a process in which synaptic plasticity is reinforced, and the synapse as a consequence functions with more efficacy.

Such sensitization, or facilitation, can be short-term (for example, several minutes in the case of *aplasia*, a sea snail), or long-term, lasting 1 day or even a week or longer, depending on how often training sessions are repeated. Long-term facilitation involves the synthesis of new proteins that are important in new synaptic connections. These growth processes are evident in the proliferation of presynaptic endings and eventual growth of new dendrites.

In contrast to long-term sensitization, long-term habituation is related to the eventual pruning of neuronal connections. In pruning, functional connections of sensory and motor neurons are reduced by about one third—i.e., the number of synapses with active zones decreases from 40 to 10 neurons (Kandel et al., 2012/1996).

As the result of the branching out and *arborization* of dendrites, neurons begin to form rather complex networks of communication. The result is the formation of networks of neurons that fire in cohesive ways, such that activation of a subgroup of neurons may activate a cascade of neural activity along an already established neural pathway. Thus neural networks of considerable complexity can arise—networks that, in turn, can support quite complex forms of memory and cognition. This is evident, for example, in the fact that memories can be cross-linked and/or chained—as when a memory, once activated, calls forth the recognition of already remembered events (Goldberg, 2007). The propagation of information then becomes well learned and quite automatic, as neurons combine into networks and fire together. This process is referred to as "automation" and, sometimes, "crystallization" and implies that the associated memories are activated in ways that are quite spontaneous and effortless. Crystallization has been quite widely documented in the domain of cognitive-intellectual development (e.g., Craik & Bialystok, 2006; Horn, 1970; Horn & Cattell, 1966). It implies that even quite complex representations come to be activated rather automatically, and thus no longer involve the effort that was typical of the learning phase. As a consequence, tasks that at one time have been difficult and frustrating, now are marked by a sense of pride and joy of mastery—just as Helson (1964) proposed that arriving at the set point of equilibrium is marked by a sense of competence and positive feelings.

3.6 Tension Levels and the HPA Axis

How are the expansion of equilibrium and the raising of tension thresholds effected on a neurobiological level? In Chaps. 3 and 4 we already touched upon biological models of the brain that involve three core systems: the brain stem, the limbic system, and the cortical system, with their associated functions hierarchically arranged from those that are highly automated, such as the brain stem and limbic structures, to cortical ones that involve a higher degree of reflection and awareness (see Fig. 3.1). These cortical centers function as "executives" controlling states of arousal. Early in development, these systems are not well integrated, with the result, that affect regulation at the beginning of life is fragile and requires the support of caring and competent adults. Over the course of time and experience, however, highly integrated systems

begin to form that permit individuals an advanced level of autonomous control, as we will discuss beginning with Chap. 6.

As we noted in Chap. 2, such transformations towards higher levels of complexity and integration are initiated at points away, though *not too far away*, a zone of steady state and comfort (e.g., Prigogine & Stengers, 1984; Thelen & Smith, 1994; see also Brent, 1978). This implies that *positive changes* can be initiated by levels of *moderate* stress. Recent neurohormonal theories have detailed the relation between such stresses and cognitive functioning (e.g., McGaugh, 2000, 2004, 2006; McGaugh & Roozendaal, 2002; McEwen & Sapolsky, 1995; de Kloet, Oitzl, & Joëls, 1999; Lupien & Lepage, 2001; for a summary see LeDoux (2002). That is, although stress can pose a threat to homeostasis and equilibrium, it may nevertheless also initiate adaptive changes in the brain. In order "for a situation to induce a stress response from the body, it has to be interpreted as being novel and/or unpredictable, and/or the individual must have the feeling that he/she does not have control over the situation (Lupien, McEwen, Gunnar, & Helm, 2009, p. 445)."

Following an event experienced as such a challenge or threat, a number of changes related to stress are induced in the brain and the body as a whole. The system that initiates and regulates these stressful changes is the hypothalamic–pituitary–adrenocortical (HPA) system. Upon the arrival of a stressful stimulus, this system produces an output of cortisol, often also called hydrocortisone.

Cortisol secretion itself is the result of a chain of reactions in the brain (depicted in Fig. 3.2) that begin with a stress (or emotional) stimulus that impinges upon the paraventricular nucleus of the hypothalamus (PVN), causing the release of stress hormone called corticotropin-releasing factor (CRF). The release of this factor into the pituitary gland (PIT) further triggers the release of the hormone adrenocorticotropin (ACTH), which in turn triggers the secretion of so-called stress hormones. Two main stress hormones are important in that context: the *glucocorticoids* (called corticosterone in animals and cortisol in humans), and *catecholamines* (epinephrine and norepinephrine) are secreted into the adrenal cortex, which then releases cortisol into the bloodstream. Through the bloodstream, cortisol then travels through many body tissues, including the brain. Once released, cortisol can set in motion a fight-or-flight response, characterized by such symptoms increases in heart rate and blood pressure. This *stress response*, if mild, is considered to constitute an entirely adaptive response to stressful stimuli: it is necessary for functioning and the mobilization of physical and mental energy at low levels. There is, for example, considerable evidence that such mechanisms of arousal can enhance memory functioning (e.g., Cahill & McGaugh, 1998; McGaugh, 2003, 2006; McGaugh & Roozendaal, 2002): from a neurobiological perspective, increased levels of corticosteroids during arousal can positively affect the functioning of the hippocampus and prefrontal cortex, facilitating the encoding of contextual and declarative features of information (Lupien, Maheu, Tu, Fiocco, & Schramek, 2007). In contrast, at levels of arousal that are *too low*, cognitive functioning cannot benefit from the enhancement effect of typical moderate levels of arousal.

If, in contrast to relatively moderate-stress situations, the activating events cause cortisol to be secreted at very high and/or continuous and chronic levels, cortisol

can cause a *habitual* "fight-or-flight" reaction (Selye, 1956) that has been identified as the cause of a number of damaging changes related to cognitive performance and health. In this case *heightened and prolonged* activation of the HPA axis is, the result poses threats to cognitive functioning: under highly arousing conditions, complex and integrated cognitive functioning is vulnerable to disruption and disintegration. High elevations thus are known to be related to deleterious effects on the cognitive level (e.g., de Kloet et al., 1999; Lupien et al., 2007; see Labouvie-Vief, Grühn, & Mouras, 2009, for review), and can even lead to damaging consequences for health (Lupien et al., 2009).

The circle of reactions that leads to such deleterious changes has been outlined by LeDoux (2002). The main structures of this reaction circle, the amygdala and the hippocampus, play a somewhat different role in propagating the cycle of cortisol release. The amygdala *activates* the PVN and thereby stimulates cortisol release, whereas the Hippocampus serves an *inhibiting* function. As LeDoux notes, "Because the hippocampus normally inhibits the PVN (indicated by the minus sign) and the Amygdala normally excites it (indicated by the plus sign), the effects of CORT can lead to a feed-forward cycle where CORT release leads to more CORT release. That is, the ability of the hippocampus to slow release down is compromised at the same time as the ability of the amygdala to stimulate release is facilitated (LeDoux, 2002, p. 224)." As a result, the unregulated cortisol level causes the hormone to bind to hippocampal receptors, leading to a disruption of the activity of the hippocampus, and in turn suppressing the ability for memory formation. In fact, if the stress continues, hippocampal cells degenerate and eventually die. In addition, since stress hormones also negatively impact the prefrontal cortex, they are likely to impair decision making under stress, while enhancing the amygdala's role in the creation of fear.

3.7 Stress as a Source of Adaptive Change

In agreement with the major tenet of the book, we have seen that although stress can have extremely negative consequences on development and behavior, slight levels of stress and tension are nevertheless at crucial in initiating adaptive changes. Levels of stress/activation that potentiate adaptive learning can arise from many different sources. At the simplest level, these sources are inherent in the ancestral homeostatic systems that regulate imbalances related to bodily needs such as hunger, thirst, fatigue, body temperature, or levels of unsatisfied lust and desire. All these drive animals and humans alike to enthusiastically search to satisfy needs and desires by seeking the resources necessary for well-being and survival (Panksepp & Biven, 2012). Panksepp has coined the notion of a SEEKING SYSTEM as the system that operates continuously to deal with these needs; this system thus it is continuously active and activating. In animals however, note Panksepp and Biven, this system operates differently from humans:

> In animals that are not as intellectually bright as we are, the SEEKING system operates without the admixture of forethought and strategic planning that is so characteristic of humans. In humans, strategic thinking plays a major role in SEEKING arousal because this system, like all our emotional systems, has abundant connections to the frontal cortex, the most highly developed part of the cognitive MindBrain. When the SEEKING system arouses the human neocortex, it energizes thinking processes—a kind of virtual world—yielding complex learned behaviors that are not instinctual and may even be counter-instinctual (Panksepp & Biven, 2012, p. 102).

The notion of "counter-instinctual" responses here indicates that the neocortex functions, in large part, not to *facilitate* automatic responses; motivation for such responses derives from the activation of subcortical emotional systems, which is purely automatic. In contrast, many occasions require that such automatic responses *not be carried out*; rather, it is necessary than they be *inhibited* so as to encourage more adaptive behavior that serves not just personal interests, but that facilitates functioning in social settings. For example, if we find ourselves in the throes of an attack of violent rage, it is generally necessary that we *not* act upon these violent impulses, but attempt to *control* them through inhibition. Such control results from effortful and intentional engagement in *emotion regulation*, which is not at the core of the ancient emotion systems of which Panksepp speaks. We will turn to the topic of *emotional control* and its development in the next chapter.

While involved in the control and downregulation of too-strong levels of affect, however, the intentional and conscious efforts of the neocortex do not *always* have as their aim the *contro*l of emotions, (in the sense of *dampening* affect. In fact, it also may subserve their amplification and enlargement. This is true, especially, for the types of activities that are driven by human curiosity and creativity. In the words of Panksepp and Biven,

> … the SEEKING systems of artists, writers, politicians, and scientists urge them to discover new and better ways to solve problems to express themselves. This system energizes all of human creativity—it has been a mental engine for all civilizations.

This is hardly a minor point. It highlights the fact that, in many ways, the neocortex—the source of our human intellect—is the servant of our emotional systems. The SEEKING system impels the neocortex to find ways of meeting our needs and desires … (It) urges the neocortex to do things that make us feel important and in command or our destinies; we try to manipulate social ties in ways that make us more influential or powerful. WE build monuments to ourselves and to our gods and we express ourselves through artistic endeavors. The SEEKING system prompts us to satisfy our liking for novelty … The SEEKING system also urges the neocortex to devise ways to gratify each and every one of our desires. We don't just farm and milk cows; we also make chocolate. Our clothes are not just for protection but also for beauty and sexual allure. Mankind's great and unique achievements, the products of our prodigious neocortices, are firmly rooted in the psychic energy provided by this system.

The SEEKING system is driven by brain dopamine, but it is much more than just the creation of that one energizing neurotransmitter…. It is just a super efficient get-up-and-go system. Human cognitive aspirations, for good and evil, spring forth from its vast affective "energy" (pp. 102–103).

The site that has been most consistently associated with the ability to engage in "counter-instinctual" thinking and action widely has been identified as the prefrontal cortex (see Fig. 1.3).[1] To be sure, the capacity to work in such a counter-instinctual way is a gradual achievement of neuroplasticity. As individuals expend effort and attention expended in the interest of regulating emotional states, (through dampening, inhibition, "downregulation," or interest, curiosity, and upregulation) neurons of prefrontal cortex create activation and initiate processes of growth. The growing neurons seek connections with other neurons from lower, more automatic layers of the brain, creating pathways of communication between the different layers and centers of the brain. This process becomes more and more efficient and automated, and eventually is executed with apparent ease. Initially highly effortful and energy consuming and accompanied by high glucose metabolism, eventually relatively complex tasks are performed with lower effort and decreased metabolism cost. Eventually, an elaborate network of connections responds in a highly efficient way—the notion of crystallized representations or emotional–cognitive schemas. We will return to a more exhaustive discussion of this process of the creation of a more complex brain and more complex capacities in the chapters to follow.

How the expansion of equilibrium and the lowering of tension are effected on a biological level? From a biological view, regulatory functions are processed along three core systems: the brainstem, and the limbic and cortical systems. At first, integration is lacking since automatic processes predominate and cortical controls are not yet established. Eventually, these systems are vertically integrated (e.g., Panksepp, 2005). This developing hierarchical system draws on brainstem-related homeostatic systems that provide the original physiological foundation for the regulation of state, attention, and emotional reactivity. With cortical growth and developing connectivity between these diverse systems, high-order self-regulatory abilities are built on these automatic forms of regulation. A first milestone is the development of attention modulation capacities, after the age of 3 months, which affords the adaptive coordination of vigilance and distress during information processing (e.g., Eckerman, Oehler, Hanna, & Molitor, 1995). The second relevant milestone is the growing connectivity between limbic and cortical systems during childhood. For example, the transition to self-regulatory behaviors during the second year of life often draws on higher control systems, reflecting the integration of the anterior cingulate gyrus that is implicated in the coordination of distress and attention. The functional connectivity to prefrontal regions marks the final steps in the development of this system by exerting inhibitory control (Diamond, 1990). The maturation of top–down frontolimbic connections then enables a better regulation of tension generated by stressful events. This emotion-regulation system—which is intimately tied to emotion processing systems—continues integrating during childhood and only achieves maturity after late adolescence (e.g., Steinberg, 2008).

Overall, the formation of connections between "automatic" centers and those that are related to effortful control processes leads to growing regulatory abilities

[1] The prefrontal cortex is usually defined as the center of cognitive control, and is related to functions of attention, intention, expense of effort, control, and awareness.

from infancy to young adulthood. Language is a prime example of such regulation, involving as it does the emergence of representations (e.g., Hariri, Bookheimer, & Mazziotta, 2000; Lieberman et al., 2007; Luria, 1932). For example, Luria demonstrated that the use of language acted to dampen peripheral arousal and motor excitation (Luria, 1932); more recently, research has established that the use of linguistic labels functions to downregulate activation of brain regions involved in emotional processing, such as amygdala (e.g., Hariri et al., 2000; Lieberman et al., 2007). Thus, using functional magnetic resonance imaging (fMRI), Hariri et al. (2000) showed that merely labeling emotional faces decreased activity in the amygdala while increasing prefrontal activation, thus indicating the inhibitory function of cortical regions on emotional processing.

In early childhood, the interconnection between cognitive and emotional processes grows in complexity and allows a better prediction of the social environment. More complex cognitivo-emotional representations will allow more precise expectations about the world, thus widening the range of the equilibrium zone as the child matures. For example, the growing ability of the child to recognize and make predictions about the mental states of self and other (theory of mind capacities) increasingly equips the child with a cognitive behavioral repertoire that offers increasing capacity to deal with tension and perturbation.

In early adolescence, increasing metacognitive and emotion regulation skills are sustained by the growing complexity of prefrontal and limbic connectivity. Hence, increasingly skillful emotion regulation and tension tolerance are expected with the passage from childhood to adolescence (see also Lewis, 2005). Using event-related potentials[2] (ERPs), Lewis and Steben (2004) isolated the processes underlying the cognitive control of emotional outcomes. These authors tested children from 6 to 16 years in a go/no-go paradigm and showed that medial prefrontal ERP amplitudes diminish with age. At the same time, the ERP amplitudes become more sensitive to anxiety, and internalizing children showed higher amplitudes than non-internalizing children, especially when anxious. According to the authors, younger children expend more effort controlling their response in general, whereas older children recruit more effortful self-control more specifically under anxious conditions (Lewis & Steben, 2004). Supporting developmental differences in cognitive processes dedicated to the regulation of negative emotion, this study suggests that tension reduction with increasing age is based on an automatization of processes that require effort at younger ages. Another ERP study examined changes in the form and amplitude of error-related negativity (ERN), a wave associated with cognitive control, in participants aged 7–20 years (Davies, Segalowitz, & Gavin, 2004). These authors found that the amplitude of the ERN increased with age, with the increase most evident at 17–20 years. According to the authors, this trend reflects a developing capacity for the cognitive control of impulsive action. In the same vein, neuroimaging research shows less prefrontal activation in adults than in children (Casey et al., 1997; Durston, Thomas, Yang, Ulug, Zimmerman, & Casey, 2002) and adolescents (Luna et al., 2001) during tasks requiring inhibition or

[2] Electrophysiological recordings of the brain.

directed attention, suggesting that inhibition is achieved with less effort in adults, as attested to by less prefrontal engagement. All these studies suggest that increasing cognitive–emotional integration and improved emotion regulation with age is based on the development of well-automated networks between the respective functions of the brain (Casey et al., 1997; Luna et al., 2001).

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Chapter 4
Cognitive–Emotional Development in Infants

Emotions, we noted, are an endowment we inherit from a long chain of evolutionary acquisitions that form an ancestral equilibrium system whose function is to secure homeostasis through the regulation of critical parameters crucial to the maintenance of homeostasis and survival. At first, these systems are quite automatically activated, and they function to automatically restore those critical parameters. With advancing development, however, these automatic mechanisms are enriched and increasingly guided by the capacity to reflect upon and understanding emotional situations; from the original, automatic, and reflex-like responses, emotions over time can be transformed into quite complex systems that are able to integrate considerable levels volition and understanding. In this chapter, we address the early processes by which these developmental changes are initiated in the period of infancy. As we will see, this period is a time of rapid gains in how infants begin to deal with important emotional situations—a period important in setting a future developmental pathway. The direction of this pathway—whether positive of problematic—is influenced, to an extent, by genetically determined tendencies; but consistent with the findings that developmental changes are highly experience dependent and plastic rather than rigidly predetermined, another factor of tremendous importance is the quality of guidance of sensitive and caring parents/caretakers, who for better or worse must help regulate the emerging emotional states of infants that still are highly vulnerable to high levels of emotional stimulation.

4.1 Emotion–Cognition Relations in Development: Piaget's View

The capacity for and limits of emotional experience at first are regulated by basic biological programs, but eventually this capacity undergoes significant changes. The resulting expansions of emotional life are largely a result of the interactions of the infant and his or her physical and, especially, social environment

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(Fogel & Thelen, 1987). As a result of these interactions, automatic emotions become increasingly influenced by the general experiences and learnings that result from the daily social interactions between infants and their physical and social surround. In this way, cognitive processes gradually come to transform and to guide the nature of emotional experience: the daily experiences of the infant initiate learning processes that begin to sustain certain habits and expectations about events of daily life, from situations of feeding to playing, and so forth. In this way, emotions grow from initially purely automatic processes to ones that are far more complex and empowered by ongoing processes of cognitive development.

As we noted, one of the first theoreticians to write on this developmental accomplishment and its parallel to less emotion-laden cognitions, was Piaget (1981). Although not widely noted as a theoretician of *emotion*, but rather acknowledged as the foremost theoretician of cognitive development, Piaget began to offer important theoretical contributions about emotions' relationship to budding cognitive processes as early as the 1950s. At the base of his thinking was the conviction that the ancient polarization between cognition and emotion was not a constructive way of thinking about either. Instead, he maintained that emotions and cognitions fulfilled somewhat different functions that were, however, complementary. Emotions, he stated, provide the energetic and activating side that can energize cognitions; on the other hand, cognition—with its characteristic focus on structure and order—serves to enrich emotional processes with a higher degree of structure, order, and stability. His vision of emotional development, therefore, was that emotions and cognitions co-develop and ideally become quite integrated in development. As a consequence, to understand children's emotional development, it was also important to be aware of the parallel process of their cognitive development. That is, just as the development of cognition brings thinking of increasing consistency, order, differentiation, and complexity, so emotional development should show a similar progression. As a result of such progression, emotional life becomes more orderly, conscious, and intentional—at least, to a degree.[1]

Piaget hence held that emotions and cognitions ideally had a mutually enriching and supportive relationship—not only did emotions also frequently imply a cognitive aspect, but similarly, cognitions usually have an emotional element, also.[2] Piaget's thinking about this mutual enrichment of cognitive and emotional processes is gathered in the volume *Intelligence and Affectivity* (Piaget, 1981), in which he proposed that a developmental transformation from automatic to complex structures is common to emotional and intellectual development alike. Thus he stated that:

> If our … hypotheses are correct, we shall be able to parallel, stage by stage, the intellectual structures and levels of emotional development. Since no structure exists without dynamic and since, respectively, a new form of energizing regulation must correspond to any new structure, a certain type of cognitive structure must correspond to each new level of emotional behavior. (Piaget, 1981, p. 10)

Consistent with that view, Piaget presented outlines of the expanding levels of cognitive–emotional development for different periods from infancy to adolescence. The first level is presented in Table 4.1; Later levels displayed in Table 4.2 will be

[1] As noted in chapters to come, genuine integration remains an issue throughout the total span of life.

[2] As, for example, when one feels pleasure at a thought.

Table 4.1 Levels of affectivity/emotional development in relation to cognitive development according to Jean Piaget

Piaget: levels of affectivity: infancy	
Sensorimotor intelligence	Intraindividual feelings
I. Hereditary organizations	*Hereditary organizations*
These include reflexes and instincts present at birth	These include instinctual drives and other inborn affective reactions
II. First acquired schemes	*First acquired feelings*
(*2 to 6/8 months*)	These are joys, sorrows, pleasantness, and unpleasantness linked to perceptions as well as differentiated feelings of contentment and disappointment related to action
These include first habits and differentiated perceptions. They appear before the sensorimotor intelligence, properly so-called	
III: *Sensorimotor intelligence*	*Affects regulating intentional behavior*
(*6/8 months to language acquisition*)	These regulations …. Include feelings linked to the activation and retardation of action along with termination reactions such as feelings of success or failure
This includes the structures acquired from 6–8 months up to the acquisition of language in the second year	

Reproduced by permission from J. Piaget, (1981) *Intelligence and Affectivity*: *Their relationship to during child developmen*t. Palo Alto, CA: Annual Reviews p. 14

Table 4.2 Levels of emotion–cognition relations according to Piaget

Piaget's levels of affectivity: toddlers to adolescents	
Verbal intelligence	Interpersonal feelings
IV. Pre-operational representations	*Intuitive affects*
(*From language to 7/8 years*)	These include elementary interpersonal feelings and the beginning of moral feelings
Here actions begin to be internalized. Although this allows thought, such thought is not yet reversible	
V. Concrete operations	*Normative affects*
(*From 7/8 to 10/11 years*)	This stage is characterized by the appearance of autonomous feelings with intervention of the will. What is just and unjust no longer depend on obedience to a rule
This stage is marked by the acquisition of elementary operations of classes and relations. Formal thought is not yet possible	
VI: *Formal operations*	*Ideological feelings*
(*From 11/12 to 14/15 years*)	Feelings for other people are overlaid by collective ideals. Parallel to this is the elaboration of the personality, where the individual assigns himself a role and goals in social life
This stage is characterized by thought employing the logic to propositions freed from their content	

Reproduced with permission from Jean Piaget, 1981, Intelligence and Affectivity: their relationship during child development. Annual Reviews, Inc., Palo Alto, CA, p. 14

detailed in Chaps. 6 and 7. His ideas on the parallel development of emotion and cognition have influenced a large body of research that confirms progressions in individual's emotional understanding that are consistent with his theory (see Labouvie-Vief & DeVoe, 1991; Labouvie-Vief & Marquez, 2004). Thus at the

beginning of life, the infant is equipped with ancestral reactions that at first are purely *sensorimotor*, automatic, and reactive. Over time, however, these reactions become transformed into ones that involve more and more memory and representation, and that give evidence of intentionality, goal orientation, and temporal and spatial extension and stability. In this way infants and children, and later adults, continue to demonstrate more complex understandings of emotions—how those are organized over time, how they are judged by social partners, how they reflect on our desires, wishes, and thoughts—and also how they differentiate us from those of others. All of these understandings contribute to greater awareness of emotions and how one can take command of them rather than to merely react automatically. These positive developments are especially evident, if the familial context in which individuals develop is sufficiently supportive to foster necessary cognitive–emotional growth. In contrast, if the necessary supports by caring adults are missing, the development of mature emotional understanding and behavior can be restricted in dramatic ways that may set the stage for difficulties in managing emotions throughout the course of life.

4.2 Early Emotional Development and the Psychosocial Context: Erikson's View

In contrast to Piaget's views that were strongly expressive of his cognitivist interests, Erikson's approach was one that had a more direct emphasis on the nature of the social ties between the infant and his social context, especially the mother/caretaker. Erikson (1982) held that positive development implied that the individual be able to develop an equilibrium among three organized components or forces of the individual: one the *somatic* experience of one's body, the second, the *psychic* organization of one's personal experience, and the third, the *cultural* organization of human interdependence. Thus, although still rooted in a Freudian view of psychoanalysis, his theory more explicitly focused on the harmonious and equilibrated development of these three processes together, at least so, in the ideal case.

As already stated in Chap. 1, Erikson held that the most important task in infancy is to develop a core sense of trust—an experience that ideally is nurtured by a context of loving and sensitive caretaking interchanges of mutual regulation that, if all works sufficiently smoothly, fosters—"a sense that the surrounding world is a benign, predictable, and trustworthy place to be" (Wulff, 1997, p. 375). Such an experience builds trust in others, and simultaneously fosters a sense of trust in the self, as opposed to a lasting sense of pervasive mistrust. The infant then acquires a core sense of basic hope, "…. the enduring belief in the attainability of fervent wishes, in spite of the dark urges and rages which mark the beginning of existence (Erikson, 1964, p. 118, as quoted from Wulff (1997), p. 376.)." We will see, in the sequel of this chapter, that Erikson thus complements the more soberly oriented view of Piaget with one that is highly sensitive to the social context of development. As a counterpart, Piaget's view offers a rich rendition of the emotion–cognition interplay throughout this and later periods of development.

4.3 Emotions in Infant Development

As we have seen so far (see Chap. 1), it is a quite general assumption that heredity equips us with emotion systems that provide highly automatic means of securing important homeostatic requirements. Piaget, too, proposed that such systems were evident from birth, where they appear as "reflexes" (see Table 4.1). In this category, Piaget included reflexes related to sucking, grasping, and limb and other bodily movements. In fact, he held that these reflexes were the very origin and basis of complex cognitive processes. This complexity, he proposed, gradually grew as a result of the way babies exercised them and simultaneously learned from them.

Consistent with that view, Piaget provided especially careful observations of the reflexes of his children, Lucienne and Laurent, whose reflexive movements (related, for example to sucking, reaching, and looking) were carefully analyzed in his book, *The Origins of Intelligence in Children* (Piaget, 1972). His interest in reflexes was motivated by his conviction that an important continuity existed between biology and the development of intellectual capacities, as evidenced by his book on *Biology and Knowledge* (Piaget, 1972). He held that this continuity was based on the fact that thought develops out of action—that thus the activity of the child was *the* driving force that initiates a gradual differentiation of action, and brings forth the development, eventually, of complex forms of thinking. Indeed, the name of the first general level of intelligence he proposed, *sensorimotor intelligence*, was a direct reflection of this belief that reflexes, from the very outset, are highly organized activity patterns that are directed towards adaptive needs such as being nourished, cared for, entertained, and stimulated. With the accumulation of experience and practice, these patterns gradually are transformed and come to support the emergence of quite intentional and planful forms of behaving (see Chapman, 1988). This is not to say that reflexes are devoid of intention from the outset; however, the first "intentions," according to Piaget, Panksepp, and Damasio alike, are not driven by awareness, but rather are inherent in the inherited pattern of stimulation → action. Hence, the *intentions* of these precursors of more mature emotion are *intentions-in-action.* In contrast, more mature emotions are characterized by a greater degree of awareness, which creates *intentions to act* (Panksepp & Biven, 2012, p. 10). In that way, they imply a greater degree of awareness, planfulness, and willfulness.

Piaget's general view of infant development of emotions is detailed in Table 3.1. The figure classifies the development of affectivity in the first 2 years of life into three subperiods characterized by different tasks and acquisitions. The first subperiod, hereditary organization, spans the first 2 years of life, and begins with the initial automaticity and, progressively, the more differentiated and intentional forms of emotion that eventually emerge. In the first 2 months, Piaget maintains, infants' emotional behaviors are rather instinctive and reflex-like as noted above; feelings are, therefore, determined by "hereditary structures"—the same ancestral structures we already encountered. But even so, he observed Laurent's progress in the originally purely reflexive response of sucking over a period of 29 days from birth on. Very soon after birth, the newborn Laurent began to engage in a kind of "reflex search"

associated with locating the mother's breast and then sucking. This response of initial pure assimilation began to gradually be modified by the accommodative experience of locating the nipple in such a way that it became less groping but more efficient. In this way, experience gradually modified the initially purely reflexive behavior, which eventually became more precise and directed.

Infants soon begin to form initial adaptations or schemes.[3] For example, the initial sucking scheme is purely aimed at finding nutrition, but soon the infant begins to aim at other objects, whatever objects are available: its own fingers or those of others, blankets, toys, and so forth are put to the mouth to suck. In this way, the infant explores the sucking response with a variety of objects by mouthing and *getting the feel* of different objects. Piaget called these activities that reproduce liked sensations over and over, "circular reactions." Such *primary circular reactions* soon also are extended and oriented towards seeing and looking, hearing, and grasping, and phonation.[4] These activities also become more intentional; thus children do not just react reflexively to sound by looking, but they begin to look in order to see something, listen in order to hear something, or grasp for the pleasure of grasping. In the 6–8 months to follow, proposes Piaget, infants further begin to coordinate the various schemes, such as grasping, looking, and sucking. Now they begin to coordinate their movements more precisely, as when vision and grasping all are coordinated in the interest of being able to suck a desirable object. All this aspects form part of the brain that develops along with these activities and skills.

At the final substage of sensorimotor intelligence, circular reactions become even more complex and intentional. For example, at the age of 3 months and 5 days, Lucienne was observed to inadvertently begin kicking some dolls that were suspended from the hood of her bassinet. She then looked at the dolls, smiled, and moved her legs again. By day 16 she was observed to begin to cause the dolls to swing as soon as her father suspended them above her head, shaking her legs in precise and rhythmical movements. "Success gradually causes her to smile," stated Piaget; "This time the circular reaction is indisputable" (Piaget, 1963; quoted by Chapman 1988, p. 86), as is the joy experienced by the infant at her success.

4.4 Sroufe's Research on the Organization of Emotions in the Early Years

Piaget's commentaries on the cognitive parallels of the development of emotions have deeply influenced researchers on emotions who have provided detailed descriptions of the development of more specifically *emotional* behaviors over the first two decades, and as we will see, many of the investigations to follow are quite consistent with his predictions of the unfolding of emotion–cognition relations over that span

[3] A "scheme" refers to an organized set of experiences about some aspect of reality; an organized conceptual structure.

[4] Phonation refers to the production of sounds.

of time. As far as infants are concerned, a particularly careful analysis of their emotional repertories has been provided by Sroufe (1996) Like Piaget (1981), this author notes that the first emotion-like responses of infants could not be called truly *emotional*, per se, at the outset; more likely they are reflex-like initial precursor patterns that are wired to safeguard well-being. For example, Sroufe notes that newborns often display a "sleep smile"; this smile is not, however related to external events, but reflects fluctuations in the Central Nervous System and forms a prototype for later expressions of joy. In turn, states of high and sustained arousal, with their related to expressions of distress, can be the result of distressing events such as pain, hunger, physical restraint, or sudden and especially strong stimulation; these states form the precursors of negative emotions.

The perspective of Sroufe, therefore, is somewhat different from that of Piaget who, true to his interest in structure and organization, places a particularly strong emphasis on the structural and organizational side of the development of affect. While aware and appreciative of this aspect of emotional development, Sroufe is, however, also particularly interested in the *dynamic* side of emotions, as evident in how infants deal with the *energetics* of emotions—i.e., states of arousal and how these affect the emotional responses of infants—in particular, when exploring the question of when the infants are more likely to be fearful or delighted at emotion-producing situations. For this purpose, he asked mothers to participate in an experiment in which he instructed them to perform various actions on the infants, from auditory ones like lip popping, slowly building an "AaH" sound in a voice from low to loud, to gentle blows and tickles, and so forth. Table 4.3 presents these various situations.

Table 4.3 Instructions for individual items

Auditory
1. Lip popping: Four pops in a row, then pause. Starts with lips pursed, cheeks full
2. Swelling "Aah"; Starts low, builds to loud noise, abrupt pause. Six. second pause
3. Using a loud, deep voice pronounce, "Boom, boom, boom," at 1-s intervals
4. Mechanical type of sound, varying voice pitch from low to high and back down again
5. With mouth 1 ft from baby's ear, whisper "Hi baby, how are you?" Avoid blowing in ear
6. With falsetto voice (like Mickey Mouse) say, "Hi baby, how are you?"
7. With lips relaxed, blow through them as a horse does when tired
Tactile
8. Blow gently at hair for 3 s. Blow from the side, across the top of the head
9. Four quick pecks, on bare stomach
10. Gently stroke cheek three times with soft object
11. Place baby on knew facing away. Five vigorous bounces
12. Hold baby waist high, horizontal, face towards floor and jiggle vigorously for 3 s
13. Using finger, gently tickle under baby's chin for 3 s
14. Open mouth wide, press lips on back of neck, and create suction for 2 s

(continued)

Table 4.3 (continued)

Social
15. Focus baby's attention on your fingers. Walk fingers towards baby, then give baby a poke in the ribs
16. If laughter is achieved, do another trial followed by poking
17. Playing tug: Allow baby to grasp yarn, then tug three times, trying not to pull it away. Pause and repeat
18. Put cloth in mouth and lean close enough for baby to grasp it. Allow baby to pull cloth out and replace this if this is his or her tendency. Place the end of the cloth in baby's hand if necessary
19. Say lyrically, "I'm gonna get you" (make the I quite protracted), while leaning towards baby with hands poised to grab. Then grab around stomach. If laughter is achieved, do another trial not followed by grabbing
20. Stand at baby's side. Put cloth over baby's face. If baby does not uncover his or her face immediately, uncover for him or her. Do not drag cloth across Baby's face. Emphasis is on baby getting out from underneath
21. Stick out tongue until baby touches it (make baby's hand touch it if necessary). Quickly pull tongue back in as soon as he or she touches it
22. Using black cardboard, get baby's attention with face uncovered, cover face for 2 s, uncover quickly and pause for 3 s. Do not say "Peekaboo"
Visual
23. Using a white cloth, proceed as in number 28
24. Use one of your baby's favorite toys. Focus his or her attention on it (out of reach). Cover it for 2 s, uncover quickly
25. Sucking baby bottle: First make sure that the baby is not hungry, then take bottle, bring towards your lips, take three pretend sucks, lower bottle
26. Crawling on floor: Place baby in highchair or infant seat. Crawl across, not towards, his or her field of vision. Stand, return to starting point
27. Penguin walk: Stand with arms extended to sides, walk in exaggerated waddle across the baby's field of vision. Return to starting point walking normally
28. Shake head vigorously at a distance of 1 ft of baby's face three times. Do not allow hair to touch baby
29. Obtain Baby's attention. Hold mask up so he or she can see it. Place mask in front of your face, lean slowly to within 1 ft of baby's face, pause for 2 s. Lean back slowly, remove mask slowly
Extra items
30. Crawl behind baby, ostentatiously chasing, slapping hands on floor
31. Lift baby slowly to position overhead, looking down back. Minimize tactile and kinesthetic aspects
32. Mirror image: To reduce peekaboo effects, move baby slowly in front of full-length mirror. Hold for 3 s, then pause for 3 s
33. As in number 18
34. As in number 15

Reproduced with permission of Cambridge University Press from Sroufe, L.A. (1996). *Emotional Development*: *The Organization of Emotional Life in the Early Years*. New York: Cambridge University Press; Table 5.2, pp. 86–87

Sroufe's analysis of these experiments focuses especially on the emotion of joy, as reflected by smiling and laughter, as well as the relationship of these responses to advancing age (see Table 4.4). As already stated, the neonate sometimes shows a weak form of smile as indicated by an upward drawing the corners of the mouth, but these "smiles" are attributed to fluctuations of the Central Nervous System and

Table 4.4 Instructions for individual items

Age	Response	Stimulation	Latency	Remarks
Smiling				
Neonate	Corners of the mouth	No external stimulation		Due to CNS fluctuations
Week 1	Corners of the mouth	Low level, modulated	6–8 s	During sleep, boosting of tension
Week 2	Mouth pulled back	Low level, modulated, voices		When drowsy, satiated
Week 3	Grin, including eyes	Moderate level, voices	4–5 s	When alert, attentive, (nodding head with voice)
Week 4	Grin, active smile	Moderate or moderately intense	"Reduced"	Vigorous tactile stimulation effective
Week 5–8	Grin, active smile, cooing	Dynamic, first visual stimulation	3 s or less	Nodding head, flicking lights, stimulation that must be followed
Week 9–12	Grin, active smile, cooing	Dynamic, first visual stimulation	Short	Trail-by-trail effects, effortful, dynamic assimilation, at times more effective than static
Laughter				
Month 4	Laughter	Multimodal, vigorous stimulation	1–2 s	Tactile, auditory most effective
		Tactile stimulation		Items that previously may have caused crying
Month 5–6	Laughter	Social, visual, primarily dynamic	Immediate	Items that previously may have caused crying
Month 7–9	Laughter	Social, visual, primarily dynamic	Immediate	Tactile, auditory decline
Month 10–12	Laughter	Visual, social	Immediate, anticipation	Visual incongruities, active

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occur in the absence of external stimulation. At 1 week, low level stimulation can produce a similar response during sleep. But soon such smiles become related to external stimulation in a more direct fashion. At week 2 after birth, slight stimulation related to the feeding situation elicits a somewhat more drawn out smile evident after 6–8 s, but as Table 4.4 indicates, this latency decreases over time.

A shortening of latencies to gentle stimulation is one important characteristic of a developing emotion system. But over time, infants gradually also begin to express enjoyment of stimulation that is slightly stronger. From week 3 on, smiles become more active, as infants give signs of attentiveness and alertness—for example, when responding to a person nodding the head and talking to them. This engagement through attention and effort is further increased through weeks 4–12, with responsiveness to more dynamic stimulation and smiling responses that occur quite quickly.

At the age of about 4 months, infants' acceptance of, and enjoyment of and interest in, stimulation that is moderately intense, becomes evident in the emergence of full-blown, adult-like laughter, which typically is characterized by a sudden and rather explosive release. At first, laughter is elicited, from age 4–6 months, by quite vigorous auditory and tactile stimulation; over time, however, the response to the sheer vigor of stimulation tends to decline and, from week 5–8, tends to be provoked by dynamic *social* stimulation such as nodding the head, flicking lights, or stimulation that must be followed, hence demands attention. In the words of Sroufe:

> At first, physically vigorous stimulation is most potent. Of 28 items in our battery, laughter was produced in one-third of the 4-month olds only by a vigorous kissing on the stomach and the "I'm gonna to get you" game (looming approach with talking, building somewhat slowly but abruptly terminating with tickling the ribs)…Five-month olds laughed in addition at the mother vocalizing a resounding "BOOM BOOM BOOM". One third of the 6-month olds laughed at a swelling, loud "Aah" with abrupt cutoff, at being rather gently jiggled, and being tickled under the chin…As time progresses, infant's smiles become even more sophisticated, as they laugh most at situations that display an element of incongruity: for example, mother "walking like a penguin", or sucking at the baby's bottle. (Sroufe, 1996, p. 85)

Sroufe's research provides an excellent demonstration of the core processes of emotional development we discussed in Chap. 3. At the beginning, with their low thresholds of tension, infants are easily overwhelmed and distressed by levels of stimulation that are relatively vigorous. Over time, however, they are able to accept more dynamic, complex, and intense stimulation. In fact, rather than continuing to be overwhelmed, they begin to focus their effort and attention on the event and try to comprehend (or accommodate to) it. Thus they actively engage with the tension generated by the event, and as an eventual consequence, they do no longer find it disturbing, but in fact seek it out and enjoy it.

Sroufe's work also demonstrates another principle we discussed in Chap. 3: from an equilibrium perspective, such advances are witness to the development of more complex representations. Indeed, close to the end of the first year, infants appear to demonstrate an awareness of the intentional, but at the same time playful, nature of the stimulation provided by close others. Hence vigorous stimulation is no longer frightening, as there is increasing awareness of the *playful* nature and enjoyment of rough-and-tumble play and even joking—as when mother walks "like a penguin" or pretends to suck at the baby's bottle.

4.5 The Relational Context of Early Development and the Infant Brain

The infant's increasingly alert and active involvement in, and interpretations of, emotionally significant events is evidence of important gains in the maturation of the brain (Brain, 2012; see also Kandel, Schwartz, Jessell, & Siegelbaum, 2012/1996). Much of this development occurs in utero, during the prenatal period, when there is

rapid growth of neurons as a result of a process called *neural induction*. After this process of neural induction, neurons begin to travel to different positions in the brain in a process called *migration*, beginning at about 3–4 weeks after conception. As a consequence of resulting rapid proliferation, the newly developed neurons travel to their final destination. Directed by genetic instructions, different layers of tissues emerge—the *endoderm*, the *ectoderm*, and the *mesoderm*; these tissues differentiate from an initial structure called the "neural tube," a precursor of the spinal cord, and they subsequently develop into different tissues—organ, muscle, bone, skin, and nerve tissue. This process is directed by genetic instructions, but it also is affected by specific events in the environment, such as abuse of alcohol or cocaine, or radiation (Brain, 2012).

Once the neurons have reached their final locations, they begin to make connections with other neurons so as to take on a particular function, such as vision or hearing. Unlike the previous phases that are strongly directed by internal (e.g., genetic) factors, the formation of connections is increasingly affected by external events and the activities to which they lead—activities such as the emotional encounters discussed above. We already noted in Chap. 5 that the growth of neural structures is dependent on experience. Of the experiences that have been considered particularly important are those of the relationship between infants and their mother or primary caretaker. As we will witness through this chapter and chapters to come, these experiences have a defining and lasting effect on emotional development from the beginning of life through subsequent stages, and well into adulthood.

Probably the most important author to introduce the significance of the early relationship between mother and infant was the psychoanalyst Bowlby (1969, 1973, 1981). Influenced by the thinking of Freud (1823/1957), who underscored the importance of the relationship of mother/caretaker to infant, and familiar with the Nobel-Prize winning work of ethologists Lorenz (2011) and Tinbergen (1963), who wrote on similar relationships in animals such as ducks and fish, Bowlby applied these notions of the importance of early mother–child relations to the nature of human infants and their mothers, as well as their research. Even before these ethologists, Harlow (1958) had presented his famous work of the relationship of infant macaque monkeys to their mothers. In this research, Harlow showed that a close and intimate tie of the infant monkey with his mother was essential not just for the provision of nourishment, but also of the comfort of touch and closeness when situations of threat arose. Harlow and his collaborators documented the heart wrenching terror the infant monkeys experienced when these sources of comfort were not available. Indeed, continued research by his former student Steven Suomi documented the profound developmental retardation such monkeys experienced in the long run.[5]

Bowlby (1969) himself had documented the reactions of infants in need of hospitalization for diverse reasons, and observed similarly severe reactions when the infants were separated from their mothers. In his book *Attachment and Loss* (Bowlby, 1969), he proposed his theory of *attachment processes*, stating that the

[5] An excellent presentation of this work can be found on YouTube under the title "New Insights about attachment in rhesus monkeys."

infant–mother relationship is of enormous importance not only at the human level, but also indeed among *all* primates. This is because for baby primates, the mother is the only figure the baby must seek out when conditions of urgency arise—such as the presence of predators, the need for nourishment, problems of temperature regulation, and others. Bowlby hence postulated that between mother and infant, a system of *attachment* regulates the necessary closeness. That system, moreover, needs to be active at all times on both sides—only in that way is the safety of the infant secured. To this purpose, Bowlby proposed that the infant is equipped with representations that automatically assure the necessary closeness.

Attachment processes can be analyzed at different levels. One of those is similar to the automatic processes of the ancestral systems that secure homeostasis. In particular, in addition to the reflexes underscored by Piaget, infants are already from birth equipped with a repertoire of behaviors that promote their orientation towards others: for example, they search out, and prefer to look at, human eyes and faces, and favor the mother to cling on to and be comforted by (Bowlby, 1969; Harlow, 1958). Over the course of the first 8 months of life, these various preferences begin to form a coherent attachment orientation, with the mother or primary caretaker in the firm position of the infant's preferred base of security.

A particularly noteworthy display of the resulting need for and enjoyment of intersubjective intimacy is the frequent observation that even in the very first few months of life, there emerges something akin to a "dialogue" among mother and infant. Although not based on a coherent verbal exchange, this "dialogue" consists of the exchange of mutual regards and vocalizations—an exchange that is often compared to a mutual dance in which face and body movements, coos, and verbalizations are exchanged. Trevarthen (1989) described these exchanges as *protoconversations*, and proposed that these conversation-like interactions reflect a direct sharing of the subjective experiences of two individuals—mother and child. He called these "primary *intersubjective* engagements"[6] that are universal and unlearned forms of communication. These forms, he suggested, build a direct emotional contact between infant and mother/caretaker: "the eye-contact, smiling, and other facial expressions, coos of fretting and crying, and the varied postures and gestures of a young baby constitute a coordinated display of changing feelings, that may interact immediately with the affect in a partner's expressions" (Trevarthen, 1989, as quoted by Labouvie-Vief, 1994, p. 95).

Nadel's work on contingent mother–infant communication. The researcher Jaqueline Nadel and her coworkers (Nadel, Carchon, Kervella, Marcelli, & Réserbat-Plantey, 1999) have provided stunning evidence of the importance of such mutual engagements. She proposed that such interactions characterized by mutuality require that the behavior of the mother be *contingent* upon the signals of the infant. That is, the mother responds in a direct and appropriate manner to the signals of the infant, at the same time, as the infant responds to mother's contingent behaviors. In contrast, a non-contingent response of the mother does not take account of, and

[6] The term *intersubjectivity* is used to indicate that the self arises inherently in a relation of communication with and mirroring of/by others (see Labouvie-Vief, 1994, 1996).

therefore is not adapted to, the infant's expectations. To test this hypothesis, infants about 9 weeks old watched the simultaneously televised image of an ongoing interaction with their mothers; the images were televised from television stations placed in an adjacent room, and the prediction was, that the infants would respond negatively if the mothers' behavior were non-contingent. In that way, they would evidence an early sensitivity to the violation of social contingency in face-to-face interactions.

The experimental setup consisted of three conditions that were repeated without interruption. The first condition (Live1) consisted of mothers' acting contingently for 1–3 min (depending upon the quality of the initial contact). In the second condition (Replay), a non-contingent interaction of about 30 s was broadcast immediately after the first session. This second session consisted in a presenting 30 s of mothers' earlier live communication; thus, this communication was not contingent on the infant's momentary behavior. Finally, the third session (Live2) consisted of a second contingent interaction of about 30 s.

Results showed that when comparing Live1 with Replay, there was a reduction in infants' smiles and looks at mother from Live1 to Replay; this negative reaction indicated that the babies were sensitive to non-contingency during Replay. There also was an increase in frowning and keeping the mouth closed from the first to the second session. In contrast, there were no such differences from Replay to Live2, a sign that even though infants seemed to be disturbed at first, they recovered and no longer showed reduction of smiling and time spent looking at mother. In other words, even though the babies are very sensitive to lacking contingent communication, they equally quickly respond in a positive fashion once mother re-establishes socially contingent responding.

In a subsequent study, Nadel, Soussignan, Canet, Libert, and Gérardin (2005) further explored how infants' responding was affected by their past relationships with mothers. For that purpose, they had two groups of 2-month-olds who interacted with mothers that previously had been categorized as depressed or nondepressed. As in the previous study, infants experienced a 30-s contingent *live1* episode, followed by a *replay* of an earlier maternal communication, followed by an episode of 30-s contingent communication. Results showed that infants of depressed mothers showed a lower percentage of negative facial expression that those of nondepressed mothers. However, a significant difference emerged between the infants of nondepressed mothers and those whose mothers were depressed. Infants of nondepressed mothers showed decline of smile from live1 to replay, but their smile rose again from replay to live2, suggesting resilience of recovery. In contrast, infants of the depressed mothers evidenced a continuing decline in smiles throughout the three episodes. Nadel and her coworkers concluded from this study that the infants of the depressed mothers, though they were able to detect non-contingency on the side of their mothers just as well as had those of nondepressed mothers, nevertheless responded quite differently to the event: in fact, they appeared to have already adapted themselves to the lack of contingency and responded with passivity rather than the active engagement evident on the side of the infants of the nondepressed mothers. Some of the infants even were observed to turn away from their mothers in an apparent attempt to

avoid the source of stress—their mother. These data are similar to a study by Field (1984) in which 3-month-old infants of depressed mothers showed lower negative reactions than those of nondepressed mothers, and suggested that this was a sign of the evolution of a passive coping strategy. Indeed, several other studies suggest that (a) infants of depressed mothers more often engage in self-comfort activities (Hentel, Beebe, & Jaffe, 2000), and that (b) their mild behavioral responses to mother's insensitivity hides a high physiological reaction to the stressor (Brennan, Calhoun, Walker, & Stowe, 2002). Hence for all their quietly succumbing to the insensitivity of their depressed mothers, these infants show sign of heightened stress.

The stressfulness of lack of sensitive, contingent exchanges of the infant with mother or other caretakers may be a surprising phenomenon, since it speaks to a great sensitivity even very young infants have to the mother's displays of emotional engagement. Nevertheless, it is consistent with Darwin's (1872) claims that even from early infancy, babies are able to respond to facial expressions by a kind of "innate recognition device" (Harris, 1989). As a result of this ability to respond consistently to the facial expression of their caretaker, and even from the age of about 10 weeks onward, they begin to orient their behavior according to the caretaker's expression; as a result if the caretaker expresses negative emotion towards an object, infants are more likely to avoid rather than approach that object. This result is also consistent with the role of the HPA axis we discussed in the previous chapter. As Bowlby maintained, the responsive, caring, and sensitive presence of an attachment figure is of the essence for infants whose capacities to manage their own emotions still is very limited, and who therefore are entirely dependent upon the role of mother as regulator of their states—and, therefore, highly attuned to the mother's/caretaker's signals.

The presence of sensitive social support is an important buffer against stressful experiences not just for infants, but also at *all* stages of life (Lazarus & Folkman, 1984; Stansbury & Gunnar, 1994). With infants, in particular, the presence of caring person, but especially mother, has been shown to lower levels of cortisol when briefly separated from mother. At the same time, cortisol concentration in the blood tends to adapt, decreasing over the course of a period as short as 2 days even in newborns—but more likely so in situations that are not highly anxiety laden. This was evidenced in *decreases* in cortisol level in infants who experienced a rather innocuous physical exam twice over 2 days; in contrast, an *increase* in cortisol level over the 2 days was observed when the stimuli consisted of more obnoxious heel sticks (Gunnar, Bruce, & Grotevant, 2000).

The neurobiological significance of such intersubjective and contingent exchanges for the positive emotional development of the infant, as well as the damaging effect of the failure of such exchanges for infants, has also been widely discussed by Schore (2001a, 2001b). In a series of important contributions, this author notes that the psychological observations of the crucial nature of mother–infant coordination are confirmed by neurobiological data that expand on the significance of these intersubjective engagements. With their eye-to-eye contact, exchange of vocalizations, and display of tactile and bodily gestures, these engagements build up positive feelings and pleasurable excitement that synchronizes the brain activity of

the infant with that of the mother. In particular, the brain area especially affected by this intersubjective play of emotions is the right hemisphere of the brain, which matures ahead of the left hemisphere, and which is especially involved in processing social-emotional information which is stored in a way that is imagistic, implicit, and automatic rather than through representation and symbolization. This imagistic type of store is especially strong since it is less accessible to representation. In this way, the mother comes to function as a regulator of the infant's brain activity, since the brain area that is strongly engaged through this communicative process is the limbic circuit comprising the orbitofrontal cortex, anterior cingulate, and amygdala (Davidson, Putnam, & Larson, 2000), as shown in Fig. 6.1. Ideally then, in the case of successful and harmonious mutual engagements, the mother/caretaker helps set up well-integrated regulatory circuits in the infant's brain and thereby facilitates a positive course of emotional development. In the case of problematic mother–child attunement, on the other hand, the infant is set on a course of faulty emotion regulation and vulnerability to unregulated negative emotions (Davidson et al., 2000).

Ainsworth (1967), as well, stated that the resulting memories of positive or problematic interactions between mother and infant "are built into the nervous system, in the course and as a result of the infant's experience of his transactions with the mother" (Ainsworth, 1967, p. 429). The positive or toxic effects of early parental treatment of children are hence of crucial significance for the early development of the brain. Since, as noted, the early emotional experience of the infant is imagistic, implicit, and automatic, it is primarily stored and processed in the right hemisphere during the early stages of brain development (Semrud-Clikeman & Hind, 1990; Schore, 2003a, 2003b). This implies that the infant does not yet possess explicit, left brain cognitive capacities that can afford him- or herself protection from excessive arousal through cognitive means. Instead, he or she is likely to fall into a desperate state similar to that demonstrated for young monkeys by Harlow (1958) and Suomi (1999). Similarly, Kaufman and Rosenblum (1969) reported if young monkeys' mothers' absence is long terms, the infants are likely to fall into a state of severe depression and withdrawal characterized by high states of fear including huddling, resting immobile in rolled-up posture, and/or displaying facial expressions of fear. They also noted, however, that the specific individuals' display of expressions were not, uniform, but varied with the nature of the mother–infant relationship, as well as the specific group in which the pair lived. In turn, the return of the mother or, if not possible, the provision of substitute mothering was able to relieve the stress, depending again on the degree of mothering provided. Kaufman and Rosenblum (1969) from their observations that the states of severe depression and withdrawal appear to be a response that permits the infant to conserve his resources by retreating into a state of hypoarousal—a state of highly reduced arousal and lowered brain metabolism. For all its evidence of terror and distress, this state termed "conservation-withdrawal" Kaufman and Rosenblum (1969) and Kaufman and Zigler (1989) permit both animal and human infants in helpless and hopelessly stressful situations to "hide" and disengage from the stressful situation in order to conserve energies. In this way, it permits a profound detachment from an unbearable situation—but with the toll of dissociating and disengaging from social contact.

The intense negative, stressful experiences early in life are also related to alterations in brain metabolism in the infant's brain, with long-term consequences for the brain of adults. Among the changes attributable to early adverse experiences, Kaufman, Plotsky, Nemeroff, and Charney (2000) list multiple changes in neurotransmitter systems, changes that may create increased concentrations of stress hormones, while interfering with the prefrontal regions' and hippocampus' capacity to control acute stress. If sustained, such stress responses, with their increased output of glucocorticoid, these stress reactions can disrupt the functioning of the HPA Axis and even can result in neurotoxicity responsible for permanent hippocampal neuron loss. For example, in a study with rats, induced brain changes in rats involved a loss of 20 % of hippocampal neurons (McEwen & Sapolsky, 1995). Similar reductions may also be effected by decreases in neurogenesis—the tendency of neurons to replace and renew themselves. Structural changes in the hippocampus have also been documented in adults with depression or with post-traumatic stress disorder (PTSD).

For all the negative changes discussed, many of the deficits due to highly stressful early experiences are not necessarily irreversible. As already noted, in young monkeys, obtaining substitute care was effective in reversing many of the observed problems. For example, in a series of studies with rat pups, maternal licking and grooming behavior was related to increased exploration in novel environments, better HPA regulation; findings such as these have been suggested to indicate that maternal grooming behavior may "program" the development of neural systems that influence stress reactivity.

On the behavioral side, this research underscores the importance of positive and caring early attachment relationships; at the same time, they raise profound concerns about the frequency and severity of attachment failures for children and adults alike. In that respect, Cichetti, Ganiban, and Barnett (1991) noted that maltreated toddlers showed profound deficits in the ability to talk about their inner states and their emotions—the result, likely, of a dysregulated system that is overwhelmed by visceral memories of adverse experiences. As we will see in Chap. 6, these deficits persist well into adulthood, with profound deficits in emotional processing.

Attachment: Process and Styles. Bowlby's (1969) formulation of attachment theory not only has stimulated a plethora of research studies, but his theory has remained an important framework in which to conceptualize the importance and long-term, life-long effects of early relationships between infant and caretaker attachment processes. This work was stimulated by his observation of the reaction of very young children who had to be hospitalized. He was impressed by the heart-wrenchingly disturbing expressions of fear, grief, and protestations; Bowlby interpreted those as *the* core sign of the infant's close and critical tie to the mother/caretaker, and proposed a coherent theory of the mutual attachment of infant and mother—*attachment theory* (Bowlby, 1969). According to attachment theory, the infant already possesses at birth a repertoire of automatic responses/representations that optimize the attachment link between him or her and the mother/caretaker. These exist at first of a repertoire of innate behaviors that orient the infant towards others—the eye contact, recognizing and favoring of mother/caretaker, and similar *pre-attachment*

behaviors. At first, these behaviors are not yet exclusively directed towards mother, but directed at others, as well. But over the first 6–8 months, they become quite selectively oriented towards the mother/caretaker—at this time, the caretaker has become the *basis of security*, and the attachment process has been strengthened by the experience-dependent formation of an "internal model," or representation, of the *secure base*. In fact, by about 12–16 months of age the caretaker has become the single preferred figure of security, whereas strangers tend to evoke *stranger anxiety.*

Ideally, attachment processes work to form the necessary secure base, but such security of attachment is not always achieved. Bowlby therefore distinguished between *secure* and *insecure* attachment styles, and suggested that whether or not children developed a secure style depended on the quality of the attachment relationship. Ainsworth (1967), student of Bowlby, examined aspects of this relational quality in 27 young Ugandan children by observing mother and child during brief periods of separation and following reunions in an experimental paradigm called "Strange situation" (see Table 6.4). Observations indicated that infants characterized as "secure" displayed the following signs: (1) they did not show anxiety in the presence of mother, (2) they turned towards mother in situations of felt concern or danger, (3) they did not resist being held in the arms, (4) they did not become distressed when mother left the room briefly, (5) they joyfully greeted mother on returning to the room. Thus in sum, they showed all signs of being able to use mother as a secure base.

In contrast to such securely attached children, Ainsworth identified several styles of children that are *insecurely attached*. This work was further continued by her former student Mary Main, whose team continued to identify and describe different types of insecurely attached children. Generally, *secure children* are able to use the mother as a basis for security. In fact, when mother leaves the room, these children may show signs of disturbance and even distress, but upon return of the mother, they indicate joy and even jubilation at their return. These children hence have learned to "repair" the distress of brief crises due to the mother's absence by returning to her with positive feelings and vocalizations or gestures indicating joyous relief.[7]

Avoidantly attached children, in contrast to securely attached ones, already indicate sign of a problematic attachment relationship. Upon separation from mother, these infants do not show distress, but begin to explore the room. Their distress is evident, however, in the fact that they do not greet the mother upon return, but rather avoid her and continue to concentrate on the toys. If the mother attempts contact, the infant may turn away, indicating an already problematic attachment relationship. These signs of ambivalence and even anger towards the parent become heightened and more pronounced in *ambivalent/resistant* children who show a mixture of distress, anger, and passivity; they are not able to let themselves be comforted by the parent, and neither able to engage in exploring the room. Finally, attachment organization reaches quite chaotic proportions in children that are characterized by a *disorganized-disoriented* form of attachment.

[7] An informative and empassioned presentation by Dr. Gunnar can be found on YouTube by entering "Megan Gunnar, Hennepin University Partnership 2013."

The Toll of Early Attachment Failures. The development of attachment styles is highly dependent on the interaction between caretaker and infant. That interaction, in turn, is shaped by the attachment experience the mother/caretaker herself had in her infancy and early childhood. As an example, Main and coworkers (2005) looked at the cross-classification between infants' and their mothers' attachment classifications. Results showed that infants that were characterized as *securely attached* had mothers characterized as "autonomous"—that is, the mothers themselves had experiences that left them with positive attachment experiences, and that caused them to be free to be sensitive to their own infants and their communications. In contrast, infants that were classified as avoidant-dismissing have mothers who were similarly classified; hence mothers had difficulties with acknowledging their own attachment needs which they tended to dismiss. As a result, she was not able to be sensitive to the attachment needs of her infant. The mothers of infants who were classified as *avoidant resistant*, in turn, were confused about their own attachment histories which had remained unresolved. These mothers were not appropriately coherent in the treatment of their infant.

A particular dramatic history of attachment is evident for infants classified as having a disorganized/attachment. This classification is most likely in infants who have a history of maltreatment—in fact, about 80 % of maltreated children are so characterized (Carlson, Cichetti, Barnett, & Braunwald, 1989). These children suffer from high levels of stress. For example, Spangler and Grossman (1993, 1999) reported that these infants showed high distress reactions and cortisol levels in the strange situation (see Fig. 6.2). These infants show behaviors that indicate a bizarre mixture of conflicting approach and avoidance of mother—behaviors that indicate the consequences of a traumatic history in which the need for maternal protection conflicts with the need to protect themselves from terror and fear. These children are found to dissociate in terror and show reactions of numbing, withdrawal, overcompliance, and withdrawal into an inner world (Tronick & Weinberg, 1997). As Schore (2001a, 2001b) points out, there events occurring in a period of rapid brain development prime the infant to the development of PTSD characterized by hyperarousal and dissociation. These maladaptive developments of brain processes, in turn, set the stage for such dysfunctions of emotion regulation in childhood and adolescence, and well into adulthood.

Failures to form positive attachment relationships are, however, not solely due to parental maltreatment; they can derive, as well, from unfortunate circumstances such as losing one or both parents to death, ill physical or mental health, or abandonment. Megan Gunnar from the University of Minnesota and Charles Nelson of Harvard University and their colleagues (Nelson, Bos, Gunnar, & Sonuga-Barke, 2011) have provided detailed evidence of the developmental deficits that can result from such misfortunes. One domain of the surveyed research concerns the toll of institutionalization following being orphaned or abandoned. This research has documented profound malnutrition and related stunting of brain growth. These and other studies attest to the fact that early institutionalization has long-lasting effects on brain development. These children also evidence changes in the functioning of the HPA system and may show elevated cortisol levels after being adopted out of the institution after about 4–6 months of age (Gunnar & Grotevant, 2000).

Parental mental health problems also have been found to be related to a toll on children. For example, Azak, Murison, Wentzel-Larsen, Smith, and Gunnar (2012) reported that maternal depression and comorbidity with anxiety was related to elevated cortisol levels when infants were 6 and 12 months old, although no differences between depressed and nondepressed mothers' infants were observed at the age of 18 months. Possibly, these results reflected both better capacities of stress regulation in the infants and/or improved coping strategies on the side of the mothers.

All of the above contributions converge on the conclusion that the specific form of early relation between infant and caretaker is crucial, therefore, for the neurobiological wiring of the infant's brain. The degree to which the form of early relationship affects the growth of the brain has been the subject of the *National Council on the Developing Child*, a multidisciplinary, multi-university collaboration interested in bringing the science of early childhood and early brain development to bear on public decision making (2012: see also Nelson et al., 2011). In the ideal case, these protoconversations form a kind of "serve and return," reciprocal interaction in which children, on one hand, reach out to parents/caregivers by babbling, gestures, and facial expressions, to which adults, in turn, respond with gestures and vocalizations. These reciprocal protoconversations add to genetic instructions in shaping the development of the neural circuitry of the brain. The interactions, if successful, not only support the development of the brain, but they prime the growing infant to be able to experience a sense of pleasure and security with the parent—feelings that are a strong basis for a positive developmental course. In the worse case, these setting can set the stage for future difficulties in interpersonal relationships, since they involve the activation of disturbing memories that yet are not consciously elaborated. With sometimes grave consequences for mental health not only in infancy and childhood, but well into adolescence and adulthood, as well. The resulting memories are dominant for processes that are quite unconscious (Schore, 1994, 1998, 2001b) in that it "remembers" and stores abusive interactions outside of conscious awareness; this implies that the brain, which houses two representational systems of left and right hemispheres, is not able to integrate these systems (Zaidel, Esiri, & Beardsworth, 1998). In addition, as pointed out by Kandel et al. (2012/1996), during the first 2–3 years of life, the infant relies primarily on "procedural memory systems,"[8] which primarily are related to right hemisphere functions and record experiences in a way that is imagistic, implicit, and visceral (Schore, 2003a, 2003b), with the result that "early emotional learning of the right, especially of stressful, threatening experiences, can be unknown to the left (Joseph, 1982, as quoted by Schore, 2001b, p. 226)," since they remain unsymbolized by thought.

In working paper 12 of the National Scientific Council on the Developing Child (2012), the Council details different types of and consequences of unresponsive care. The least severe is characterized by occasional inattention, consisting of intermittent

[8] The procedural memory system contains memories of actions stored in an imagistic implicit, visceral-automatic, and nonconscious fashion that in some sense can be compared to Piaget's "sensorimotor skills."

reduced attention in an environment that otherwise is responsive. In such an environment, the consequences can be even growth promoting as long as the conditions are, in general, caring; hence no intervention is needed. A more serious problem is evident if children remain chronically understimulated, with low levels of responsiveness to and enrichment towards children. In such cases, interventions that address the needs of the caregivers and access to high-quality early care and education for children can by effective. More severe problems are likely in situations of severe neglect in a family context, and especially severe neglect in an institutional setting, where individualized, reliable relationships between adults and children are rare. Although such relationships can meet basic survival needs, they are related to severe impairments in cognitive, physical, and psychosocial development that requires interventions by removing children to a stable, caring, and responsive environment.

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Chapter 5
Cognitive–Emotional Development in Childhood

Although emotions begin as purely automatic processes, we saw in Chap. 6 that the infant already begins to acquire a certain degree of control over emotions and the events that produce them. In this chapter, we survey how this budding mastery of emotions continues to expand throughout subsequent years until the dawn of adolescence. A major aspect of this expansion is that emotions become more elaborate cognitively; these elaborations become more and more differentiated and sophisticated, as children become more aware of the emotional states of themselves and others. Children also begin to evaluate emotions according to which emotions are "good" or "bad," or desirable versus undesirable to express, and accordingly, they begin to distinguish situations in which it is socially appropriate to express particular emotions from ones in which it is not. We will discuss, too, how in this way emotions gradually become more complex: from an initial pure automaticity to the sharing of emotional states with caretakers and others, the children begin to incorporate the understanding of conflicts about emotions, as when different emotions seem to compete in their own minds. They also acquire a more acute awareness of the reactions of others to their emotions, and this capacity, in turn, brings a set of new, yet more complex emotional capacities. For instance, when feeling an emotion they have learned not to be socially approved, they may begin to dissimulate a more acceptable emotion in the interest of social harmony and/or self-protection. Further, they develop awareness that emotions often are related to one's preferences, tastes, and desires, hence carry different imprints for different individuals. All of these gains indicate an increasingly sophisticated cognitive repertoire that becomes integrated, to various degrees, with emotions, and that even brings forward a new set of complex emotions that reflect an emotional repertoire characterized by the integration of cultural and social rules and conventions into the emotional life of children.

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5.1 Thinking About Thinking: The Toddler's Growing Cognitive Repertoire and Its Significance for Emotional Development

In the previous chapter, we saw that already in infancy, children begin to develop a sense of control over certain emotionally relevant situations. This sense of control rises with the next Piagetian period of cognitive–emotional development. As indicated in Table 5.1, Piaget refers to the beginning of this next major period of development, during the fourth phase of *sensorimotor intelligence*, as being marked by the appearance of *pre-operational representations*. The examples of the third phase of development, with their interest in the regulation (activation and retardation) of action, already indicate a degree of intentionality and awareness; however they are, to Piaget's thinking, not yet truly characterized by *representation*, since they still are intimately tied to particular actions. As children move on to the phase of pre-operational representations, in contrast, they begin to *internalize* actions *as well as* objects—that is, they can relate not just to objects and actions experienced at the here-and-now; rather, they begin to relate to a world of "objects-of-knowledge"—that is, they begin to *think about thoughts*, which thereby become "objects" to be contemplated by the mind. This notion of treating thoughts as *objects* is quite similar to that of Plato (discussed in Chap. 1), who proposed that at an early juncture of cultural intellectual development, thought no longer is intimately and only linked to action, but can become an object of our reflection and contemplation all by itself. This process of *internalization* renders "thought" available in the form of the

Table 5.1 Piaget, Jean (1981): Levels of affective development from childhood to adolescence

Verbal intelligence	Interpersonal feelings
IV. *Pre-operational representations*	*Intuitive affects*
(From language to 7/8 years)	
Here actions begin to be internalized. Although this allows thought, such thought is not yet reversible	These include elementary interpersonal feelings and the beginning of moral feelings
V. Concrete operations	*Normative affects*
(From 7/8 to 10/11 years)	
This stage is marked by the acquisition of elementary operations of classes and relations. Formal thought is not yet possible	This stage is characterized by the appearance of autonomous feelings with intervention of the will. What is just and unjust no longer depend on obedience to a rule
VI. Formal operations	*Ideological feelings*
(From 11/12 years to 14/15 years)	
This stage is characterized by thought employing the logic of propositions freed from their content	Feelings for other people are overlaid by collective ideals. Parallel to this is the elaboration of the personality, where the individual assigns himself a role and goals in social life

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presence of some kind of real or mental image, and eventually even utterance or name or even concept, that stands for (that is, represents) a particular object, event, or state of affairs the child has experienced and remembered, and henceforth can call forth from memory.

5.2 Language and Emotion

Piaget also notes (see Table 5.1) that the beginning of pre-operational representations and internalized thought or representations coincide with the emergence of *language*. The emergence of language at this age is very important, since language is a new medium in which thoughts can be represented and communicated. With language, "thoughts" or "representations" are no longer merely an inward, fleeting, and entirely intuitive and private activity of one's mind; rather, language preserves thoughts, which can acquire stable, repeatable, and communicable forms; these forms, in turn, can be translated into standard expressions and thus shared with others. They even can be expressed in written language, which permits to mentally manipulate them and to submit them to detailed analysis. In this way, thought begins to acquire a more social and external character that offers stable and socially shared meanings (Karmiloff-Smith, 1992; Werner, 1957; Werner & Kaplan, 1963). At the same time language, as a cultural medium, also adds rich social and cultural meanings to the thus-far personalized meanings of children; in this way, it broadens and shapes inner experience that previously had a strongly private aspect. Indeed, as Harris (1989) states, the acquisition of language to describe emotions produces a "psychological revolution" which allows children not only to think and communicate about their current emotions, but also about past and present ones, and even hypothetical and imagined ones.

The Soviet Psychologist Alexander Luria (1932), an early pioneer in the study of neuropsychological research, was probably the first researcher to write extensively about the importance of language for emotions. Luria was interested not only in the communicative function of language, but also, and especially, in how language comes to regulate our speaking and thinking (Luria, 1967)—in other words, in the way in which language recruits cognitive activities that help transform emotional events from a mere fleeting experience to one that becomes an object of thought. In this process, language functions to help regulate emotions and make them more controllable.

Luria was a major pioneer in the study and theorizing of the role of the brain and language in the activation and/or control of emotional arousal. Well before the advent of modern neuroscience, procedures of examining emotional arousal through a variety of psychophysiological measures of arousal—from skin conductance, to changes in heart rate and blood pressure, electrophysiological recordings from the brain directly—and several decades before the development of the direct observation of brain processes through processes of imaging such as positron emission tomography (PET), or Functional Magnetic Resonance Imagery (FMRI), Luria demonstrated that in the absence of language or other symbols such as images,

strong emotions, such as those induced by situations related to high emotional conflict, are characterized by extremely high levels of arousal. In contrast, if individuals are asked to describe emotional events in terms of symbol systems, such as conventional images and words, the result is that arousal is dampened and hence becomes more controlled.

Specifically, Luria had individuals recall and re-experience emotionally disturbing situations. As a measure of the resulting arousal, he electrically recorded their hand tremor; in addition, he observed such behavioral indicators of high arousal as emotional outbursts and sobbing. In this way he showed that, when individuals reported directly about their disturbing events, they were highly likely to show strong emotional agitation as evidenced by high levels of hand tremor, along with outbursts and sobbing. In contrast, when they were asked to provide symbols, or to use linguistic labels, for the conflict situations, tremor was greatly reduced, and crying and outbursts were controllable. For example, one women first talked about her husband's drinking in a high state of arousal, with crying, sobbing, and tearing her clothes. Thereafter, Luria told to describe her experiences with paper and pencil. At first, and with considerably more calm, she drew a picture of her drunkard husband with a bottle and a glass in his hands, all surrounded by the word, "spendthrift" as well as other illegible words (another indicator of her state of arousal). When next asked to draw a *symbol* of what bothered her, she quietly and quite affectlessly proceeded to draw a bottle towards which a green snake was creeping—a green snake being a symbol of drunkenness in Russia, according to Luria. From this and many other experiments, Luria thus concluded that activation/agitation was less readily controllable when individuals reported their experience directly, without adding symbolic or linguistic elaboration; in turn, arousal and disturbance were more readily controlled and calmed when individuals were encouraged to shift from direct experience to a symbolic expression of that experience.

Researchers using more modern neuropsychological studies found similar effects and confirmed, moreover, that the calming and dampening effects of symbols and language are related to the role of the prefrontal cortex, widely identified as the brain's "center of control" (Goldberg & Costa, 1981) which responds to high activation of the amygdala by inhibiting amygdala activation and thus calming or *dampening* arousal. This interplay of amygdala and prefrontal cortex was demonstrated by Hariri, Bookheimer, and Mazziotta (2000; see also Lieberman et al., 2001), who showed their adult participants pictures of emotionally activating stimuli (e.g., angry or fearful faces). Participants then were asked to identify the emotion portrayed in the pictures either by pointing to the image of a face that corresponded to the emotion shown, or else by labeling the emotion shown by saying, for example, *angry* or *fearful.* The hypothesis here was that *pointing* to an image of the emotional expression would primarily activate the amygdala (i.e., provide the heightened activation of direct emotional experience). If, in contrast, participants were directed to *label* the emotion shown, the involvement of language would more strongly engage the prefrontal cortex. As predicted, the results confirmed Luria's notion of the regulative function of language: it showed that, when simply *pointing* to the stimuli, amygdala activation was greatly increased whereas prefrontal activation was

reduced; in turn, when *labeling* the emotion rather than pointing, activation of the prefrontal cortex was increased, and correspondingly, activation of the amygdala was reduced. This finding is similar in meaning, if not modern method, to that of Luria, in that it further supports the conclusion that the use of language and/or symbols engage more cognitive processing and with it, a shift to a more well-regulated emotional responses. At the same time, it confirms, with methods more contemporary than those of Luria, the respective roles of the prefrontal cortex in dampening or downregulating arousal states, but the opposite though complementary role of the amygdala in amplifying arousal (for discussion, refer back to Chap. 5).

Beginning Self-Awareness. The discovery of a world of "objects-of-knowledge," then, allows children to begin to reflect upon and talk themselves, as well—their thoughts, emotions, and wishes. In Piaget's language, the "subject takes consciousness of himself and his own activity (Piaget, 1981, p. 41)." He continues to make reference to psychologist James Mark Baldwin who proposed that consciousness of self can only emerge if at the same time the child also takes consciousness of others. As a result, children's emerging awareness of self is necessarily related also to becoming awareness of others: they not only become aware and reflect upon being an object to the thinking and evaluation of self, but of others as well.

This idea was of the mutuality of recognition of self and others was famously expressed by sociologist Cooley (1902) who proposed the notion of a "looking glass self"—that is we perceive, so-to-speak, quasi a reflection of ourselves through the eyes of others, whom we feel to be as an audience of observers to our actions. We (self-consciously) impute to this audience, in turn, certain sentiments and evaluations of us. The result is a growing sense of being evaluated, along with engaging, ourselves, in evaluations of others.

Piaget proposes (see Table 5.1) that at this juncture of discovering the reciprocal nature of being observed as well as being an observer, the child discovers a parallel world of "interpersonal feelings." The internal world of children's feelings becomes restructured in a profound way, because a new understanding of the self emerges. Up until this point, the child's understanding of self was quite intuitive and directly fused with his/her relationship to close others, especially the parents. But contemplating on self and parents as somewhat separate individuals, they soon begin to understand parents and others as autonomous agents that in many ways are independent of the self. Piaget hence proposes that the child's very conception of his or her world is expanded:

> … It is a restructuration of the entire affective and cognitive universe. When another person becomes an independent, permanent, and autonomous object, self-other relationships are no longer simple relationships between the subject's activity and an external object.[1] These relationships start to become true exchange relationships between the self and the other person. These exchanges make more important, more structured, and more stable valuations possible. Such valuations indicate the beginning of interpersonal "moral feelings" (Piaget, 1981, p. 41).

[1] In the language of psychology and psychoanalysis, and even in ordinary discourse, "object" often refers to a person (e.g., parent) of whom the child has a representation and to whom he or she is attached—as in the popular reference to somebody as an "object" of our desire.

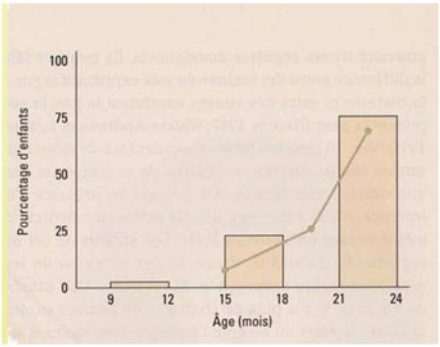
As Piaget suggests, this advance is at the same time intellectual *and* affective. On the affective side, children begin to evaluate their actions and become aware of how those are valued by others. The result is a new set of feelings related to these valuations of self and by others: "there is estimation of the self and, therefore, positive and negative self-esteem from the moment that a person begins to judge himself superior or inferior to other people (p. 47)."

Research has addressed the development of such forms of self-awareness by studying just how and when children demonstrate conscious of themselves. The expression of emotions during the first 6 months is largely focused on the primary emotions such as contentment/joy, interest/surprise, and negative emotions such as distress, sadness, disgust, anger, and fear. However, at this early age, children do not appear to be *aware* that they are feeling a particular emotion—that is, even though they give evidence that they *experience* a particular emotion, they do not appear to have *explicit knowledge of themselves having this experience* (Lewis & Haviland-Jones, 2000).

Developmental Psychologist Jerome Kagan in 1998 addressed the question of self-awareness in children by posing the question. "to what extent is there is a self in infancy?" He suggested that, of course, infants do not have a concept of self as a person, nor do they have, as already stated, *conscious* awareness of their feelings, intentions, appearance, or their actions. Nevertheless, a *budding* sense of awareness is evident early in the fact that around the second birthday, children first use their name. They also begin to direct the behavior of others. In fact, about one third of the child's utterances at this time are descriptive of what he/she is doing. Thus children at this age *do* seem to have a limited awareness of their qualities and capacities. Particularly striking evidence of this budding awareness is the finding that they show anxiety and distress after they fail at a task—or even, if they feel a task presented to them might be too difficult, and they would be likely to fail at it! Later in the second year, in contrast, children show a smile when they have mastered a task, even when having done so in solitary play. Such activities, Kagan proposes, demonstrate that children of this age show processes that require that one posit a concept of the self in infants, rudimentary as this sense might be.

Emerging knowledge or awareness of oneself that becomes evident in the second half of the second year also has been demonstrated with a different task. In a now famous study, Lewis and Brooks-Gunn (1979) placed children in front of a mirror (see Fig. 5.1). Generally, children of this age are not particularly interested in their mirror image; they tend to look briefly, but then look away again, giving no evidence that it is *themselves* they have seen. The researchers then put a red dot on the children's nose (the so-called rouge test) and directed the children again towards the mirror, with the aim of observing their reaction to the red dot on the face. Children younger than 15 months did not show any reactions to the dot; however, at the age of 15 months, about 20 % of them did so. With increasing age and normal development, children are more likely to touch the dot—at the age of 24 months, 100 % do touch their fronts, showing that they recognize their own image in the mirror. Almost simultaneously with this self-recognition, the children also begin to refer to themselves. In fact, about one third of the child's utterances when referring to themselves and their actions are "me" and "mine."

In about the middle of the second year, the infant shows self-recognition when looking into a mirror.



Percentage of infants who touch the red spot on their face by age

Fig. 5.1 Recognition of self in a mirror and reference to self appear at about the same time. Reproduced with permission from Lewis & Brooks, 1978, pp. 214, 215

Self-Conscious Emotions and Morality. As suggested by Piaget's above-cited quote, then, the awareness of self brings about a restructuring of the child's emotions, and it does so in several ways. One of those ways is, that out of the simple and basic, automatic and "ancestral" emotions proposed by Darwin, more complex emotions can arise. These more complex emotions are not simply activated as a result of particular external situations, but add and include cognitive evaluations of the situation. Becoming aware of being observers *as well as* objects of observation, children now become aware of relatively new emotions that reflect this awareness of being evaluated. These *self-conscious emotions* (Lewis & Haviland-Jones, 2000) comprise feelings such as *embarrassment*, *shame*, or *guilt* in situations that lead individuals to believe that real or imputed evaluations of others are negative; if, on the other hand, the belief is that others judge the self positively, *pride* is likely to be the result. The interpersonal side of emotions, therefore, moves to the fore of the child's awareness, since all of these emotions attest to the fact that children now begin to relate themselves to, and internalize, social standards and rules of how one should, or is expected to, behave. It is for that reason, in effect, that Piaget invokes the term of *moral emotions.*

What makes self-conscious emotions have *moral* implications and meanings is the fact, that they motivate and incorporate the standards of acceptable behavior children have already realized. Moral emotions hence are evoked by self-reflection and self-evaluation on oneself and one's action; in this way they serve affective consequences that are based on an evaluation of the ethical nature of one's behavior, such as conformity to standards, propriety, and consequences for others (Tangney, Stuewig, & Mashek, 2007). The two self-conscious emotions of shame and guilt,

both involve a negative evaluation of the self, but of the two, *shame* is considered the more problematic one, since it involves a negative evaluation of the self in the global way; guilt, in contrast, is considered less severe because it involves a negative evaluation of a specific behavior, rather than the global self. Understandably, shame is a much more painful emotion than guilt, because in shame the core of one's self appears to be in question, whereas in the case of guilt it is only the specific behavior that is being judged. In shame, one feels a sense of shrinking and wanting to hide, of worthlessness and powerlessness, and one would like to deny, hide, and escape. Guilt is considered less painful because it is only a specific behavior that is being judged and not the entire self; moreover, guilt can be repaired by engaging in some kind of action to repair the act through apologies or otherwise making up for an offensive action.

The emergence of self-conscious emotions underscores Kagan (1981) already cited finding that young children begin to be aware and recognize external standards (Lagatutta & Thompson 2007; Tracy, Robins, & Tangney, 2007). Precursors of this awareness are, nevertheless, already evident before the advent of a more advanced sense self-consciousness. For example, as noted in Chap. 6, between the first and second year, infants already begin to engage in "joint attention" by looking to adults when unsure about how to interpret a situation. Indeed, even before they may consciously define external standards, they seem to show some recognition of them by their reactions in particular situations. This was exemplified in a study by Kochanska et al. (2002), who showed children aged 22, 33, and 45 months of age the stained t-shirt of the experimenter; the aim was to see if they might show signs of guilt. The results revealed that indeed all of the children showed such evidence to different degrees; this was demonstrated by the fact that they looked away, showed bodily tension, and expressed signs of distress. Thus children as young as 22 months, when believing they have committed a transgression, show a reaction which indicates heightened tension.

To assess if this tension reflected genuine guilt rather than a more diffuse state, Kochanska et al. (2002) also had the mothers of the infants tested evaluate if their children had a tendency to demonstrate signs of guilt—such as turning quiet and shy after having done "something stupid," or being reminded of having done one. The results showed that the mothers' evaluations and the behavioral indicators of the children were positively correlated—but only for children from the age of 56 months on. The authors concluded that the feeling of guilt seems to appear in a progressive fashion, since it emerges already very early as anxiety related to the disapproval of adults. Hence it is likely that this fear of disapproval is a precursor which eventually gives rise to the full-blown sentiment of guilt. The authors suggested that this evidence points to a gradual emergence of guilt, and that at the outset, the reactions of discomfort more likely reflect fear related to being disproved or punished by the adults.

The further evolution of emotions such as shame or guilt is strongly affected by how parents/caretakers deal with them—and whether they are able to turn them into an occasion for a stronger sense of self. Schore (1998a, 1998b) has provided an analysis of the emotion of shame, which can become evident around the middle of the 13–17th month of age. One reason shame is moving to the fore at this juncture

of development are qualitative changes in mother–child interaction; these changes may reflect higher demands for "mature behavior" on the part of the children. For example, at the age of about 10 months, the majority of communications between mother and child involve positive and rewarding messages; in contrast, at the age of about 13–17 months, the majority involves prohibitions given at the rate of about every 9 min! This (to the child) unexpected change, according to Schore, creates a sudden deflation of accustomed-to positive affect, since thus far, the children encountered primarily praise and reward; this deflation suddenly propels the child into a negative state he/she is not able to self-regulate. Schore proposes that these positive-to-negative changes involve a sudden change in the mobilization of energy—from sympathetic activation, to the energy conservation of parasympathetic arousal inhibition—that is, from a state of hyper- to hypoarousal. The child in the process displays evident signs of shame, indicated by changes in posture and facial expression, especially "postural collapse and gaze aversion."

The results of this "crisis" depend on the mother's ability to help repair it. For example, if she is able to re-establish visual and affective communication, she fosters a transition to a state dominated by sympathetic arousal, supporting the development of a secure attachment model; the result of this model is a positive pattern of dyadic regulation and coping; here again, we encounter the fact that temporary crises in development can have salutary consequences in the long run, given sensitive guidance by a parent who is himself–herself mature. In contrast, if the mother/parent responds in a poorly attuned fashion ("misattunement"), he/she can encourage a pattern typical of either hypo- or hyperactivation. If misattunement is extreme, the result may even be a pattern of heightened sympathetic *and* parasympathetic activity—a pattern that can be characterized by shame-rage cycles typical of extreme stress responses.

The emergence of self-consciousness permits even quite young children to show a new and more complex register of emotions. For example, Lewis and Haviland (1993) report that from 18 months of age on, children show an awareness that particular situations are most likely to create embarrassment, shame, envy, or pride. For example, breaking an object, even involuntarily, could result in *embarrassment. Envy of jealousy* could be the result from watching a little sibling being fed a special meal, whereas on the positive side, *empathy* would be evident if one consoled one's little brother. From the age of 24 months on, children can give as an example of *pride*, that one is able to climb by oneself; *shame* would be the likely result if one were seen not being able to go potty in time, whereas *guilt* might be felt if, after being punished, one then feared that one would lose the love of one's parents.

Children's emotions also become more complex in that they begin to understand emotions not just as simple and relatively predetermined events. Rather, they begin to show awareness that emotions are complex in the sense that they do not *automatically* result from certain situations. Thus what one feels is not simply an automatic event driven by some specific situation, but also includes consciousness of, and attention to, the psychological dynamics into which emotions are embedded. In particular, children now become aware that emotions can arise from a variety of *inner* causes and tendencies of people—for example, the particular likings, wishes, and desires

that individuals bring to emotional settings. Thus the ifs, whens, and whys of particular emotions arising are not necessarily subject to easy explanations, but require knowledge of the feelings and thoughts of the person emoting—in other words, awareness and knowledge of the protagonists' inner states, as well as the capacity to imagine the desires and preferences that motivate him or her.

Imagining Inner States. Self-consciousness, then, highlights new aspects of children's emotional life. As already noted, children at an early age are able to identify different emotional states expressed by others such as their parents, and show responses and behaviors that indicate such understanding. This is consistent with Darwin's idea that a certain degree of emotional understanding is part of our inheritance and thus comes quite automatically and preverbally. Over time, however, emotional understanding and the ability to identify emotions becomes more explicit and sophisticated Harris (1989). For example, children of x years of age not only are able to identify emotions by labeling them; they also begin to understand that emotions can be complex in that they can be mixed and ambivalent, as when one is aware of two different emotions at the same time, such as feeling part happy, part sad at a particular event. However, even though they give indications of ambivalence *very early*, they do so *explicitly* only later. Thus children from 3 to 6 years old are not able to label opposite emotions. From 6 years on, they *can* do so, but only if the emotions are in succession (e.g., first happy, then sad); from 7 to 8 years on, they understand that two emotions of the same valence (e.g., happy and excited) can co-exist at the same time, but from 10 years on, are they able to mention two emotions of opposite valence.

Growing awareness of the nature of one's own and others' inner states also advances children's understanding that one can control and hide one's emotions, indeed *needs* to do so on occasion. This is due to the fact that cultures provide rules of how it is appropriate to display emotions. Even children from 6 years of age onward are aware of such display rules and attempt to hide their emotions, for example if as a "reward" for solving a problem, they are given an unattractive toy rather than an attractive toy they had been led to expect (Saarni, 1984, 1999). Cole (1986; Study 2) found that even 3- to 4-year-old girls concealed their disappointment, but only when the interviewer was absent; when she remained present, they attempted to conceal it with a half-smile.

Children's attempt to hide their emotions does not mean, however, that they are necessarily aware of the difference between real and apparent emotions. Harris, Johnson, Hutton, Andrews, and Cooke (1989) reported that children 6–10 years old readily understood that somebody could feel really sad but try to look happy in some stories, but in others feel really happy but try to look sad. In contrast, when asked to describe what the expression of a person would be who really tried to portray a feeling he/she did not feel, the task was much more difficult. Six-year-olds could distinguish between how the story character would feel and what he would look like, but 4-year-olds were not able to do so (Harris, 1989). This is despite the fact that already at the age of three or four years, children are able to hide feelings of disappointment to a certain extent—even though they have little understanding of the difference between real and apparent emotion.

As children develop a more sophisticated understanding of how emotions work and how they can be mastered, they also begin to relate emotions people are likely to feel in certain situations to the particular inner states; that is, they become aware that the emotions aroused by different situations are not *just* determined by those respective situations (such as, for example, whether or not one got to play with a puppy) alone; rather, one's reactions also depend to a great extent on the *expectations* one has of the outcomes of such situations—that is, on one's wishes and desires. Thus Harris (1989) concludes that even at about the age of two or three years, if children know that the character of a story desires a particular outcome, they are able to predict whether the story character is happy or sad at the end of the story depending on whether her or his desire was met. For example, if the story was about a child who wanted to play with a puppy, children would be aware that she would be happy if she got to play with a puppy, but sad, if she would not get to play with it (Stein & Levine, 1987).

The growing capacity to understand the dependence of feelings and emotions on inner states has been referred to as the emergence of a "Theory of Mind" (TOM) in children. For example, children of age 3 understand that emotions are related to inner/mental states such as intentions, expectations, desires, and so forth. This is not to imply that they have a full-blown, coherent theory of how the mind functions—certainly, the capacity to relate wishes and desires to how one feels about an outcome does not require an elaborate theory! Harris (1989) proposes that it is more likely that children, who already early on are equipped with a probably innate capacity to respond appropriately to the feelings of others, already have amassed elaborate personal experience with feelings such as joy or disappointment, and they probably are able to build upon their own *intuitive* knowledge of emotions. Thus, given a situation in which they observe a girl who would like to play with a puppy, and learning that she was able to do so, they can imagine how they themselves would feel if they liked puppies and got to play with one. It is hence the ability to draw on this intuitive and personal knowledge and to imagine how one would oneself respond in a given situation that explains how young children can make predictions of how others might experience emotional situations.

Young children face, however, a more difficult task if they are not simply asked if, for example, one is likely to be happy if one desires and obtains a particular result; but, proposes Harris, a much more difficult question arises if children need to set aside *their own desires and preferences* in making decisions about a situation. For example, in the puppy story, children might simply understand the girls' joy because they liked puppies themselves. But what would happen, if they need to judge situations according to the tastes of characters other than themselves?

For this purpose, Harris et al. (1989) told children stories about characters who only liked a certain type of food or drink. They were told about a toy elephant, Ellie, that she likes either only milk to drink but nothing else—or else, that she likes only Coke to drink and nothing else. They then find out about a mischievous Monkey called Mickey who exchanged the contents of the containers; for example, he might pour all the Coke out of the Coke can, fill it up instead with the milk, and then offer the can to Ellie. Children then were asked how Ellie would feel once she drank

from the can. The results of the study showed that 4- and 6-year-old children's predictions were based on what they had been told Ellie would like: if it was milk she liked, they predicted she would be happy; if it was Coke, on the other hand, she would be sad. Hence one can conclude that even children of that age are able to imagine what a person other than themselves would feel—they do so by comparing what they know about the person's desire and the outcome of the situation. That is, they are quite able to take into account differences between themselves and others when it comes to predicting what somebody finds likable.

However, one interesting difference occurred between the 4-year and the 6-year-olds, in that the 6-year-olds were able to also take into consideration not just Ellie's preference for either Coke or milk, but also the likelihood that, upon seeing the Coke can that *unknownst* to her had been replaced with milk, she'd *mistakenly* believed it to contain Coke. Thus, given that Ellie likes milk, she would be disappointed because she assumed she'd find coke in the can instead. When children therefore were asked to predict what Ellie would *expect* what to find in the can, 4-year-olds were not able to correct for Ellie's likely mistaken assumption and predicted that she would expect to find milk "because she likes milk." Six-year-olds, in contrast, predicted Ellie's feelings on the basis of the *apparent* and not necessarily *real* content of the can, e.g., by saying "Cos Ellie doesn't like Coke, etc. (Harris, 1989, p. 72)" Thus, they are able to understand that, to predict another person's emotions, one needs to be able to see the world through that person's eyes. This means that one needs to be able to place themselves in their situation and imagine their inner states—that is in the current case, to assume the mental perspective somebody who was misled and not knowing about it, would be likely to adopt in a particular situation.

The Emergence of "Moral Emotions"—Piaget's View. We already noted that self-consciousness tends to awaken moral feelings, as well. One reason this is so, suggests Piaget, is the gradual development of a complex sense of mutuality and interpersonal dynamics in the child's interaction with others, especially parents. The interactions between parents and child, and the understandings and mutual dependencies they nurture, are the source of a growing sense of "moral" obligation that emerges in children: they begin to comprehend that emotions can have a moral relevance/reference. Nevertheless, they still tend to be confused about the nature of moral standards. Piaget (1981) has extensively discussed the why and how of this emerging moral understanding, citing an extensive body of historical writings on moral consciousness. In particular, he discusses (Piaget, 1981, pp. 53–55) the work of Swiss Psychologist and Psychiatrist Pierre Bovet who proposed that morality inherently springs out of an interpersonal relationship that is directed by respect; this sense of respect in turn creates a felt sense of "obligation" on the part of the child to follow the rules of close adults.

Piaget agrees with Bovet's analysis, but suggests that his hypothesis does not explain the *full* evolution of moral feelings. Rather, he proposes that it explains only a sense of *morality as obedience*—a form of morality he calls *heteronomous* because it is outward oriented towards pleasing others, rather than emerging from inner

standards and hence *autonomous*. The orientation towards and attention to the standards of close others such as parents is, of course, an advance for the young child who begins to orient towards doing things that are socially desirable and avoiding those that are objectionable. But Piaget proposes that a wider and more complex sense of morality ideally, though gradually, is attained at more mature levels; at those levels, morality is more than obedience, or socially desirable responding. Instead it incorporates an understanding of the *normative* nature of moral feelings. This sense of *normativeness* is tied to *mutual respect* of rules, rather than *mere obedience* to them; as a result of such mutuality and respect children acquire a sense of *autonomous morality*, which is based on a deeper understanding and internalization of the binding nature of moral rules. Such autonomy, according to Piaget, is reached only at about the age of 8 years,[2] at the beginning of concrete operations.

Before the age of 8 years, when they still function at the level of pre-operational representations with their intuitive assessments, children do not yet possess a sense of the *normative* nature of moral rules. Instead, a prevalent sense of morality is what Piaget calls "moral realism," a form of morality that implies that the child has internalized norms in a more limited sense, such as knowing what parents expect of him/her. Thus norms could be the result of mere obedience that emerges out of the interactions between the parents and young children—interactions that are highly schematized, just as are those between children and the objects they explore. Piaget suggests that, due to the high significance of parent–child relationships to both, the relationship between parent and young child often creates a kind of *psychological obligation* in the child, a feeling of obedience and respect that is by no means free of conflictual elements, since it includes not only a degree of affection, but also of fear.[3] This is evident in the fact that children often do take not into account that morally objectionable behavior, such as breaking a rule, also must include a *subjective intention* to break a rule. Instead, younger children often judge the severity of a transgression not just be whether it has been intentional by the person engaging in it, but rather by the sheer outcome of the action. If the action (which might even be a lie) results in a positive outcome, it is more likely to be judged good or acceptable; if the outcome of the action is negative, they are more likely to say that the actor is guilty. This is hence a quite self-serving sense of morality that utilizes very concrete criteria of what is or is not moral. Piaget likens this sense of morality to the cognitive limitations typical of this stage of pre-operational representations: that is, "good behavior" is motivated out of the respect and duty, which itself is oriented towards the expectations of others. Piaget calls this aspect of morality "heteronomous" (or other-oriented) morality. This level of moral understanding Piaget terms "intuitive affects"–feelings that constitute merely the beginning or precursor of genuine moral feelings. They do not yet integrate a sense of the normativeness which is inherent in moral behavior, but rather a "non-normative" morality that still lacks a deeply interiorized feeling of

[2] In later chapters we will see that this sense of "autonomous" morality continues to develop well into adulthood.

[3] As pointed out later, the *specific* nature of the child–parent relationship is extremely important in that respect.

and motivation towards *moral righteousness*—a sense including intentions to be moral and just that will emerge only at the next stage of concrete-operational intelligence. As stated by Piaget in Table 4.1, "this next stage of 'normative affects' now is characterized by the appearance autonomous moral feelings with intervention of the will. What is just and what is unjust no longer depend on obedience to a rule (Piaget, 1981, p. 1)."

To examine the understanding of intentionality in transgressions, Piaget studied children's judgments of *lies*. Children were first asked for their definition of lies. They were then given stories that either contained a simple exaggeration, or else a direct intention to deceive. For example, children were presented with the following stories (Piaget, 1981, p. 57):

Story 1. *Returning from school, a young boy tells his mother that he was quizzed and received a good mark when nothing of the sort had happened. His mother rewards him with some chocolate.*

Story 2. *A little boy meets a large dog on his way home from school. When he gets home, he tells his mother he saw a dog as big as a cow.*

At about the age of seven or eight, according to Piaget, children make the correct interpretation of stories of this nature: that is, they show awareness of the *importance of intention* when judging if a given act was moral or immoral. Thus they do take into account that the boy *lied* to the mother about being praised. At the age of two to seven, however, they judge the second story as more serious than the first—asserting, for example, that it is impossible for a dog to be as big as a cow, thus thinking the boy guilty of a major exaggeration. On the other hand, they claim that in the first story, the boy's lie is quite believable, since it *could* have happened that he had received a good mark. Thus the child equates believability of a story with its moral correctness.

In yet another task, children are told a story of a child who touched a pair of scissors his mother had forbidden him to touch. A little later he goes outside and crosses a stream by walking over a plank. Suddenly, the plank gives way and the boy falls into the stream. Asked about why the boy fell, older children will explain that he fell because the plank was rotten and broke. Younger children, in contrast, construe a causal relationship between mother's interdiction and the fall, as shown by the following answers to the question, "why did the boy fall?"

> Because he disobeyed.
> And if he had not disobeyed?
> He would still have fallen.
> then why did he fall?
> Because he disobeyed. Etc. (Piaget, 1981, p. 58).

In these studies, Piaget was primarily interested in how children understand and reason upon certain emotionally relevant situations on moral grounds. His studies suggest that young children's understanding about what constitutes a moral transgression is quite confused—when claiming social believability and probability as the crucial criterion, they remain quite unaware that a particularly important—perhaps *the* crucial—aspect is whether or not an intention to deceive

was involved in the act. The younger children's moral judgments were quite concrete in that they assumed that "bad" actions such as disobedience automatically and almost magically were followed by punishment, as when the boy fell into the stream after disobeying.

Kohlberg's Levels or Morality. In the wake of Piaget's writings on morality, Harvard psychologist Lawrence Kohlberg (1981) conducted an influential project of research and theorizing about moral development in which he and his collaborators refined criteria of moral judgment and formulated levels of lower or higher moral understanding. Kohlberg's interests had been influenced by the climate of the second world war, in which the moral devastation of widespread obedience to National Socialist Rule and its mass murders clearly brought to the fore the danger defining morality as a form of obedience. Kohlberg adopted Piaget's distinction between heteronomous and autonomous morality and was convinced, that a truly mature form of morality would be able to abandon a heteronomous stance and portray indeed a deeply internalized, autonomous stance characterized by a firm "sense of moral righteousness." To assess the understanding of "justice," Kohlberg and his collaborators asked individuals of different ages, how they would act in a particular moral situation termed the Heinz dilemma. The dilemma asks individuals how Heinz should act as he attempts to save his dying wife by buying a drug a druggist has recently discovered, and that doctors thought was the only drug that could save his wife. The drug was very expensive, as the druggist charged ten times the production price. Even though Heinz had been able to amass half of the required sum by borrowing the money, the druggist was not willing to sell it to him for a cheaper price or to let him pay later, but insisted he needed to make money from it. In his desperation, Heinz then breaks into the store to steal the drug to save his wife's life. Individuals then are asked if Heinz should have broken into the laboratory to steal the drug to save his wife's life?

In coding the answers, the *primary* criterion was not whether or not individuals thought Heinz should steal, but rather, individuals were told to also justify *why*, or *why not*. For example, answers that emphasized mere adherence to the rule that one should not steal, and/or that stealing would be bad because one would end up in prison, were considered relatively low, whereas answers that mentioned the moral conflict between the druggists' commercial interests and the value of a human life would have been scored at a higher level of morality. From the answers, Kohlberg's group developed a coding stage of a total of six levels.

Level 1, *Pre-conventional Morality*, is most common in very young children, but not exclusive to them, because it may be displayed by adults, as well. At this level, individuals are oriented towards obedience and avoidance of punishment; they judge whether an action is *good* or *bad* depending upon whether it is likely to be punished or rewarded. Somewhat later, children often adopt rules that satisfy their momentary interest—if an event brings pleasant consequences, it is judged *good*.

At *Level 2*, *Conventional Morality*, individuals begin to understand that the moral value of an action depends on the general perspective of society—one tries to live up to society's conventions and rules, with the hope that in this way one is more

likely to gain respect and acceptance. Others now are more likely to be judged in terms of their intentions. Towards the end of this stage, individuals become less dependent on direct approval, but display a heightened sense on the importance of maintaining *law and order* and upholding common laws and values in the sense of maintaining social order.

At Level 3, Post-conventional morality, individuals are less dependent on concrete rules, but begin to reflect on more abstract moral and ethical that should guide societal and human functioning. Rights and values are defined by a "social contract" which serves to promote general welfare of all, and laws are valid only to the extent that they fulfill this purpose. Compromise and democratic decisions are accepted as a necessary way of life. Some individuals of this level may further proceed to searching for universal ethical principles that link moral reasoning to religious principles and values.

Kohlberg was particularly interested in moral justice as a criterion of morality, and proposed that the notion of justice changed not only throughout childhood, but in fact throughout the total of the life span. For this purpose, a large study was conducted that examined the presence of levels from the age of 10 years on to adulthood (36 years) (Colby, Kohlberg, Gibbs, & Lieberman, 1983). Results showed that higher levels were quite systematically related to increasing age, but lower levels decreased as age increased. Among individuals coded as pre-conventional, 26 % of the 10-year-olds were coded as occupying Stage 1, compared with 60 % at Stage 2. Pre-conventional moral reasoning declined to 0 % by age 16–18, while Stage 2 reasoning was about at 0 % or very close by age 30 and higher; simultaneously, and in a complementary fashion, the percentage of moral reasoning at the conventional level systematically increased from about near 0 % at age 10 to about 60 % at the 24–26 age level, and reached somewhat over 60 % for 36-year-olds. Individuals coded at the post-conventional level were very rare; even though, reasoning began to increase from the ages of 16–18 on and reached between about 7 and 10 % for individuals aged 24–36. In general, then, the distribution showed the expected order with a decrease in low-level thinking and an increase in higher-level moral thinking with increasing age. Interestingly, however, there were no large differences among people who came from high versus low socioeconomic/educational background.

The Nature of Moral Emotions. Understanding individuals' morality is important, of course, to understanding moral emotions and how they function. But what exactly *is* the nature of moral emotions?! This rarely stated question has recently been raised by Jonathan Haidt (2003), who noted that the work of Piaget and that of Kohlberg (1969) did not really address the nature of the *emotions* related to moral issues per se—even though it *did* highlight the nature of the understanding morality. It might have been interesting to know what the children in Piaget's research thought had moved the boy to say he had seen a dog as big as a cow, or why the child who claimed the boy who had disobeyed would fall into the river, even though his transgression and a rotten blank breaking were unrelated events!

Haidt suggests that when referring to moral emotions, we follow the proposals of philosophers (Gewirth, 1984; Hare, 1981) who, like Piaget, pointed out that moral

statements make claims to universality and normative, prescriptive significance, and that these criteria override sheer expedience (as in the case of Piaget's example offered above). Thus he offers a definition of moral emotions as "those that are linked to the interests or welfare either of society as a whole or at least of persons other than the judge or agent" (Haidt, 2003, p. 853).

Haidt goes on to propose that to define moral emotions, it is useful to point out two component features of all emotions—in particular, first, the events eliciting them and the physiological reactions associated with an emotion, and second, the motivation or action tendency arise from them. He further suggests that the two most important prototypical features of moral emotions are that (1) they are based on *disinterested elicitors*, and that (2) they are evident in *prosocial action tendencies*. These criteria imply that emotions can be called moral, if they are *not* elicited and motivated by self-interest—that is, *not* because good or bad things happen to the self—but rather by an interest in the welfare of *others*, or even society as a whole.

Haidt proposes to define different classes of moral emotions that meet these criteria. The first criterion of *disinterested elicitors* implies that the emotion elicited by, for example anger, is not primarily in the service of the self, but in that of others—that is, they are due to events that happen to *another* person. The anger could arise because the person is somebody the self is related to; often, however, anger can be elicited by witnessing an event involving injustice and/or suffering experienced by a person other than the self.

The second criterion of *prosocial action tendencies* states that the action tendencies associated with a moral emotion are directed towards goals, such as affiliation, or comforting. This does not necessarily imply, however, that the emotions aroused necessarily are "good" or "nice" emotions, since even emotions considered as very negative, such as *anger* and even *revenge*—can result in actions that benefit others in that they are directed at benefiting others, or the social order, more generally. In that sense, so-called negative emotions can be placed in the service of supporting justice, as when we speak of a "moral anger."

In a way, Haidt hence proposes that it is not, or not *just*, the complexity of emotional understanding that defines moral emotions, but rather, that they have an inherent moral and prosocial aspect in their orientations and goal. We will, in the sequel of this chapter, comment on developmental aspects of different emotions, and pay particular attention to one specific prosocial emotion, empathy throughout childhood.

As far as specific prosocial or moral emotions are concerned, Haidt proposes to classify them into various groups or "emotion families," as detailed next. In the first class of the *Other-Condemning Emotions*, Haidt lists the emotions of *Contempt*, *Anger*, *and Disgust*. Although *Anger* is not usually valued as a moral emotion, it nevertheless can lead to moral behavior, as when one responds with anger to unjustified insults to self or other—*a moral anger*! *Contempt* and *disgust* responses indicate that one is strongly repelled by physical objects, but by social violation, as well. Tomkins (1962), following Darwin, noted that disgust typically is associated with the facial response of raising up one's nose and opening the mouth as if expelling an unwanted, noxious substance. In turn, the emotion of contempt is often thought to

be related to the anger family, although it shares associations and facial expressions with disgust (Ekman & Friesen, 1975) (see Fig. 1.1 for demonstrations of elements of such Responses in infants.)

Second, among the *Self-Conscious Emotions*, Haidt (like Lewis, 2002) lists the emotions of *Shame*, *Embarrassment*, *and Guilt*. In general, these emotions are associated with events in which the individual feels exposed and even humiliated, and accompanied by painful feelings indicated by gaze aversion and hiding in the case of Embarrassment, and even extreme signs of distress such as fear and postural collapse in the case of shame. Most often, these emotions are related to the awareness of having engaged in, or fear of being accused of, some transgression.

The third group of emotions proposed by Haidt is that of the *Other-Suffering Family*, because it comprises emotions that reflect the distress at another person's misfortune and distress, or sympathy and compassion at seeing or hearing another individual in distress. Most generally, this emotion is referred to as *empathy.* This emotion occupies an important role not only in developmental studies, but also in religious approaches to morality; we will conclude this chapter with a synopsis of its developmental course in childhood and continue to follow its evolution throughout later stages of the life span in later chapters.

The final family of emotions proposed by Haidt is the *Other-Praising Family.* Here Haidt mentions emotions that are aroused by the admiration of other extraordinary human beings; the core of such emotions is the expression of the positive valuation of awe and wonder at in the presence of the beauty of art or nature, as well as the awe and admiration at extraordinary human actions and abilities—as, for example, those of Mahatma Gandhi or Nelson Mandela. A more ordinary other-praising emotion is that of gratitude, an emotion little studied but important in religious traditions such as, for example, Christianity and Buddhism, as well as other spiritual traditions.

Haidt's proposal of these emotion families is important and refreshing, not only in clarifying in what ways the various emotions express moral motivations, but also in opening up a new way of describing emotions and to study from childhood onward throughout subsequent stages of life—a way that defines emotions not simply as "positive" or "negative," but that adds the crucial question whether particular feelings and/or actions are motivated, even intended, by a moral evaluation of the emotions and actions concerned.

The Development of Empathy, *a Key Emotional System.* As to their developmental course, Haidt proposes, consistent with the theme of this book, that moral emotions do not emerge full blown, but derive from simple precursors that are not generally accepted as "moral" emotions. Probably the best studied thus far of the moral emotions is that of empathy, an emotion that has been researched intensively from early childhood well into adulthood, and that is important in humans and animals alike.

It was once again Darwin (1872) who first proposed that highly automated emotion forms that recognize the states of others as different from the self are already present at birth. For example, he commented on what seemed to him such an *instinctual* form of empathy in his infant son:

> When a few days over 6 months old, his nurse pretended to cry, and l saw that his face instantly assumed a melancholy expression, with the Corners of the mouth strongly

> depressed; now this child could rarely have seen any other child crying, and never a grown-up person crying, and l should doubt whether at so early an age he could have reasoned on the subject. Therefore it seems to me that an innate feeling must have told him that the pretended crying of his nurse expressed grief; and this through the instinct of sympathy excited grief in him (Darwin, 1872/1998, p. 359).

In contrast to this view of the instinctual nature of the recognition of others' emotions, developmental psychologists have often emphasized the essential cognitive nature of complex moral emotions (see Harris, 1989; Labouvie-Vief et al., 1989). Recent proposals from neuroscience (Decety & Jackson, 2004; Singer, 2006) and primatology (Preston & de Waal, 2002) confirm the Darwinian claim of a continuity among simpler and perhaps innate forms of recognizing emotions to more complex forms. At the same time, they add specific proposals of how eventually, the innate precursors yield the mature and complex forms that can characterize humans.

According to Decety and his collaborators (e.g., Decety & Jackson, 2004; Decety & Meyer, 2008) the development of emotions proceeds in terms of two component processes that highlight two classes of abilities: one of those reflects the inborn tendency to resonate automatically with the emotional state of another, prior to any cognitive understanding. This ability, which reflects a form of "emotional contagion" and constitutes a precursor for developing more explicit and shared emotional meanings. The ability for explicit and shared emotional understanding results from cognitive elaboration and representation of one's own and others' subjective feelings (Decety & Meyer, 2008). This more advanced ability emerges from a clear distinction between the feelings of self and others—a cognitive advancement that permits responding with sympathy and compassion or empathic concern to the other's distress, rather than simply experiencing emotional contagion.

The important differentiation of self and other in empathy also defines the core strategy by which empathy is measured in research studies. One frequently used design is to present research participants images or videos that present a person in a situation likely to evoke pain, such as a door or drawer shutting closed on a foot or hand. Research participants are instructed to either imagine how the other person would feel in that situation (other perspective), or how one would feel oneself in that situation (self perspective). The assumption is that the self-perspective automatically elicits activation in areas of the brain, such as the somatosensory cortex, that are related to pain perception; in contrast, the other perspective is related to lower activation of the somatosensory cortex, but greater activation of areas, such as the prefrontal cortex, that are related to cognitive control (Lamm, Batson, & Decety, 2007; Lamm, Porges, Cacioppo, & Decety, 2008). When examining pain stimuli, it was further found that pain judgments had longer latencies in the other than in the self-perspective, suggesting that the distinction between self and other involved less automaticity and instead increased the cost or effort involved in the decision (Jackson, Brunet, Meltzoff, & Decety, 2006).

The studies on the two component model of empathy thus confirm that genuine empathy constitutes a cognitively more demanding response than feeling overwhelmed with sadness when seeing another sad person. Rather, genuine empathy requires that the observer is able to differentiate between his or her own response to the distress of another, rather than being him-or-herself distressed. Yet this capacity for

empathic distress develops gradually, according to Hoffman (2000). For example, newborns aged 2–3 days, when hearing another baby cry in the nursery ward themselves being to cry—a response of emotional contagion referred to as *reactive crying* of newborns. By contrast, towards the end of the first year react less passively and instead attempt to engage in self-comforting activities, a form of *egocentric empathic distress*. By the beginning of their second year, however, the distress of the observing babies is less likely to result in empathetic crying and fearful looks and instead show attempts to make physical contact with the crying baby.

A real form of empathy appears when, in about the middle of the second year, the young child begins to show self-awareness by recognizing self in the mirror and understanding that much as he or she is able to observe others, so they also can observe him or her. The child hence begins to understand that others also have inner states which, further, can differentiate from those one has oneself. Finally, proposes Hoffman, children yet older, as well as adults can begin to feel empathy even for a person they do not know personally, but of whom they know that they experience difficult situations of living.

How sensitive young children can be to others was shown in a study by Warneken, Hare, Melis, Hanus, and Tomasello (2006)[4] in which young children about 18 months of age, as well as chimpanzees, observed the behavior of an adult experimenter who clumsily tried to complete different tasks.[5] For example, he tried to pick up a marker but could not reach it. In a second task that required that he put some magazines into a cabinet, he kept bumping into the cabinet. Next he purposely slipped a book of a stack by placing it next to the stack, unaware that finally, as a spoon dropped through a hole in a box, he tried to retrieve it through a small hole, unaware that there was a flap on the side of the box. Results showed that the children carefully observed the experimenter, quickly understood his predicaments, and immediately came to his aid—usually, with what seemed to be a display of pride at their own savviness. Overall, the children came to the aid of the experimenter in 6 out of 10 situations; 22 of the 24 children came to his aid in at least one situation, and 84 % of the helpful acts were offered immediately and spontaneously.

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[4] The experimental setup and the children's astonishingly competent responses can be watched by turning to youTube and entering "Heineken Prizes—Professor Michael Tomasello".

[5] The addition of chimpanzees may seem a surprising research choice—but it was motivated by a great scientific interest in the evolution and development of empathy and confirmed that chimpanzees, too, are endowed with it.

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Chapter 6
Cognitive–Emotional Development from Adolescence to Adulthood

During and after late childhood, rapid development of cortical structures brings increasing powers of thinking. How do these increases relate to emotional development in adolescence, and how do the gains achieved in adolescence affect further development beyond adolescence? This chapter begins by summarizing advances in cognitive development as shown in Piaget's views on adolescent thinking and emotion, as well as touching upon neurobiological advances in the cognitive and emotional systems and their relationship. We go on to discuss how these advances are carried further in adulthood. In this extension we note that Piaget's theory of development proved limited for an account beyond childhood and adolescence, because he had relied strongly on a very rational and even idealized view of adolescent thinking and emotion. He did not fully elaborate how and whether these gains in thinking continued into more mature or even late adulthood, nor did he offer an account of how adolescents did or did not succeed in creating a well-integrated relationship among cognitive and emotional components. As a result, the early 1980s brought several reformulations and extensions of Piaget's views on the cognitive–emotional development of adolescents.; these extensions proposed that integration of cognition and emotion—and hence, healthy continued emotional maturation—required, that the cognitive system become more flexible and move beyond the still quite rigid rule-based thinking typical of adolescents. We will review this literature and discuss how gradually emerging integration prepares youth for more flexible emotional understanding that reaches its heights only in mature adulthood.

6.1 Piaget on Adolescence and Formal Operations: "Thinking Takes Wings"

Piaget's theory of cognitive development proposed that the fifth stage of cognitive development, concrete operations, was followed by a sixth stage of cognition. He termed this stage "Formal operations," and suggested that it begins to emerge

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at about the age of 11–12 years, but that is not completely realized until the age of 14 or 15.

Formal thinking goes beyond concrete operations in that preadolescents and adolescents can begin to master not just concrete facts and relationships, but can begin to think about abstract matters—that is, they can reason upon, and eventually master, matters that are not part of their concrete experience, but that are purely hypothetical and theoretical. Take, for example, a syllogism,[1] such as "All Men are human; all Humans are mortal; therefore, all Men are mortal." Such a logical argument requires that from the two premises, a conclusion can be derived on a merely logical basis, whether or not one has personal experience with such statements.

Piaget's use of the term "Formal Operations" refers to the emerging capacity to consider statements for their purely logical structure, and derive consequences in that way. The concrete meaning of the statements is not so much at issue, but rather whether the conclusions follow from the premises in a logically consistent and correct manner. Hence Piaget defines formal operations as "thought employing the logic of propositions freed from their content (Piaget, 1981, p. 149)." This is to say that adolescents no longer depend, or do so less, on concrete contents as do children of concrete operations, but can begin to work with pure hypotheses and abstractions. This intellectual feat permits the young person to operate in a world of sheer possibility, rather than referring back to reality. The result is a high degree of flexibility that implies that youth are no longer embedded in their concrete personal viewpoints, but can contemplate abstract concepts from multiple perspectives: they can comprehend new possibilities and multiple viewpoints that permit problems to be examined in purely abstract, formal ways for their logical coherence, as one finds, for example, in pure mathematics or other scientific fields that require that one can understand abstract propositions that deal with purely formal matters. Since adolescents can begin to deal with purely formal matters without reference to concrete content, Piaget states that "This makes reflection in the strict sense possible; it allows thought to turn upon itself. In other words, formal operations make it possible for a person to think about what and how he thinks (Piaget, 1981, p. 69)." Thus thinking is primarily about the logic of abstract relations among concepts, and not about the contents these relationships are about, nor the contexts out of which they arise (Labouvie-Vief, 1980, 1982).

Neuroscientific studies concur with Piaget's notion of the growth of adolescent thinking in that adolescence indeed is a period of vigorous growth of the brain. In a study by Giedd et al. (1999), the authors performed a longitudinal MRI study of brain growth involving children and youth ranging in age from 4.2 to 21.6 years. Results showed that the volume of white matter increased in a linear fashion with age from 4 to 22 years, with a total increase of 12.4 %; increases were somewhat smaller in females than in males. Cortical grey matter increased in a nonlinear fashion during preadolescence, with a maximum size achieved for males at 12.1 and for females at 11.0 years of age—a difference possibly due to the earlier onset of puberty in girls; during post-adolescence, this increase was followed by a decline that resulted in a net decrease across the age span studied. The authors note that it is

[1] A syllogism is a formal argument in logic that is formed by two statements and a conclusion which must be true if the two statements are true (Merriam Webster).

not known clearly at present if the increases in grey matter were due to neuronal size or to dendritic or axonal arborization, a question to be addressed in further studies. Possibly increases are related "to a second wave of synapse overproduction and indicate a critical stage of development when the environment or activities of the teenager may guide selective synapse elimination during adolescence (p. 863)."

6.2 Limits of Adolescent Thought

The notion, however, that solutions to problems can be generated purely from a logical calculus, without any attention to the content one attempts to formalize, or the context to which it applies, is quite problematic. We already referred in Chap. 6 to the spurts in understanding reality when children become self-aware and understand their own role in social discourse. We already referred, as well (see Chap. 3) to the emergence of new theorems during past century—theorems that state that no logical system can prove its own validity, coherence, and truth-value from *within* itself. This is because simple logical systems per se emphasize purely mechanical execution of certain rules of thinking, but do not leave room for the fact that logic is also a *personal activity* that, moreover, always takes place in a certain context. Even logic can never be performed merely in the pure abstract, because as a human activity, even logical conclusions are part of intellectual activity that takes place in, and is influenced by, a historical and cultural and interpersonal context; in abstracting from these social and cultural dimensions, logic aims at dispensing of subjectivity, interpersonal life, imagination, and creativity (Blasi & Hoeffel, 1974; MacMurray, 1978). In fact, it aims exactly at avoiding uncertainty, and in so doing, is forced to discard important problems in order to maintain a consistent method. As a consequence, it does not account for the recognition and understanding of the self with its predilections and biases, hopes and wishes, and emotional life (Blasi & Hoeffel, 1974; Labouvie-Vief, 1980, 1982, 1984, 1996). To be sure, in a simple syllogism problem that excludes these aspects, individuals may well be able to provide a logically correct answer—but then, according to the limitative theorems (DeLong, 1970), such answers will be extremely limited in their interpretive range. The focus is on complete certainty of answers. Or, as Macmurray (1978) remarks, "the logical empiricists are content to elaborate the subtleties of formal analysis—and often with be beauty of genius; so far as the substantial problems go, they use their formalism to erect notices on every path which say 'No road this way!' (p. 27)"

In contrast to such stringent formalism, the theorems already discussed suggested that richer statements about truth and reality are possible if one does not merely bet on certain and infallible (but inconsequential) answers, but if one lets uncertainty enter into one's search for truth. In fact, it is exactly this leap from giving up (imagined) certainty to admitting uncertainty into one's thinking that provides the very mechanism by which development proceeds; (see Chap. 5 for discussion). Such leaps into a state of uncertainty are widely associated with the potential to eventually move towards higher and more complex forms of understanding. This is possible once adolescents begin to understand that logical conclusions are not

merely mechanical and impersonal, but they take place in interpersonal, social settings, in which all the (nonlogical) rules of social discourse, varying personal histories, and pragmatic rules of behavior must be taken into account.

Piaget asserted the importance of a tie between "pure logic" and a pragmatic (e.g., experimental) context in his book, "Insights and Illusions of Philosophy" (Piaget, 1967). He suggested, for example, that in scientific discourses, one first tends to propose a purely deductive, internally consistent, logic—but that his logic needs to be related to a pragmatic context. This is true for two reasons:

> … The first of these is that if the norms, the antecedents and consequents, of an argument, implications, etc., can be directly grasped by the mind that can analyze them in manipulating them, an experimental fact necessitates, on the contrary, the isolation of factors that cannot be obtained deductively and presupposes an controlled experiment, in contrast to the brute facts of experience, which are invariably misleading … . Contrary to commonsense opinion, it is hence much more difficult to verify facts and to analyze them than to reflect or perform deductions. This is why the experimental sciences originate long after the deductive disciplines, the latter forming both the framework and the necessary conditions of the former, but not the sufficient (Piaget, 1971, pp. 70–71).

In fact, Piaget here suggests that logical argument requires empirical validation—if it did not, it would be impossible to draw limits between a brilliant scientific theory and a brilliant delusional system. Not drawing these limits is, in effect, a problem for the thinking of adolescents:

> with hypothetico-deductive operations, by a system of all combinations of propositions, a formal logic can emerge in the form of an organizing structure applicable to any content whatever. This is what makes possible the constitution of "pure" mathematics as a construction of forms of organization, ready to organize everything, but from time to time organizing nothing, insofar as it becomes dissociated from its application! (Piaget, 1971, p. 358; emphasis added).

Here Piaget suggests, then, that the budding new capacity reflects a new power that, however, can be both used and abused:

> with the advent of formal intelligence, thinking takes wings, and it is not surprising that at first this unexpected power is both used and abused … each new mental ability start off by incorporating the world in a process of egocentric assimilation. Only later does it attain equilibrium through a compensating accommodation to reality … Adolescent egocentrism is manifested by a belief in the omnipotence of reflection, as though the world should submit itself to idealistic schemes rather than to systems of reality. It is the metaphysical age par excellence, the self is strong enough to reconstruct and big enough to incorporate it. … Then, the metaphysical egocentrism of the adolescent is gradually lessened as a reconciliation between formal thought and reality is effected. Equilibrium is attained when the adolescent understands that the proper function of reflection is not to contradict but to predict and interpret experience (Piaget, 1967, pp. 63–64).

6.3 Integrating Cognition and Emotion in Adolescence

But how do adolescents become able to integrate aspects of pragmatic limitations ("reality") with their comprehension of and penchant for "pure logic"? This question was addressed in a study by the author and her students (Adams, Labouvie-Vief,

Hakim-Larson, DeVoe, & Hayden, 1988), with the aim of finding out when individuals were able to take account of pragmatic questions of reasoning while utilizing a logically structured argument. For that purpose, we presented preadolescents, adolescents, and adults with a brief written, fictive script about John, who tends to drink heavily. His wife Mary warns him that, if he comes home drunk *one more time*, she will leave him and take the children. The participants then are told that John indeed came home drunk one more time, and asked what they thought would happen next: would Mary leave John?

The preadolescents and adolescents in that study responded from a purely logical perspective. They had no awareness that one's answer to the problem depends on how one interprets it. Rather, they affirmed that Mary would leave John and justified their answers by saying "because it says so right here!"—even pointing to what they had read and perplexed that the investigators did not seem to comprehend! (Labouvie-Vief, 1984, p. 190)

In contrast to this purely formalistic answer that did not take into account whatever might have been the possible motivations that led Mary to make the threat, somewhat older adolescents realized that one's interpretation entered into the problem solution. For example, they wondered if Mary, in her state of frustration, was in the habit of making empty threats, or if she was likely to back up on her threats? However, they had difficulty providing an integrative answer in which both the logical argument and one's own interpretation of Mary's conflict entered into the solution. Nevertheless, they were aware that different answers could result, depending on whether one used an approach they termed "logical," "objective," or "rational," as opposed to one they termed "subjective," "emotional," or a matter of "opinion."

In some individuals, this antagonism between logic and subjective elements gave rise to an inner struggle, as in the answer of a man in his 30s: "The key is 'one more time.' Mary's simple statement—if she meant it—is weighted off of John's drunkenness. The logic is clear, clean—if you choose to ignore human dimensions. If A happens, then B will result—again, when my creative urge is not suppressed, I can misfire, hear what I want, distort the story, and place a wrong answer, firmly convinced that I am correct (Labouvie-Vief, 1984, p. 191)."

A few individuals, however, were able to give up this dualistic reasoning that alternated between relying on one's knowledge of logic as compared to and one's personal interpretations; these individuals affirmed that, to solve problems, one had to rely on an integration of both "objective" and "subjective" elements. Indeed, individuals began to understand that by shunning the "subjective," it becomes impossible, too, to claim objectivity, since objectivity requires that we take into account our own subjectivity and that of others, as well. "It is this knowing—that objectivity is not something contrasting subjectivity, but consists of the way in we are aware of and express our subjectivity … ultimately, we realize that objectivity is a way in which we coordinate and integrate our own and others' subjectivities, following particular methods and disciplines in doing so (Labouvie-Vief, 1994, p. 191)."

6.4 Threats to Adolescent Development

Piaget's earlier cited comment on adolescent "misuses" of logic is echoed in a more recent article by Laurence Steinberg (2005) (see Table 6.1). Steinberg notes that adolescents' lack of being able to integrate advances in thinking with everyday aspects of reality renders adolescence a vulnerable period of development, with many threats to adjustment. Despite enormous gains in logical reasoning, adolescents exhibit pronounced failures of judgment and decision making in important real-life issues. Of great importance in that respect is the fact that adolescence not only brings surges in brain and cognitive development; at the same time, it is also a time of rapid development of other biological systems, including hormonal systems related to puberty, that profoundly affect emotional processes. Steinberg proposed, indeed, that these changes "precede the development of important self-regulation capacities in a manner that creates a disjunction between the adolescent's affective experience and his or her ability to regulate arousal and motivation (Steinberg, 2005, p. 79)." In support of this conclusion, he cites a number of studies that show that, much as adolescents are capable of high levels of performance in hypothetical and formal-logical problems, this capacity for logical conclusions does not necessarily carry positive implications for their behavior in social contexts in which reasoning is called for. This is evident from studies that show that (a) adolescents thinking about moral problems is more advanced if these problems are hypothetical than if they are real, or if they deal not with general ethical problems, but with their own subjective preferences (Klaczynski, 1997; Klaczynki & Gordon, 1996; Wainryb et al. 2001). At the same time, adolescents as a group show increases in sensation-seeking, risk-taking, and reckless behavior (Schulenberg & Zarrett, 2006); this may be in spite of the fact, that their penchant for high risk is not due to lack of comprehension of the dangers of risky behaviors such as, among others, engaging in dangerous activities, drug use, and unprotected sex (Kuther & Higgins-D'Allessandro, 2001).

The notion that adolescence is a period of potential crisis was also proposed by Erik Erikson (1968), who held that a crucial task of adolescence of developing a sense of his or her identity. Erikson associated several accomplishments with such

Table 6.1 It has been speculated that the impact of puberty on arousal and motivation occurs before the maturation of the frontal lobes is complete

Early adolescence	Middle adolescence	Late adolescence
Puberty heightens emotional arousability, sensation-seeking, reward orientation	Period heightened vulnerability to risk-taking and problems in regulation of affect and behavior	Maturation of frontal lobes facilitates regulatory competence

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This gap may create a period of heightened vulnerability to problems in the regulation of affect and behavior, which might help to explain the increased potential in adolescence for sir-taking, recklessness, and the onset of emotional and behavioral problems

achievement: first, the young person should achieve a conscious sense of being a separate and unique being that (2) experiences a sense of sameness and continuity over time, and as a result can (3) attain a sense of deep sense of "inner solidarity" with his own self-definition, and the ideals of a group that affirms in turn the person's own identity (Erikson, 1968, pp. 89, 102).

The achievement of such an integration is no easy task to do for many adolescents, as demonstrated by a plethora of studies noting the risks and mental health problems of adolescents. For example, a study based on nationally representative panel data from the Monitoring the Future Study (Johnston & Bachman, Schulenberg, 2004) indicated that in the general population, mental health improved and problem behaviors subsided. However, the incidence of psychopathology increased: Major depressive disorders, schizophrenia, bipolar disorder, and borderline personality typically manifest during late adolescence and early adulthood (Cicchetti & Rogosch, 2002; Walker, 1994; Trull, 2001. This is not surprising in light of the fact that the period of adolescence brings a series of profound changes and transformations: identity, independence, transitions in parental, peer, and romantic involvements, transitions from school to work (Keating, 2004; Masten et al., 1999), transitions in school (Keating, 2004) and required movement towards self-reliance and financial independence (Arnett, 2004), as well as already noted changes in prefrontal cortex and expansion of executive functioning (Giedd et al., 1999; Keating, 2004) all combine to take their toll on adolescent mental health.

6.5 Depression and Gender

One toll of the stresses discussed is the rise in pathologies such as depression. While in prepubertal children, depression is relatively low and equal in boys and girls, in early adolescence, it begins to increase, and differences among girls and boys rise, to a 2:1 ratio (Nolen-Hoeksema, 1990; Reinherz et al., 1999). Why would there emerge such a preponderance of depression in girls as opposed to boys? There has been considerable discussion of the gender gap in depression over the last 20 years of so, and one emerging proposal is that the gap reflects societies' gendering of the capacities of boys and men versus girls and women (Labouvie-Vief, 1984). Whereas in boys and men, capacities of excellence, agency, and competitiveness are considered desirable, in women they often have been derogated as inappropriate and shrill displays of "anger" or "egotism" (Heilbrun, 1988). For example, Freud held that over the course of development, the roles of girls and boys became polarized, calling forth differentiation of gender roles through defensive processes: the boy needed to define himself against the "feminine" in a superior and externalizing-contemptuous attitude, while girl, having no such externalizing option, had to identify herself with this inferior position and surrendering and "active orientation"). Somewhat earlier, Thorndike (1910) had pronounced that, since most of the world's great accomplishments in science, art, and other extraordinary accomplishments had been achieved by men, men were more deserving of leadership and eminence than women.

The derogation of women and denial of their powers of intelligence and agency began to change with the participation of women in academic activities, and one of Thorndike's students, Leta Hollingworth (1926) began to critique Thorndike's conclusions. Thorndike had claimed that among retarded men and women, it was the women who were worse off, but Hollingworth demonstrated that there were actually no differences among their test scores. Instead, she claimed, the causes were social, since retardation in boys and men was recognized and treated with institutionalization early in their life span, whereas the girls were more likely to be kept home to help with child care and household chores. Thus she claimed that it was not gender per se, but social customs and values about gender that were at the base of many observed differences in boys and girls. their test who were due to and boys needed to defensively define themselves women in a superior and externalizing attitude a (1923/1963) and Thorndike (1910): role of women and research on gifted girls, women of creative potential had difficulty.

The debate about the respective capacities of men and women created a storm of Responses by women writers who, often speaking from their own experience, pointed out that creativity and agency became an enormous problem to young women who did not feel the nurturing affirmation nor encouragement to pursue their own dreams of excellence; instead, they learned to fear their self-identification as creative, experiencing itself as something dangerous, something outside the self against which the self needs to defend herself. For example, the poem "Storm" by Adrienne Rich (1969), the self emerges as a dangerous storm—a metaphor for a woman's creative strivings that she cannot repress, yet that continually threatens to surface. Similarly Heilbrun (1988) that many highly creative and powerful women, including Emma Goldman, Eleanor Roosevelt, and Golda Meir never spoke about their important accomplishments in their own autobiographical narratives.

Similarly astonishing conflicts about their achievement were also documented in a famous study by Terman and Oden (1925) of the "mental and physical traits of a thousand gifted children." Although when they were children, the group showed but small differences, as they grew into adolescence, a rather decline in IQ scores was observed for the girls. Kerr (1987), in a recent study of giftedness, suggests that girls begin to engage in a paradoxical denial of their own giftedness which, unlike for boys, is difficult and threatening for them to accept in themselves—indeed, suggests Kerr, becomes for them a source of denial and shame.

We noted earlier that Erikson emphasized that one component of positive identity development is the presence of an affirming social–cultural context, but if culture fails at such strong affirmation, the formation of a strong and secure identity is likely to go astray and undermine the potential for positive development.

In sum, taking together the above analyses by Piaget, Steinberg, and Labouvie-Vief, and others, it is fair to conclude that, from the perspective of integrating cognition and emotion, adolescence is a particularly difficult period, fraught with new emotions that often overpower their capacity for clear and logical thinking. It is with continuing experience and further maturation of the prefrontal cortex that an integration of cognition and emotion can gradually emerge and move the adolescents of adult maturity. But it is similarly important that cultural contexts be provided that affirm for each gender a core of identity that is coherent with their capacities and potentials.

6.6 Beyond Formal Operations: The Integration of Emotion and Cognition in Adolescence and Adulthood

As the previous discussion testifies, Piaget's proposals about the virtues of adolescent logic came more and more under criticisms. These criticisms arose not just as a result of Piaget's neglect to include adolescents' awareness or non-awareness of their own self and subjectivities in their reasoning; an additional criticism was raised by researchers interested in movements beyond adolescence and into the adult period (Labouvie-Vief, 1980). Piaget's theory proposed Formal Operations to be a kind of penultimate stage of intellectual development, and consequently did not propose further evolutions that reached well into adulthood and even later life. The result was, that some phenomena of adulthood were difficult to interpret as important new developmental accomplishments of mature individuals, but rather often were overladen with connotations of deficit and regression (Labouvie-Vief, 1982).

These various anomalies began to draw the attention of a considerable number of researchers who not only re-examined some of Piaget's claims about adolescent intelligence, but proposed further developmental movements that reached well beyond formal operations. These various proposals resulted, in 1982, in these individuals meeting in a conference at Harvard University, with the aim of proposing extensions of developmental processes into adulthood. The conference was organized by Michael Commons, Francis Richards, and Cheryl Armon, and included some 19 experts in developmental psychology who proposed models of "post-formal development." These contributions were published in a volume entitled "Beyond Formal Operations: Late Adolescent and Adult Cognitive Development" (Commons, Richards, & Armon, 1984).

The chapters of "Beyond Formal Operations" join in each proposing critique of Piaget's interpretation of adolescent and adult cognition. The general and shared aim of the authors is not only to offer criticisms however, but to propose outlines for solutions consisting in revising various aspects of Piagetian theory. The common interest is to point out ways of dealing with the considerable potential for development after Piaget's Formal Operations, and the general conclusion from these various contributions is that there is a great deal of important developmental potential for further expansions of cognition and reasoning, and that this potential begs to be included into further elaborations of descriptions of cognitive development along the total of the life span—hence the term, "post-formal development."

In introducing the book, Commons et al. (1984) proposes that the extensions are of essentially two kinds. Some authors present examples of advanced thinking already established in other contexts, such as the dialectical tradition (Basseches, 1984), Philosophy of Science (Labouvie-Vief, 1984; Linn & Siegel, 1984), relativity theory (Sinnott, 1984), or Moral Philosophy (Armon, 1984). Other methods of extension are based on careful analyses of the nature of the developmental process. For example, Piaget held the concept of "equilibrium" as a paramount process pervading the process of development, with its alteration between periods of calm, integration, and equilibrium, followed by periods of transition in which the system structure opened to accept doubt and tension that eventually become resolved in

new equilibria (see Chap. 4); these more powerful equilibria are based on integrations of higher power than those existing at earlier levels. Hence although all of the authors addressing post-formal development come from somewhat different perspectives, all of them propose that the various approaches, in combination, offer a more comprehensive account of the full span of development.

For the purposes of the present book, we will look at the proposal of Labouvie-Vief (1984). In her contribution to the book, as well as a number of publications preceding it, (e.g., Labouvie-Vief, 1980, 1982, 1984), Labouvie-Vief proposes a series of four levels from *pre-formal*, or *pre-systemic thinking* to *post-formal thinking*; these various levels cover formal-logical thinking and advances beyond it.

The first, or *pre-systemic level*, shares similarities with Piaget's stage of sensorimotor intelligence as discussed in Chap. 5 and Table 5.1. At this level, "hereditary organizations" with their automatic processes predominate. During this period, early automatic processes become transformed as children develop habits and differentiated perceptions and expectations; these further ripen into preoperational representations with their internalization of action, to early concrete operations related to classes and relations. From there on, representations of emotion become more differentiated and complex.

Labouvie-Vief's Research group proposed a series of levels that reflected movement into more complex representations of emotion. These levels are presented in Fig. 6.1 later in this chapter. The first quite systematic level is the *intrasystemic level*. It corresponds to the structure of formal-logical calculus, in which adolescents believe truth is defined by a polarization between logical correctness and subjective judgment; subjectivity is to be avoided in the erroneous assumption that objectivity can be reached in this manner.

Eventually, however, youth become aware of the polarization of objective truth versus subjectivity. This realization causes a decline of logical absolutism and a move to *logical relativism* (Sinnott, 1984). At this point, adolescents realize that subjectivity does enter into logical conclusions in the awareness that what is considered logical depends on the assumptions one brings to the problem.

Labouvie-Vief's (1982, 1984) theory assumes that once formal structures are solidified in late adolescence, adolescents enter the next, intersystemic level. At this juncture, one realizes that truth is relative rather than absolute. This can create a state of high incertainty, a kind of "existential vertigo" or "epistemological loneliness" from which youth may attempt to retreat by creating apparent islands of emotional safety: sensing a loss of logical certainty, they may search certainty through adherence to authority and dogma, the support of peer groups, and generally, efforts to diffuse rather than accept their subjectivity.

Confusing and troubling as it can be, the erosion of logical certainty throws the self explicitly back upon his or her own subjective resources. Rather than taking refuge in abstract formal structures. Perry (1968) has commented on this ushering in of self-reference and personal commitment to and responsibility for one's thinking:

> Reason reveals relations within any given context: it can also compare one context with another on the basis of metacontexts established for this purpose. But there is a limit. In the end, reason itself remains reflexively relativistic, a property which turns reason back upon

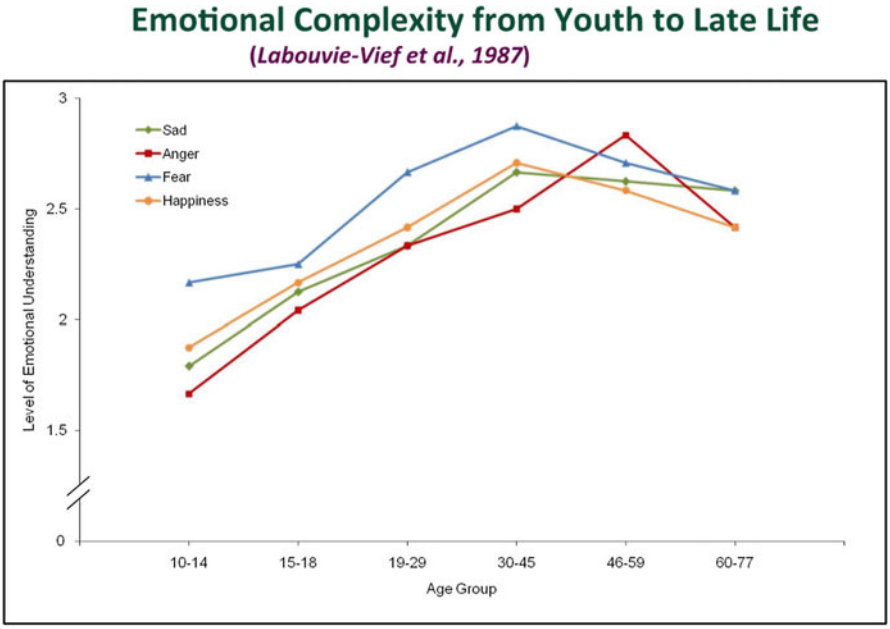

Fig. 6.1 Levels of emotional complexity from youth to late adulthood. Reproduced with permission from Labouvie-Vief, G., DeVoe, M., & Bulka, D. (1989). Speaking about feelings: Conceptions of emotion across the life span. *Psychology and Aging*, *4*, 425–437

> reason's own finding. In even its farthest reaches, then, reason will leave the thinker with several contexts and no way of choosing among them—no way of least he can justify through reason along. If he still is to honor reason, he must now also transcend it; he must affirm his won position from within himself in full awareness that reason can never completely justify him or assure him (Perry, 1968, pp. 135–136).

For Perry, therefore, youth is forced to accept the necessary relativity of multiple intellectual perspectives. This realization provokes, in turn, a new integration: the realization that one needs to abandon one's search for logical certainty and accept the pragmatic constraints of adulthood. Rather than getting caught in a vertigo of possibilities with no clear *external* decision criterion, one needs to give up certainty and a degree of idealism for commitment and specialization.

The explicit reintroduction of the self initiates the next structure of Labouvie-Vief's (1982, 1984) theory: *the autonomous, or integrated level*. The use of the term "autonomy" in this context is not meant to invoke the meaning of "autonomy" as a rejection of interpersonal dependency. Rather, it intends to describe the mature individual's capacity to fully accept responsibility for her or his course of development, and to engage in interpersonal relations and generative endeavors out of a sense of integrity and conscious choice; these capacities are the results of abandoning the belief in logical certainty, and instead embracing a wholesale acceptance of and responsibility for one's subjectivity. In this way, the mature self is able to relate to others with a sense of secure identity, personal integrity, and deeply internalized responsibility and control.

The discovery of necessary self-reference and the general increasing sophistication of adolescent thinking brings about an increasing complexity of adolescents' understanding of the nature of their "self." However, it is a complexity that cannot necessarily yet be integrated. Adolescents become aware that the self is not a fixed entity with a clearly circumscribed core, but that it varies with different situations: for example, one feels to be a different self depending on the different roles one occupies, say, vis à vis parents versus friends, romantic partners versus classmates, and so forth (Monsour, 1993). This diversity of selves may create great confusion for adolescents can avoid a hopeless conflict of different Me's (James, 1892, p. 185).

The question arises, therefore, how adolescents can arrive at a sense of a unified of self—an important task if they are to mature into adults with a sense of coherence and integration of their personality. Monsour (1993) demonstrated, in effect, that in a sample of 64 7th, 9th, and 11th grade boys and girls. The study revealed that complexity of self grew over the period concerned, but also that there were intrapsychic and emotional consequences to this increasing complexity. The observed signs of complexity and associated discomfort varied with the age groups: it was lowest in the youngest group, the preadolescents, rose to a peak in middle adolescence, but then began to decline in later adolescence, where it reached a resolution for many. Specifically, results showed that from early to middle adolescence for, various parameters reached a peak for the number of conflicts between self-attributes (e.g., being depressed and happy, inconsiderate and caring, shy and outgoing, quiet and rowdy, etc.). These contrasting attributes were associated with signs of conflict and distress such as affirming that attributes were in conflict, and indicating a high number of such conflicts. Overall, the individuals who reported that the opposing characteristics were a source of conflict or even confusion was about 30 % for early adolescents, between 40 and 50 % for middle adolescents, but dropped to nearly 40 % for late adolescents. Hence the conclusion was that, with the increasing sophistication of cognitive development, young adolescents at first are apt to be recognized and feel conflicted by the recognition of their complexity, in middle adolescence they seem to be keenly aware of the conflict and however in later adolescence, as cognitive structures reach maturity, these same adolescents begin to feel a sense of confidence.

To demonstrate just how the adolescents achieved resolution of their conflict, the authors asked the students to explain the reason they felt conflict. In general, conflict arose out of an awareness that ones' intentions were in conflict with one's actions, or if there was a conflict between different intentions, such as in the statement of one adolescent who said "You want to be thoughtful with your friends, but something uncaring comes out in you. You try to stop it, you fight it all the time"; In other cases, adolescents gave evidence of integration, for example by saying, "I can be talkative with friends and quiet with friends, they complement each other, its good to be able to be both ways (Monsour, 1993, p. 256)."

The notion that the capacity for integration develops over successive periods of adolescence: in middle adolescence, capacity for integration expected to be limited, but in later adolescence. In contrast, in later adolescence, there should be greater capacity to create a sense of unification of self, even in the face of diversity.

6.7 Post-formal Thinking and Emotions from Preadolescence to Late Adulthood

The transition of adolescents towards an understanding that thinking involves awareness of context and also one's own subjective leanings represent advances that help to deepen adolescents' understanding that thinking emanates from a self who actively monitors and judges his/her own thought processes (Blanchard-Fields, 1986; Commons et al., 1984, Kitchener & King, 1981; Labouvie-Vief, 1982). This understanding also encourages a more complex understanding of intra- and interpersonal processes, as well as one's emotional processes and mechanisms of coping and defense (Haan, 1977; Ihilevich & Gleser, 1986; Labouvie-Vief, Hakim-Larson, & Hobart, 1987; Loevinger, 1969; Vaillant & McArthur, 1972). Following Piagetian conviction in the interrelatedness of cognition and emotion, Labouvie-Vief and collaborators (Labouvie-Vief, DeVoe, & Bulka, 1989) therefore began to extend the notion of an evolving deepening of one's self-reference and understanding of emotional processes of others into a system of levels of cognitive–emotional development. Preceding research had already established important changes in children's understanding of emotions (see Chap. 7): from an understanding of emotions in terms of actions, physical processes, and concrete consequences, a gradual understanding evolved that emotions involve inner processes of memories, wishes, and desires (Bretherton, Fritz, Zahn-Waxler, & Ridgeway, 1986; Harris, 1989). At the same time period, children also expand their emotional vocabulary and are able to express more complex emotional situations, such as the coexistence of emotions (Harter & Buddin, 1987), or inner mechanisms of regulating emotions such as forgetting, wishing, deciding, and redirecting attention (Donaldson & Westerman, 1986; Harris, Olthof, & Terwogt, 1981). At the same time, processes of coping and defense also become more dominated by complex intellectual and interpretive processes (Ihilevich & Gleser, 1986). The standards and norms that guide how one should regulate one's behavior, depending at first on identification with close reference persons such as parents, and later, peers. By adolescence, in turn, a somewhat more complex and autonomous self emerges that has internalized abstract collective ideals (Kegan, 1982; Kohlberg, 1969; Saarni, 1984).

These adolescent gains continue to increase as individuals move on to adulthood. As far as coping processes is concerned, a number of researchers have provided evidence that whereas young people tend to engage in relatively "immature" defense strategies such as repression, intellectualization, or dissociation, middle-aged adults showed significantly higher use of more mature strategies such as altruism, humor, anticipation, and sublimation (Vaillant & McArthur, 1972). Overall, an increase in the flexibility of coping and defense from adolescence to adulthood constitutes one of the most robust findings in the literature (e.g., Cytrynbaum et al., 1980; Haan, 1977; Hauser, 1976, Loevinger, 1969; Labouvie-Vief et al., 1987).

To examine if similar movements held in the area of emotional understanding, Labouvie-Vief et al. (1989) performed a study examining if such advances continue well into middle and late adulthood. A total of 100 individuals ranging in age from 10 to 77 years (six males and six males in each of the age groups of preadolescence

(10–14), adolescence (15–18), young adult (19–29), adult (30–45), middle-aged (46–59), and elderly (60–77). Individuals responded to an emotion interview, in which they were asked to think about a situation during the last month or so in which they had felt particularly angry, sad, fearful, or happy. Subsequently, individuals were asked a number of open-end questions in which they were asked to describe the situation and to indicate (a) how they knew they felt angry (sad, fearful, happy), and (b) how they felt inside when they felt angry (das, fearful, happy).

To validate the general procedure, participants received a number of measurement instruments in a second session. These included a questionnaire developed to measure ways of coping (Lazarus & Folkman, 1984) as well as a defense mechanism questionnaire Ihilevich (1969); Further measures administered were an *Ego development* Test (the Sentence Completion Test by Loevinger & Wessler, 1978), as well as Verbal Ability, one of the scales of the Wechsler Adult Intelligence Scale (WAIS).

To code individuals' responses, levels of emotional understanding were defined; these levels followed the levels of systemic thinking previously presented. The Levels of emotional understanding are presented in Table 6.2; these levels were used to devise a detailed coding procedure, which was the base of assigning the number of the level reached for each emotion. Answers received a 1, 2, 3, or 4 for responses that described the respective levels, but half-levels were coded if the answers fell between two levels. Two graduate students trained in the coding procedure independently coded responses into the four indicated levels, yielding on overall agreement of 96 %.

As shown in Table 6.2, the first level (pre-systemic) does not yet offer a systematic conception of emotions, but typically expresses emotions in rather automatic fashion, such as externally in terms of actions, physical processes, or concrete consequences of actions.

At the second level, intrasystemic, automatic reactions come under the control of more conscious attempts of regulating emotions by practicing certain kinds of cognitive control. At this level, individuals are very concerned about succeeding or failing at emotion regulation. Their concerns based themselves about anticipated social consequences of their emotions. Even so, they also show a beginning awareness of their inner emotional tendencies.

At the intersystemic level, emotional life becomes richer and more self-referential in that youth are able to reflect on their own emotions, and their inner tendencies. As they are able to acknowledge those inner tendencies, indeed their subjectivities, they also become better able to share their emotions with others whom they use "as a sounding board," often in the interest of making sure, they are subjective and fair in their reactions to others.

At the last and integrated level, emotional understanding becomes particularly rich in that emotions are accepted as important energies the self can use as an opportunity for further development—for example, they can be used as outer constructive action or turned inward towards deepening one's subjectivity and individual responsibility in social settings.

Table 6.2 Coding system for assessing levels of emotional complexity

Level	Level summary	Examples
Pre-systemic	Responses emphasize external, physical, and action-based aspects of emotions or involve simple, undifferentiated psychological labels. Feeling terms lack reference to inner subjective states and processes	Physical and sensorimotor actions and reactions: "I cried"; "You sweat"
		Undifferentiated labels: "I was mad"; "I felt hot" (or "cold"); "I was up"; "I was down"
		Simple qualifiers: "I was very mad"
Intrasystemic	Inner states are described through abstract conventional language. Technical terminology, conventional metaphors, and a generalized rather than personalized language are used. There is simple differentiation of emotions by degrees, category, or introduction of a new emotional label	Technical language: "Your blood pressure rises"
		Conventional terminology: "I felt tense"; "I was burning"
		Simple elaborations and comparisons: "I was not that mad, more helpless"; "It was a verbal anger"
		Nonvivid and nondynamic metaphors: "I felt empty"; "Things were bottled up"
Intersystemic	Individuals convey a vivid, felt sense of emotions. They communicate feelings through vivid, dynamic metaphors, through bodily sensations that are more personal and internal, and through highly differentiated, complex, and dynamic comparisons	Complex elaborations and comparisons: "It was not so much the fear itself at the moment, because fear can take a variety of dimensions. It could mean somebody walking up to you with a gun. But fear with him was something far-reaching. It would be fear spread over a longer period of time, not an immediate fear"
		Vivid and dynamic metaphors: "Everything is like a cyclone going around." "It felt like someone was pulling my insides out and then twisting them"
Integrated	Individuals integrate conventional, objective cultural knowledge with their own unique subjective experience and humanitarian concerns. They are no longer concerned with tension reduction but explore the tension between mental/physical and transform it in ways that permit both objective distancing and empathic engagement	Mind and body integrated as a functioning unit: "Everything was accelerated, my adrenaline started pumping, my mind started thinking what to do next. 1 was flashing things through my mind, I'm sure my heartbeat sped up. I did feel fearful"
		Psychological integration of objective and subjective awareness: "You have sunshine in your heart. During the wedding the candles were glowing. And that's just how I felt. I was glowing too. It was kind of dull outside, but that isn't how I felt. Everybody in the church even felt like they were glowing. It was that kind of feeling"

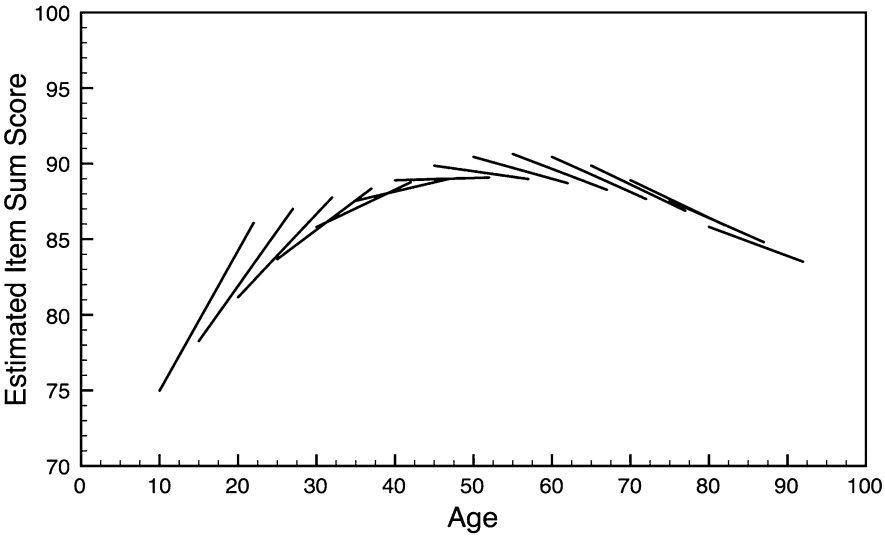

Fig. 6.2 Levels of ego development from preadolescence to late life: cross-sectional and longitudinal gradients. Reproduced with Permission from Gruen, D., Diehl, M., Lumley, M., and Labouvie-Vief, G. (2008), Changes in Ego Level for different cohorts: Developmental trajectories for ego development across the adult lifespan: Evidence from a 12-year longitudinal study. *International Journal of Psychology*, *43*, 392

Results (see Fig. 6.1) showed that, as predicted, emotional complexity for the emotions of sadness, happiness, and fear increased from the age of 14 in a linear fashion until it reached a peak around the age of 45, and then showed a downturn until the age of 60 or over. Interestingly, anger differed from these emotions in reaching a maximum particularly late, probably indicating that anger is one of the very most difficult emotions to regulate. Interestingly, in a separate study using ego level as the variable (see Fig. 6.2), a virtually identical pattern was found. Although Ego Level, (see Labouvie-Vief, 2002) does not directly assess emotions per se, but focuses on social–cognitive complexity, these results confirm the close relationship between emotions and cognitive processes.

As shown in the Harter and Monsour (1992) study, emotional complexity is not always an entirely positive achievement, but can have problematic consequences, if individuals are not able to integrate the complexity. This became evident in the Labouvie-Vief et al. (1989) study, when it became apparent that complex answers to the question about felt affect did not necessarily appear to indicate a high level of integration; in fact, for some individuals they seemed to indicate a degree of confusion. For example, the niveau of complexity was entirely uncorrelated with whether participants indicated that their overall emotional tone tended to be positive, or rather more negative. It is known that a high level of positive emotions in general is related to higher levels of integration (Fredrickson, 2013; Isen, Daubman, & Nowicki, 1987, 1992, Isen, Niedenthal, & Cantor, 1992), whereas a high level of negative emotions is

more likely to disrupt integrative processes. This notion of integration was reminiscent of the assertion of Heinz Werner (1957), an important theorist of developmental psychologist who stated that complexity by itself is not necessarily a positive quality—whether it is or not, turns with the question of *whether complexity is integrated*. In coding the answers, for example, one criterion of complexity was if individuals were able to integrate opposing attributes. For example, in development, as complex cognitive systems mature, individuals are better able to coordinate positive and negative feelings into "blended affect" through processes of inhibition, disinhibition, evaluation, analysis, and so forth (Labouvie-Vief, 1994, 1997, 2000; Lewis, Sullivan, Stanger, & Weiss, 1989; Piaget, 1981).

The overall aspect of successful self-regulation is widely held to be that one is able to achieve a sense of well-being. In that respect, however, a number of authors have proposed that distinct but different aspects of well-being should be differentiated. For example, Ryan and Deci (2001) suggest that concepts of well-being and optimal functioning tap one of two somewhat different perspectives. One is Hedonic and aimed at maintaining positive and avoiding negative affect; the other, called eudaimonic by the authors, is concerned with individuals' meaning and self-realization. Helson and Wink (1992) offered a somewhat similar conception when showing in a large-scale longitudinal study that there existed two quite different orientations that they named "competence" and "ego level." Participants were 141 senior class women who were first assessed in 1958 on their personality characteristics and plans for the future; they were reassessed about 5 years after their graduation (Helson & Wink, 1992), and re-contacted again when they were between the ages of 42 and 45 years. The authors were particularly interested in assessing two aspects of maturity: Adjustment on one hand, and ego level on the other. Adjustment often is meant to refer to "the ability to meet various expectations of society with a sense of comfort and congeniality (Helson & Wink, 1992, p. 532)." Ego level, in turn, is associated with a deeper intrapsychic dimension related to the quality of adaptive styles. More mature styles are associated with objectivity, tolerance of ambiguity, empathy, ability to concentrate on the task at hand, and the expression of feelings in an appropriate and flexible way (Helson & Wink, 1992, p. 532)."

The authors related their measures of competence and ego levels to a number of other variables related to work and health practices. Both competence and ego level were related to achievement in work, although ego level was more strongly related to work status level at age 43, recognition for work, and time in the labor force. Competence was a negative predictor related to a variety of health practices, from use of tranquilizers, sleeping and diet pills, cigarettes and marijuana, put predicted use of exercise positively. Ego Level showed a similar relation to use of tranquilizers, but a positive relationship to marijuana use and psychotherapy. Ego Level also was related to generative concerns for others and a variety of interests such as religious and philosophical ones, as well as interest in self-understanding and development. The two dimensions of competence and ego level thus seemed to express different core orientations, with higher ego level women who scored low on competence being particularly likely to experience emotional breakdown.

In the Labouvie-Vief study (Labouvie-Vief et al., 1989), similarly, two quite different ways of approaching emotion regulation seemed apparent: some individuals were more likely to expand and elaborate on emotions, while others were more likely to reduce the significance of emotions. Analyses of the two strategies yielded two independent dimensions. One, called cognitive-affective complexity, was characterized by a tendency to reach out for higher levels of complexity of coping and self-understandings; that strategy was called "amplification," in contrast to the second core strategy called "dampening." The latter implied that individuals primarily were concerned about downregulating emotions felt to be negative and uncomfortable. Relating these strategies to other study variables showed that individuals scoring high on cognitive-affective complexity (the variable indicating affect amplification) also had high scores on ego level, self-complexity, measures of fluid and crystallized intelligence, as well as low levels of depression. The variable related to affect dampening (Positive self-affect) indicated moderate but positive relationships to ego level and crystallized intelligence but a negative relationship to fluid intelligence, and self-complexity; in contrast, correlations with positive affect were strongly positive, as compared to strongly negative correlations with negative and blended affect as well as depression.

The next step was to examine how well the two dimensions of affective self-complexity and positive self-affect were integrated across the sample. For this purpose, subgroups of the sample were created on the basis of their standing on the two variables: cognitive-affective self-complexity and positive self-affect. Four subgroups were created to reflect all possible combinations: high–high, high–low, low–high, and low–low. To create these categories, each participant's standing (high or low) on the two variables was determined according to a median split: that is, those above were termed high on the respective variable, those below, low. This resulted in the definition of four groups: High–High, High–Low, Low–High, and Low–Low, with the first variable indicating cognitive-affective self-complexity, and the second, positive self-affect.

6.8 Regulation Levels and Age

Overall, results revealed four Regulation styles, as shown in Table 6.3. The first group was comprised of individuals (high complexity, high positive affect) scored high on the measures of ego level, self-complexity, as well as vocabulary and letter sets tests of the WAIS. At the same time, these individuals scored high on positive affect, but low on negative and blended affect; they also had low levels of depression. Their profile of coping/defense mechanisms also showed high levels of intellectuality and concentration, but low levels of repression, and doubt; this suggested that this group was able to bring cognitive processes to bear adaptively on emotion regulation. They also showed high tolerance of ambiguity and a tendency towards exploring emotions in the interest of arriving achieving objectivity. This group therefore was called the "Integrated" group.

Table 6.3 Distribution of regulation styles, % within age groups

Age	Integrated	Self-protective	Complex	Dysregulated
Preadolescents (11.00–14.99)	0.0	75.00	0.0	25.0
Adolescents (15.00–19.99)	0.0	23.1	7.7	69.2
Emerging adults (20.00–29.99)	8.3	20.8	37.5	33.3
Adults (30.00–45.99)	34.2	18.4	26.3	21.1
Middle-adults (46.00–59.99)	33.3	21.2	36.4	9.1
Older adults (60.00–69.99)	33.3	33.3	20.8	12.5
Elderly adults (70.00–85.99)	33.3	12.5	20.8	33.3

Reproduced with permission from Labouvie-Vief, G., Emerging structures of adult thought. In J.J. Jensen & J.L. Tanner (Eds.) Emerging Adults in America: Coming of Age in the 21st Century, pp. 59–84

In contrast to the Integrated group was a second group low in self-complexity, but high in positive self-affect (low complexity/high positive affect). Although this group expressed the second highest positive affect levels overall, their scores were low on self-complexity. They showed an overall less positive pattern of coping/defense mechanisms, scoring high on denial and repression; in addition, low tolerance of ambiguity and regression in the service of the ego suggested that these individuals indicated a lack of openness and orientation towards objectivity. This group was termed the "Self-protective" group, because it showed stylistic aspects highly similar to those identified as "defended" by Neugarten, Havighurst, and Tobin (1964) in their study of middle-aged and aging individuals.

The low positive self-affect/high self-complexity group showed a pattern similar in some respects to the Integrated group; however compared to the latter, they scored rather low on positive affect (35 %) whereas the combined scores on negative and blended affect was about 45 %. Of all the groups, this group had low scores on repression and denial, but high score in intellectuality, tolerance of ambiguity, and regression in the service of the ego, all of which suggested an extraordinary tendency towards openness and objectivity. Yet they also showed elevated levels of depression, suggesting a picture of some vulnerability along with their complexity. This group was termed the "Complex."

The final group of the sample, the low positive self-affect/low self-complexity group, presented overall the most problematic adjustment. They were low in intellectual functioning and complexity, and reported high levels of negative affect, depression, and low well-being; their coping pattern further demonstrated high scores on regression, doubt, and repression, and low scores on tolerance of ambiguity, concentration, intellectuality, and intellectualization. This group was termed the "Dysregulated."

Table 6.3 shows the distribution of these levels according to age groups. Individuals are classified into seven age groups, from preadolescents to elderly adults. The data show a pattern of findings that are highly consistent with what one would expect from developmental findings (Harter, 1999). The data indicate that

preadolescents fall primarily into the self-protective group. For adolescents, the percentage of self-protective individuals declines considerably, but that of dysregulated individuals increases; these findings suggest that with increasing age and complexity of thinking, adolescents now process negative affect more deeply, but do not yet have complex enough structures to integrate resulting conflicts (Monsour, 1993): as a result, they are likely to be overwhelmed. The pattern of regulation styles among the group of emerging adults, with high levels of complex but also dysregulated, is in line with frequent reports that this period of life is characterized by complex and difficult emotions and related high levels of negative affect and depression (see Reinherz et al., 1999). Even though their affect pattern is somewhat improved over that of adolescents, this group still is clearly set off from adulthood proper. In contrast, for the post-emerging adults, the pattern is quite improved, as about 1/3 of this age group is characterized as integrated. These individuals hence demonstrate better ability to live with complexity, a trend that suggests that they can live more comfortably with complexity and conflict.

That emerging adulthood constitutes a still quite critical period is attested by a number of studies suggesting that this age group continues to have difficulty with integrating complex emotions (Blanchard-Fields, 1986, 1989. That this group continues to have difficulty maintaining a balanced cognitive–emotional perspective is shown by several studies indicating that they are easily swayed by emotions and distort their thinking in self-serving and self-protective ways, especially when tasks are presented that activate issues of security and survival (Pysczynki, Greenberg, & Solomon, 1999; Florian & Mikulincer, 1997).

In contrast to the emerging adults, the groups of adults aged 30–69.99 all show a much more balanced pattern: around 33 are coded as integrated; the levels of complexity of this group, though somewhat below those of the emerging adults, are quite high and in fact nearly match that of the emerging adults. Only a very few of the middle-aged Adults aged 46–60, are counted among the dysregulated—9.1 % of their age group.

In general, the middle-aged and older adults emerge as a group with good cognitive–emotional integration, with fairly high levels of self-complexity, though the percentage of individuals classified as dysregulated also suggests some problems of regulation. This is in line with the theory of Carl Gustav Jung (1933), who proposed different stages of life and formulated unique tasks. As for youth, the primary task is, according to Jung, a period in which children and then youth are initiated into the rules and dictates of culture. This is a period of "socialization" in which one accepts and internalizes those rules without deep questioning. This results, as well, in a degree of self-idealization, in which less desirable traits and qualities of the self are discounted; Jung referred to this process of discounting as the creation of the "Shadow," implying that as is true of a shadow, our unacknowledged self accompanies us throughout life. However, stated Jung, in middle Adulthood, individuals are faced with new tasks: those of self-realization and individuation. Now one needs to give up self-idealizations and, in Jung's terms, "confront one's shadow"—that is, take consciousness of the less admirable, petty, and

even misguided self-qualities, rather than to cling to one's youthful idealization of the self. The result is often said to be a crisis (Jung, 1933; Levinson, Darrow, Klein, Levinson, & McKee, 1978), a period in which adults work to re-define themselves and attempt to reach a new level of integration. Indeed, the pattern of regulation styles in the studies of Labouvie-Vief (2002) attest to this heightened level of integration.

6.9 Variations in Integration and Their Causes

We have seen that level of integration shows general improvements from preadolescence to well into middle and later adulthood. But what are the factors that cause one or the other deviation from an integrated pathway? Individual differences such as those already mentioned in temperament (Rothbart, Ahadi, & Evans, 2000) could be one possible factor; a problematic attachment history is another likely cause; difficult life situations beyond one's control may be yet another critical factor.

According to Attachment Theory, different forms of integration problems may arise from different attachment styles. Securely attached emerging adults and adults are likely to be complex and well-integrated; these groups behave quite differently in many tasks of emotion representation than do insecurely attached individuals. For example, insecurely attached individuals have more problematic self-representations; for example, dismissing individuals; may defensively overvalue the self, but attribute their negative attributes to others through projection; in the case of anxious attachment status, individuals may undervalue themselves (Mikulincer, 1998; Mikulincer, Florian, & Tolmarz, 1990, Mikulincer, Orbach, & Iavneli, 1998). Securely attached individuals also are able to uphold more objective judgment; for example, they judge the transgressions of protagonists less severely than less secure groups, and tend to form judgments that may diverge from predominant cultural values, even under conditions of stress.

We already indicated that failures of secure attachment, and especially even more profound histories related to abuse and maltreatment in childhood, can have profound and long-lasting consequences. One of those consequences of such problematic histories is that thy can bring long-lasting, creating impediments to individual's ability to form a coherent and integrated representation of the self.

A particularly dramatic example of such failures to integrate has been described by Markowitsch and Staniloiu (2012), who reported on their investigation of individuals who exhibited a profound lack of ability to recollect aspects of their own lives. These authors termed the phenomenon "functional amnesia,"[2] that is, a state of blockade of personal autobiographical events. In general, amnesic states can be a sign of organic problems such as neurological insults, but in the case of functional amnesia, the cause is not due to neurological damage, but typically reflects exposure to psychological stress or "psychic trauma". In the case of functional Amnesia, the

[2] Amnesia.

blockade of recollection may serve the function of protecting the individual from the terror of fully re-experiencing a situation or situations that have been, and still are, experienced as "inescapable" and "intolerable" (Kopelman et al., 1994; Freud, 1823/1957).

In normal developmental histories, individuals develop the ability to form "episodic autobiographical memories" (EAM), the recollection of personal memories that are characterized by self-reference and vivid emotions (Cabeza & St Jacques, 2007). In the case of functional Amnesia, these memories concern the personal past and hence constitute a retrograde form of Amnesia. According to Canadian Psychologist Endel Tulving (2002, 2005), these failures reflect the lack of "autonoetic consciousness", or conscious knowledge of the self. The integration of normally integrated aspects of memory, emotion, perception, and identity is characterized by dramatic failure to integrate, characterized by mechanisms of dissociation termed "psychic block syndrome" by Markowitsch (2002). These blocks can be characterized by sever and persisting failures to recollect the personal past, as well as impairments in EAM and self-related processing, as well as the processing of social and emotional information. In some cases, these individuals present an entire loss of personal identity, in which not only memories of the entire past are unavailable (Thomas-Anterion et al., 2012), but in which persons no longer know who they are.

Markowitsch and Staniloiu (2012) offer several case reports of individuals who were diagnosed with functional amnesia. One was a man about 50 years old, who was found in a central railway station of a city with a large harbor. He did not know who he was, nor why he was in the city, nor did he carry identifying papers with him. He had no knowledge at all of his personal past and simple facts of his life. He was hospitalized in a psychiatric clinic, where an intensive examination revealed no structural brain deficit.

In the clinical setting, the patient remained unchanged for months as far as his ability to recollect aspects of his past life. However, he quickly relearned aspects of daily activities, such as preparing meals, watching TV, or using elevators. He also readily regained knowledge of reading, writing, or calculating. He displayed considerable world knowledge, with interest in politics and social affairs. The authors suspected that he might be a sailor, and when they asked him to demonstrate a special knot used by sailors, he immediately produced it. But he continued to have no recollection whatever of his personal past, to which he entirely lacked access.

Another case was that of a 59-year-old woman with university education and a private business in the medical field. Because she felt that her capacity to reflect on self needed improving, she had begun studying psychology and underwent psychotherapy, but she continued to be unable to recall personal events that had taken place when she was between the ages of 10 and 16 years. She knew through her relatives that during this period of time, she had been repeatedly abused by her father. She was encouraged to express her feelings about these events through painting, producing paintings in sober colors. She felt that these paintings reflected frightening periods of her childhood, but was not able to describe those events in any way. The patient agreed

to being examined through MRI (magnetic resonance imagery) and water positron tomography while her paintings were presented to her. The findings provided support for the hypothesis that her retrograde amnesia was related to restricted processing of information—specifically, the pattern of activation showed that of a network of brain structures implicated in retrograde amnesia, only—namely, the part of the cortex which is primarily involved with the processing of emotional information. The authors concluded that these findings underscore the mechanisms of "dissociative amnesia," in which emotional and factual aspects of one's past life fail to be integrated. These dissociative amnesic states often are induced by a history of extremely stressful events such as childhood maltreatment or other traumas that result in Post-traumatic Stress Disorder (PTSD). In such cases in which amnesia is caused by major psychological trauma, Markowitsch and Staniloiu (2012) speak of *Psychogenic amnesia.* We will return to such trauma-related failures to integrate emotional experiences in the last and final section of this chapter.

Further investigations of the authors revealed that patients with functional amnesia show further brain changes, in particular, ones involving a reduction in brain metabolism (Markowitsch et al., 1998). This reduction is particularly evident in areas of the brain that are involved in memory formation, such as the hippocampal area. In the case of one patient, these reductions reached a rather dramatic range of up to three standard deviations below normal—a deviation, the authors underscore, that "corresponded to that of another patient, similar in age and sex, who after a major heart attack developed enduring retrograde and anterograde amnesia" (Markowitsch and Staniloiu 2012, p. 9). Nevertheless, after a combination of therapies, this patient a year later, and with a combination of therapies, had not only recovered from his amnesia, but his glucose metabolism had returned to a normal level (Markowitsch et al., 2000).

As do other authors (see Schore, 2003a, 2003b) reporting on similar aspects of functional amnesic states, Markowitsch and Staniloiu (2012) postulate that the major cause of these states reside in the fact that several areas of the brain respond in a very sensitive way to stressful events, as a result of which the ability to recollect personal past experiences is blocked. This statement is consistent with the argument presented in Chap. 5—namely, that stress profoundy alters the processing of and memory for emotional information.

6.10 The Genesis of "Functional Amnesic States" in the Course of Development

In the work of Markowitsch and Staniloiu, the authors make reference to the psychological (or psychogenic) causes of amnesic states, and suggest that such states may serve a protective role in that they function to shield the individual from the extreme discomfort that may accompany the recollection of highly stressful events. An important body of work has arisen in the past decades (see Schore, 2003a, 2003b)

that attests to the conclusion that functional amnesic states often result from a highly traumatic history of interactions between parents and children. These interactions can have profound influences on the regulation of brain states and, as a consequence, on the subsequent development of the brain, and they can persist throughout a lifetime in the absence of psychotherapeutic interventions.

One phenomenon related to the inability of conceptualizing one's feelings has been termed "alexithymia," literally, absence of an emotional vocabulary. The relationship between alexithymia and emotion regulation was examined in a recent re-analysis of the Labouvie-Vief et al. study already referred to earlier (Labouvie-Vief et al., 1989). The re-analysis involved 415 community living adults of the sample (Ziadni et al., under review), and related measures of alexithymia to measures of defense and ego maturity. Mechanisms of Defense were described following a classification by Haan (1977), and ego Levels were assessed by the SCT referred to in Chap. 6. Compared to individuals with lower levels of alexithymia, those with higher levels used less mature strategies of defense to deal with psychological conflict: they blamed or attacked either the self or the other when experiencing conflict, but did not instead use defenses that are considered more adaptive, but that demand more cognitive effort—defenses such as intellectualization/principalization[3]; instead, they were more likely to retreat to denial/reversal[4] Alexithymia also was related to having a less integrated sense of self and others. These results are consistent with previous literature on the association between alexithymia and defenses (Bogutyn et al., 1999); they suggest, as well, that the deficits alexythimic individuals experience in the processing of emotional information are among the contributors alexithymic individuals have with relational difficulties.

The study also followed up 49 % of the sample 6 years later, when individuals were assessed for their levels of depression and well-being. Results showed that over the 6-year span, the presence of alexithymia was related with greater depression and lower well-being 6 years later. In contrast, ego maturity, principalization, and reversal was related to higher well-being, whereas turning against the self and turning against object predicted lower well-being. Thus overall, this research indicates that individuals with higher complexity and better integration possess better awareness of their emotions and how to regulate them, use more mature and adaptive defenses, and have greater well-being later in life, in contrast to individuals who have a less complex sense of self, less emotional awareness and more difficulty with introspection, and engage in processes of ignoring and/or suppressing emotional experience.

[3] Person retreats from affect to using words and abstractions that are often inappropriate to the specific situation. Uses jargon and is pseudointellectual.

[4] The person ignores past or present facts that would be unpleasant to acknowledge and instead focuses on the benign.

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Chapter 7
Emotion–Cognition Relations in Aging

In contrast to the stages of development we so far surveyed, aging is a period of life that also brings vulnerabilities and decrements, both physical, cognitive, and emotional. The chapter shows that in the domain of cognitive functions and the brain structures that support them, aging is associated with certain losses that can make cognitive–emotional integration more difficult, especially in situations that are complex and difficult; in such situations, individuals cannot always rely on the store of their skills acquired in the past, but are required to develop novel ones. In such situations, tension thresholds no longer increase as in periods of development, but are characterized by a lowering. As a result, tension thresholds are lowered and hence reached more quickly, especially if tasks pose complex and stressful demands. By contrast, in well-mastered and well-automated tasks and provided good health, aging also often presents itself as a period in which individuals can reap from the accumulation of their rich experience, such as professional, artistic, or musical expertise, as well as social skills involving knowledge accumulated about life and people. In contrast to literature dealing with losses in cognitive–emotional integration, in such areas of expertise elders can maintain, profit from, and sometimes excel at, the use of rich world knowledge that supports creativity and wisdom. These developments are illustrated with research examples as well as real-life samples of the thinking and emotions of elders.

7.1 The Why, How, and When of Aging and Its Optimization

Aging is a universal process of living organisms, and death at the end of one's life is an inevitability. It is not difficult to understand that often, aging is surrounded with fearful and negative connotations. Yet whereas growing older results in eventual death, aging itself is not a fixed phenomenon; in fact, it has dramatically changed over the course of historical time. Indeed, in the book on "The Future of

G. Labouvie-Vief, *Integrating Emotions and Cognition Throughout the Lifespan*, DOI 10.1007/978-3-319-09822-7_7

Aging (2007)"[1] we have witnessed a "vitalization" of aging (Gruss, 2007) in the sense that elders of today are in better health and more vital than was true at earlier. For example, a contemporary 70-year-old is likely to have maintained much higher levels of mental and physical fitness that was true some 30 years ago and, in fact, may resemble more a contemporary 60-year-old than an aged individual (Baltes, 2007).

Why do we humans age? This question has occupied individuals for centuries. Gruss (2007) points out that aging is not restricted to old age, but in fact begins at the moment of conception that initiates in its turn a chain of transformations. However, these transformations are not optimized for maximal longevity of individuals, but rather, for reproductive success. That these transformations are greatly controlled by genetic mechanisms is evident from the finding that different species have widely varying life spans—for example, about 3 years in mice, 60–70 in elephants, and 150 years in giant turtles (Gruss, 2007). Nevertheless, other, extragenetic factors impinge on longevity and the rate of aging, such as general constitution, health, medical care, physical activity, and levels of stress.

The causes of aging have been the topic of considerable debate. Since part of aging is under the control of evolutionary pressures, it has presented a certain paradox (Baudisch, 2007) from an evolutionary perspective, which emphasizes that evolution is optimized for reproductive capacity, aging and its result in eventual death is difficult to explain as an evolutionary mechanism. How could it then have arisen? In 1952, Medawar proposed that the rise of mortality with increasing age was due to cellular mutations, the result of an accumulation of genetic damage that had collected over a span of generations. Thus evolutionary mechanisms had not been optimized to prevent aging; quite to the contrary, certain genetically transmitted (i.e., heritable), grave diseases, if evident relatively late in life when the reproductive phase is already active, are likely to be transmitted to descendents—evidence of a *decreased* selection pressure.

To respond to these various incompatible propositions of the causes and timing of aging, Baudisch (2007) points to an emerging renovation in thinking about aging. This renovation implies that aging not be represented primarily in a context of decline only, but that conceptions also consider positive forms of adding years to one's life. For example, she points to research that notes that some forms of life among animals and plants show dramatically different forms of growing older—forms that are characterized by processes of self-regeneration that permit some organisms to evade aging, even if not death.

As a result, Baudisch (2007) proposes that we look at aging in a somewhat altered sense—a sense that does not equate *growing older* with *becoming worse*. Rather she proposes that—in contrast to classical theories of aging—we acknowledge that once reproductive maturity is reached, life can take a multitude of different directions: mortality risk could rise fast or slowly, a period of further growth could follow, accompanied by processes of further growth or reproduction, of a phase of maintenance could begin either upon reaching maturity, or could follow a

[1] Original German Title: "Die Zukunft des Alterns."

phase of further development of aging. In other words, the constitution of the organism could improve, worsen, or remain unchanged.

As a result of these deliberations, Baudisch proposes, new models of aging are emerging. Rather than exclusively emphasizing the deficits elders accumulate with advancing age, these views offer alternatives to an emphasis on decrement; this they do in that they underscore that concepts of growing older are beginning to incorporate not only emphases of worsening and growing deficit. Instead, these conceptualizations also orient themselves to questions about the resources that come with growing older, and analyze how these resources are divided among the activities of growth, survival, and reproduction. The result is an emerging conceptualization of Optimal Aging, a process that implied the totality of evolutionary fitness that can be maximized through investing energy in growth, repair, and reproduction. The investment in these processes, she proposes, and the resulting balance among them, then will determine the mortality risk of chance of survival, along with the overall constitution of the person, rather than affirming that the mere passage of time brings decrement and loss of function. We will discuss some of the more growth-oriented views of aging in the pages to follow.

7.2 Cognition and the Brain in Later Life

In Chap. 6, we observed adults around the middle of life display considerable sophistication of cognitive functioning, as well as their understanding of emotions. For example, Fig. 6.2 (see Chap. 6) demonstrated that as far as complex emotional understanding is concerned, the Labouvie-Vief, DeVoe, and Bulka (1989) study showed that emotional complexity peaked around the midlife or even somewhat later, but then appeared to indicate a slight downward turn. In the area of the assessment of cognition and intelligence, this pattern has become widely accepted and is sometimes even referred to as a "classic" pattern of intellectual aging.

Interest in the aging of cognition or intelligence began in the early twentieth century, after intelligence testing had been established, in part, to select Army recruits by means of administering a specially designed test, the "Army-Alpha" test. In a first study, Miles and Miles (1932) reported on the correlations of intelligence tests scores and chronological age up to the age of 54. Similarly, Jones and Conrad (1933) reported on intelligence data of a group of individuals from age ten up to the age of 60. In both studies, it became evident that on some of the subtests, older adults actually had an advantage over adolescents. The concerned tests were ones dealing with "declarative"[2] knowledge such as general vocabulary and items of general information. Jones and Conrad proposed that older individuals, due to their considerable store of declarative knowledge, had an unfair advantage over younger ones; indeed, when this subgroup of tests was excluded from analysis, date indicated a

[2] *Declarative* knowledge generally refers to well-learned knowledge, such as vocabulary and general knowledge.

rapid growth of declarative up to the age of about 60, but evidence of decline from age 80–20 onwards on less well practices such as analogies or arithmetic.

About a decade later, Donald O. Hebb (1942) reported on research on individuals who had undergone brain surgery—for example, to remove tumors—and concluded that the resulting effects on individual's intelligence differed and were affected by age. Hebb proposed that there are two different kinds of intellectual abilities or functions, one of which he called "Intelligence A" and the second, "Intelligence B." He proposed that Intelligence A referred to a particular form of intelligence, a "direct intellectual power" (Hebb, 1942, p. 289) that was involved in abstract reasoning and novel learning. In contrast, Intelligence B referred to "the establishment of routine modes of response to common problems (Hebb, 1942, p. 289)."

The notion of two separate types of intelligence has become firmly established in the scientific community since: it shares, in effect, a great deal of conceptual similarity with the differentiation we have made throughout between automated "primal" emotions on one hand, and representations (in the sense that Piaget used the term) that integrate automatic and cognitively directed processes. The most widely known version of the two forms or functions of intelligence was proposed by Cattell (1971), who gave the two functions their currently widely used names of "Fluid" and "Crystallized" intelligence. Fluid intelligence (Gf) here reflects a kind of raw capacity for information processing, an ability to identify complex relations and to draw inferences upon them: it is generally comparable, as well, to executive functions that involve processes of controlled and effortful, conscious manipulation of material. Crystallized intelligence (Gc), in turn, reflects the overlearned product of the highly fluid processes of Gf, which can become invested in tasks that are learned to a high level of automation; in fact, these forms of knowledge are similar to the Piagetian "schemas" or "representations" already discussed in previous chapters.

A wide body of research (for review, see Labouvie-Vief, 1985) has established that fluid and crystallized intelligence follow somewhat different age trends. Crystallized intelligence generally is well maintained even into late life, whereas fluid intelligence may begin to show downturns even from quite early adulthood onward. This state of affairs was recently summarized by Craik and Bialystok (2006) who presented different renditions of these changes (see Fig. 7.1).

The three curves of Fig. 7.1 are based on an article by Craik and Bialystok (2006) show somewhat different ways of representing the data that have emerged over the years. Figure 7.1a shows a single curve which suggests a mirror-image type of raise and then decline from childhood to maturity and old age. Figure 7.1b is more precise

Fig. 7.1 (continued) and fluid intelligence (cognitive mechanics): the former is well maintained in older ages whereas the latter declines. (**c**) A more realistic version of (**b**), in that representations are generally well maintained at older ages, but some knowledge is either lost (especially with lack of practice) or becomes inaccessible. Control processes develop at different ages and also decline differentially, depending on the part of the brain that was involved. Reproduced by permission of Elsevier Ltd. From F.I.M. Craik & E. Bialystok (2006), Cognition through the lifespan: mechanisms of change; Fig. 1, p. 133. *TRENDS in Cognitive Science*, Vol. 10, No. 3

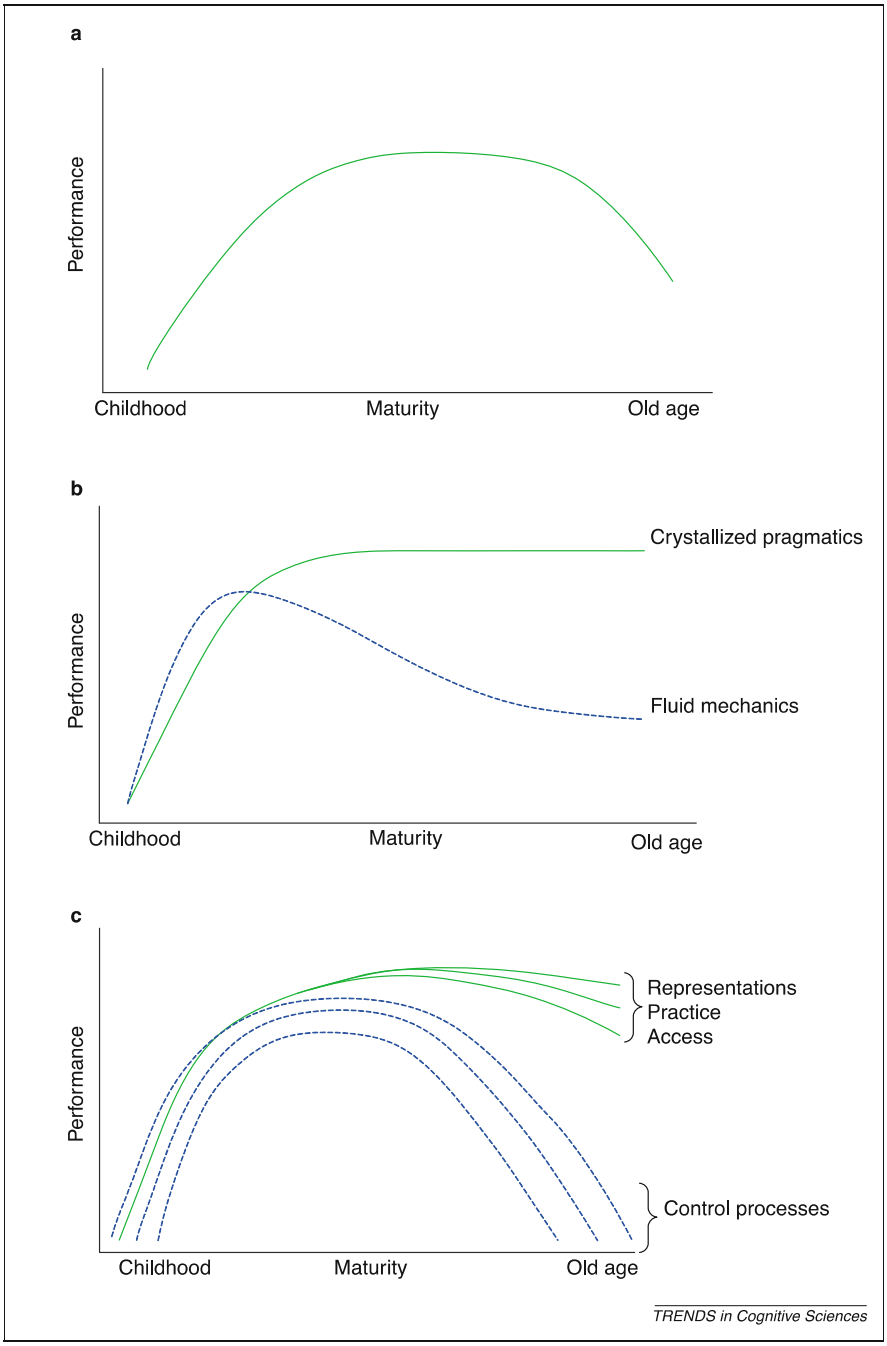

Fig. 7.1 Three speculative models of cognitive change across the life span. (**a**) A single "mirror-image" view; performance rises in childhood is maintained in middle age and declines in late adulthood. (**b**) The different life span trajectories of crystallized intelligence (cognitive pragmatics)

in that it shows the differing gradients for Cc and Cf; the latter have also added the terms "pragmatics" versus "mechanics," a terminology proposed by Baltes (1987).

Why should crystallized intelligence be relatively unaffected by aging, whereas fluid intelligence shows quite profound downturns after midlife? There are several reasons for this often replicated phenomenon. As Craik and Bialystok point out, and as we discussed in Chaps. 4 and 5, it was Piaget's notion that during the course of cognitive practice and exploration of the problems they entail, individuals gradually build great facility with those problems. For example, children become less dependent on the particular contexts which might be needed to evoke a solution, but gradually acquire the ability to represent the problem structure and solution in a way that is firmly internalized and that can readily be produced as an image and, eventually, in a truly conceptual manner. As discussed in Chap. 5, this leap, in Piaget's theory, characterizes the transition from a pre-operational mode to one that is concrete operational, and that already is characterized by the availability of true representations.; these representations become more practiced and flexible over development. As we further discussed in Chap. 5, these representations, on a neurobiological level, imply that the components of a concept have formed a well-connected structure that is *both* conceptual *and* neural. This structure is able to respond in highly automated fashion. Such structures can be produced contextually in a well-automated manner through crystallization, but they also can be invoked intentionally, through intention and effort, by engaging fluid processes.

The result of such processes of automatization is that forms of knowledge that are well crystallized are quite well shielded from decrement. In particular, with increasing age, (and barring certain deficits), aging individuals are more and more likely to quickly and reliably have available aspects of knowledge that are highly automated—that is, "crystallized." Hence, in Baltes (1987) terminology, they tend to be masters of "pragmatic" aspects of knowledge.

Whereas such pragmatic, crystallized knowledge holds up quite well with age, the second form of knowledge, called "mechanics" by Baltes, or fluid intelligence by Cattell (1971) and Horn (1970). This capacity refers to the sheer physical integrity of the brain and the functioning of its neurocircuitry—or, to the contrary, to the lack of such integrity. In that respect, research with aging individuals has documented numerous vulnerabilities of brain functioning—structural changes in the brain that work to decrease its pure "mechanic" efficacy. In recent neuroscientific studies, such decreases have been tied to alterations in particular brain regions. For example, Raz et al. (2005) and collaborators examined age-related changes in different cortical areas in a sample of individuals aged 20–80; these individuals had previously participated in a cross-sectional study, but where followed up longitudinally after 5 years in a more recent data collection. Results showed a nonlinear trend in age-related shrinkage of the hemispheres of the cerebellum[3]: the degree of shrinkage/decline of volume *decreased* in younger individuals, but among older individuals, there was a significant age-related *increase* in shrinkage rate. The researchers also

[3] The cerebellum is widely associated with the coordination of movements.

examined the relationship of the presence of hypertension with brain volume changes; results showed that hypertension was related to greater shrinkage of the orbitofrontal cortex; hypertensive individuals also showed some evidence that hypertension was related to lower hippocampal volume, and possible to decline in white matter volume. The authors further noted that such changes were not related to gender, except for the caudate, nor were there neuroprotective effects due to larger brain size of educational attainment.

7.3 Consequences of Later Life Brain Changes for Emotion–Cognition Relations

What are the consequences of the brain changes discussed for emotion regulation processes in aging individuals? Currently, there exist somewhat diverging answers/interpretations in response to this question. One interpretation holds that aging is widely related to improved emotional well-being and proposes that this is a result, on one hand, of late life motivational changes that lead elders, who begin to face mortality, to attempt to optimize their lives, through maximizing positive affect. One important way of doing so is by restricting their social relationships to those that are highly valued and positive (Charles & Carstensen, 2007; Charles, Reynolds, & Gatz, 2001; Reed & Carstensen, 2012). In fact, Reed and Carstensen (2012) point to a plethora of studies that demonstrate that older individuals attend to and remember more positive than negative information, an effect termed the *positivity effect* (Mather & Carstensen, 2005).

That emotion regulation should become easier for many aging adults is understandable, given that they are likely to have accumulated a lifetime of experience and knowledge about emotional settings—knowledge that has become highly automated and is available as readily accessible representations. On the other hand, much evidence suggests that older adults' ability to process affective information in the absence of such automated well-automated representations is likely to be compromised, especially when there is a high need for cognitive control (Labouvie-Vief, 1993, 2003, 2008, 2009; Labouvie-Vief, Grühn, & Studer, 2010). The latter view proposes that the two viewpoints address important trends, but that they begin from quite different interpretations of the current literature. The second viewpoint starts from the body of literature reviewed earlier in this chapter that indicates two essential findings: On the one hand, that effective emotion processing is fostered by having available well-automated representations that can be efficiently employed towards successful regulatory processes that involve control and inhibition. On the other hand, as already discussed, it is evident that the brain undergoes profound changes in systems that are related to emotional processing and emotional regulation. These changes include, in particular, those affecting important emotion processing systems like the prefrontal cortex and the hippocampus, whose demonstrated declines can pose difficulties to effective regulation in situations that place high demands on cognitive resources.

Labouvie-Vief and her co-authors hence proposed a theory that emphasizes that whether individuals are primed to react positively or negatively in emotion-laden situations depends *not on a single mechanism*, but is the result of a variety of processes that are dynamic and contribute towards situations in which emotion regulation is asked for. Due to its dynamic nature, the theory is termed "Dynamic Integration Theory" of DIT (Labouvie-Vief & Marquez, 2004). The theory postulates that in the moment of emotion-regulatory needs, individuals need to integrate multiple different interests and capacities. For example, they may come to experiments with specific strengths, such as great physical and emotional health and good cognitive status, all of which bear on effective emotion regulation. On the other hand, they may evidence a pattern of problems related to physical health (such as hypertension, as previously discussed), or mental health, such as anxiety and depression. In the words of Baudisch (2007), the accumulation of such risk factors would create a threat to overall constitution and state of repair of the organism.

DIT is consistent with the finding that effective emotion regulation is most likely if arousal is within well-tolerable limits; in contrast, it is strongly *negatively* affected by states that involve a very high degree of arousal, as reported in Chap. 5. Indeed, the negative effects of high arousal and stress appear particularly grave in aging individuals (Labouvie-Vief et al., 1989). Responding to high arousal with restorative reactions of equilibrium maintenance is a highly effortful and cognitively demanding task; it depends, first of all, on the integrity of the cortical structures involved in emotion regulation; in addition, the absence of general physical and mental health will constitute a further burden—a burden that may be too demanding for older research participants who already evidence declines in control processes/fluid resources. Thus Baltes (2007) and his collaborators demonstrated that the capacity of elders to attend to two tasks simultaneously (i.e., "dual-processing tasks") is strongly compromised. For example, an older individual taking a bus or tram trying to maintain a conversation is likely to stop talking as soon as the vehicle begins to shake and swerve, in an effort to be able to concentrate on maintaining balance. The reason is that, as the body becomes more frail, more attention needs to be focused on coordinating movements and maintaining balance—processes which younger individuals perform more automatically and with less intention. In a simulation of such a phenomenon, the researchers asked older individuals to walk along a simple path, established in the laboratory, while at the same time performing simple cognitive tasks of memorization. Results showed that attention to the activity of memorizing was greatly disrupted by the attention necessary to monitor walking and maintaining balance, indicating that older individuals orient much attention to avoiding instability in walking so as to avoid dangerous falls.

DIT proposes, similarly, that cognitive restrictions are most likely to be evident in situations that imply high tension and cognitive effort. Such restrictions are less important, however, in situations of low effort that involve high automation. In fact, highly automated knowledge remains functional in later life and may even increase in importance (Blanchard-Fields, Baldi, & Stein, 1999; Hess, 2005). However, whether automated representations are facilitative in a particular situation depends on whether it is facilitative in a particular task, or whether it interferes with task goals.

For example, if the task might involve an activity that is well automated (crystallized), individuals can fully depend upon their knowledge base to facilitate task performance. However, in other tasks the aim may be exactly contrary—namely, to inhibit automatic knowledge. For example, experimental instructions my direct participants to restrain from performing a well-automated response—that is, to inhibit it. For example, a person might be told to do an activity that is already highly automated in a new and completely different way, all the time refraining from the accustomed-to habit. In that case, inhibition attempts, which require intellectual effort, are likely to conflict with the easy and quick availability of automated responses. In the remainder of this chapter we will focus on examples that suggest the helpful effects of automation, and then turn to cases that exemplify its interfering consequences in contexts where automaticity is uncalled for.

7.4 Advantages and Disadvantages of Increasing Automaticity and Crystallization of Knowledge in Aging

The implication of the roles of automaticity or conscious and effortful execution of certain tasks point to the conclusion, then, that automaticity can be a great aid in some situations, but a great hindrance in others. *One of the benefits of increased automaticity* in later life has been emphasized by Carl Gustav Jung (1933), who suggested that with the move from youth to midlife, individuals experience a relaxation of the strict cognitive controls they had to acquire to become accepted members of the social system. He proposed that around midlife, individuals often experience a relaxation of controls they have internalized and automated in the interest of becoming "good" members of the social order. The result of such relaxation can have the positive consequence of liberating rigid control processes that up to then were highly automated or unconscious. Jungian Scholar Neumann termed this "centroversion"—an "inward shift" that is in contrast to the necessary extraversion that was more characteristic of early socialization and entrenchment into cultural rules and requirements (see Labouvie-Vief, 1994). One sign of such a shift, Labouvie-Vief proposed, can be a change in attitude towards information. For youth, Labouvie-Vief proposed, information seems to be an outer "given" that one was required to reproduce as literally as possible. In contrast, for more mature and older adults, information becomes something to be interpreted on the background of one's own experience, something that speaks of a landscape human motivation and intention rather than simple rule performance, and something that implies a rich psychological texture and knowledge about the inner life of people.

To demonstrate this outer-to-inner shift, Labouvie-Vief and collaborators designed a series of studies in which individuals were presented with texts that invited not merely text-dependent reproduction, but rather individuals' personal rendition and interpretation of the narratives (Jepson & Labouvie-Vief, 1992). Young, middle-aged, and older adults were presented with fable-like stories and asked to "summarize" them. The young produced almost verbatim summaries that

involved detailed, almost literal retelling of the stories. The older adults, on the other hand, primarily produced summaries that focused on highly symbolic and inner-psychological meanings that had moral implications, as well. For example, one adult response proposed that "a lot of times things that appear to be situations outside of ourselves are really things that we need to be conquering inside. But we have to have the outside confrontation to find out what we are and what we're made of" (Jepson & Labouvie-Vief, 1992, p. 130)—a statement emphasizing a rich inner orientation towards psychological motivations and with wisdom about life.

Another important example of the value of having available rich automated structures of knowledge is given by tasks that permit older individuals to draw on this inner orientation and their rich psychological knowledge of self and psychological processes. Thus several studies show that older individuals may outperform younger adults if experimental tasks allow them to draw on their personal and value-based information. For example, older adults can be more effective at solving interpersonal, emotion-salient problems than young adults. Older adults also can be more accurate when making inferences about the traits of others, and they recall more information about a target that is similar to them in terms of age (Hess, Rosenberg, & Waters, 2001).

7.5 Declines in Fluid Abilities and Emotion Processing in Later Life

In contrast to the helpful effects to older individuals of having available well-automated structures of representation, the declines in fluid intelligence, as well as associated brain changes, can begin to pose considerable difficulties to aging individuals. These difficulties are presented in Figs. 7.2 and 7.3 and further elaborated in Tables 7.1 and 7.2.

Figures 7.1–7.3 follow up on similar figures (Figs. 2.1 and 2.3) of Chap. 2 in presenting the counterpart of the equilibrium expansion and raise of tension thresholds typical for the earlier developmental periods. In contrast to the expansion indicated in Fig. 2.1, Fig. 7.1 indicates first, that the high level of performance and wide equilibrium range of the right-most curve shows considerable shrinkage in the two left figures. In one of them, the general level of performance is basically maintained, but the equilibrium range is considerably constricted. In the second, left-most figure, both level and equilibrium range are dramatically constricted, implying the system has become very vulnerable and is likely to reach breakdown limits very easily (Fig. 7.4).

The implication of Fig. 7.2 in general that tension limits are quickly exceeded and breakdown limits quickly is consistent with a body of research that supports several generalizations about developmental changes in emotion regulation in later life. Specifically, the prediction is that in general, a series of typical regulatory difficulties are observed in aged individuals. Brief descriptions of these changes are given in the box at the right of the curves themselves, but more detailed explanations are presented in the sequel.

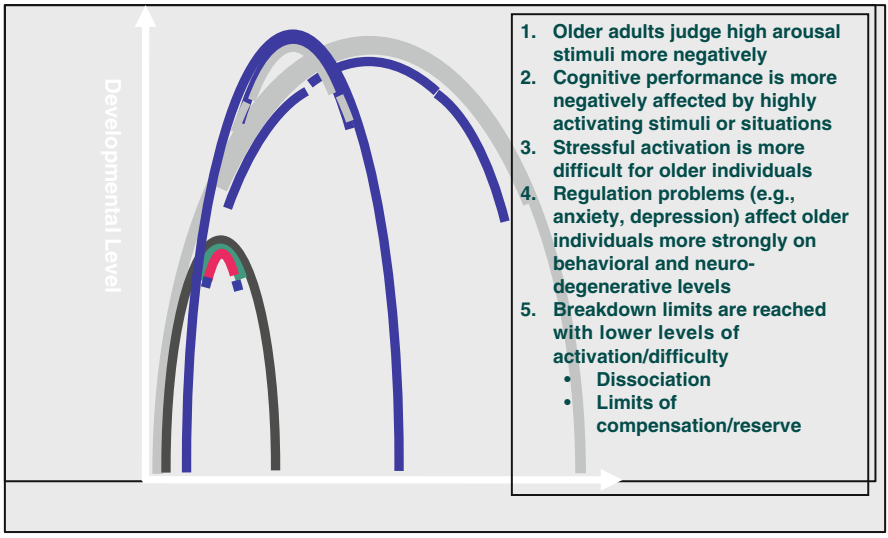

Fig. 7.2 Consequences of restriction of fluid resources in later life: although the complexity of representations may not be reduced in elderly individuals, a lowered threshold of tension will result in a restricted equilibrium—here, indicated by a narrowing of the zone under the apex of the curve. Consequences of this restriction are indicated in the right window, and documented further in the text of the chapter. Original design by the author

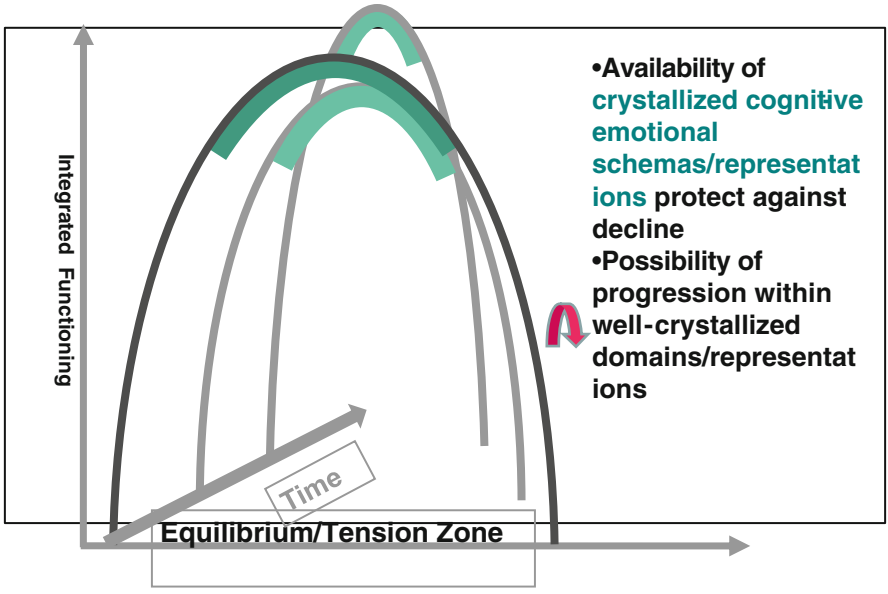

Fig. 7.3 Scenarios related to restrictions of fluid resources. Even though equilibrium zones narrow and tension thresholds lower, well-crystallized schemas or representations may permit the raise of integrated functioning complexity. For further explication, see text. Original design by the author

Table 7.1 Experimental findings related to fluid restrictions and emotion regulation

Research highlights: negative scenario
1. Older adults judge high arousal stimuli more negatively
2. Cognitive performance is more negatively affected by highly activating stimuli or situations
3. Stressful activation is more difficult for older individuals
4. Breakdown limits are reached with lower levels of activation/difficulty
• Dissociation
• Limits or compensation/reserve
5. Regulation problems (e.g., stress, anxiety, depression) affect older individuals more on behavioral level and neuro-degenerative level
6. Older adults develop a regulation style that is self-protective rather than well integrated

For further explication, see text. Original design by the author

Table 7.2 Experimental findings showing positive reorganizations in the face of certain fluid resource restrictions

Research highlights: positive scenario
• Story recall: older adults give interpretations that provide rich integrations of psychological experience (Jepson & Labouvie-Vief, 1992)
• Differences in cognitive performance are reduced if materials are relevant for older individuals—younger individuals are not affected in that way (Hess et al., 2001)
• Older adults can be more effective than young adults in solving interpersonal or emotionally salient everyday problems
➡ No lowering of performance level but narrowing of range if individuals can draw on their rich experience and/or in positive settings

For further detail, see text. Original design by the author

1. The first of the proposed generalizations states that older adults, compared to young adults, will be more adversely affected by the restriction of tension-regulating mechanisms than younger individuals. Thus, consistent with findings that under heightened stress, older individuals tend to polarize experience more strongly in terms of simple schemes such as good versus bad (Paulhus, Graf, & Van Selst, 1989; Paulhus & Lim, 1994). Further (the lowering of thresholds implies at relatively high elevations), levels of arousal are experienced as more adverse with advancing age. This prediction is supported by several studies. For example, a study by Grühn and Scheibe (2008) had young and older adults evaluate a series of 504 emotional pictures. Older adults rated negative pictures as more negative and more arousing than did young adults; they also rated positive pictures as more positive and less arousing than was true of young adults. Similarly, Gilet, Grühn, Studer, and Labouvie-Vief (2009) had young, middle-aged, and older adults rate 835 French adjectives and found a strong linear and negative association between judgments of valence (positive versus negative) and arousal level for older adults, but less so for the younger ones. A similar finding

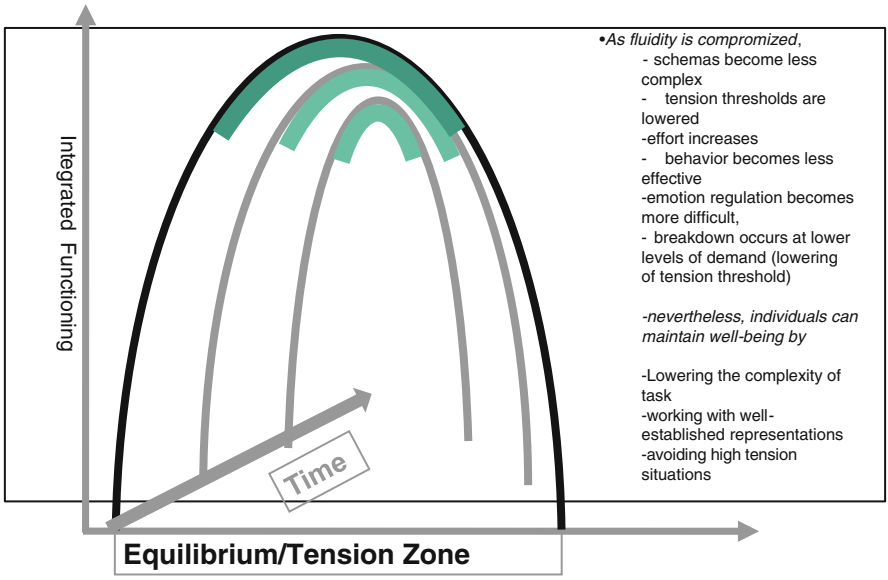

Fig. 7.4 Scenarios related to restrictions of fluid intelligence. Although lowering of tension thresholds imply difficulty of well-being in the face of high emotional activation, individuals can maintain well-being by the methods indicated. For further explication, see text. Original design by the author

was reported by Keil and Freund (2009) who similarly found that for older individuals, there was a strong linear association between valence and arousal, whereas younger adults did not give such extreme, either-or judgments but varied judgments more precisely according to the depicted picture content.

2. The data discussed imply that the processing and regulation of emotion becomes more and more difficult as older individuals experience declines in fluid intelligence. This conclusion was also supported in a study by Wurm, Labouvie-Vief, Aycock, Rebucal, and Koch (2004), in which individuals' latency of responding to low- and high-arousing stimuli were measured. High arousal words were words such as "murder," "terrorist," and so forth, compared with low-arousing words. Young adults did not show a difference in response time to low and high-arousing words, but older adults did show a significant difference, with high arousal words taking more processing time. These results further confirm that older adults experience difficulties with high-arousing situations—that is, that their tension thresholds are lower than those of young adults.

A further important finding in the literature on aging and emotions suggests that tension thresholds are particularly strongly affected negatively for those older individuals who already suffer from emotion regulation problems, such as anxiety or depression. In a study by Andeoletti, Veratti and Lachman (2006), older adults who specifically suffered from anxiety related to cognitive problems recalled fewer

words than those without such anxiety. In contrast, younger adults were not similarly affected by their existing anxiety levels.

Evidence for the conclusion that the relation between age and emotion regulation is differentiated according to age level was also reported by Jain and Labouvie-Vief (2010) in a study that examined the relationship between attachment styles and emotion regulation. The hypothesis was that insecurely attached older adults would be more susceptible to problems of overactivation. Results revealed heightened activation to fear and anger words in the elderly, but no such effect existed in the younger individuals.

The studies and results discussed so far are just a selection of a large body of emotion regulation differences in young versus aging adults. Even so, they suggest that aging brings vulnerabilities, especially if situations are such that existing emotional problems may come to interfere with emotion regulation. How can aging individuals themselves respond to the challenges posed by these age-related changes?

One strategy to cope with declining resources was discussed by Lawton and Nahemow (1973). These authors also proposed that aging brings unique challenges to emotion regulation; however, they also suggested that these challenges could be constructively confronted. From an equilibrium perspective, well-being is best maintained close to one's equilibrium range. To the extent that equilibrium maintenance can be disturbed in aging, it is however possible to respond with constructive actions. One of those implies that elders intentionally reduce the complexity of their lives by effecting changes—specifically, changes that reduce the complexity of daily living as well as the demands placed on themselves. By so doing, elders can maintain emotional activation within tolerable, comfortable levels.

In sum, it appears that aging affects the processing of emotional information in ways that are rather consistent, and that reflect a reduction of effective equilibrium-maintaining mechanisms—specifically, a lowering of thresholds of tension and a greater likelihood of the breakdown of effective downregulation of emotion in a variety of situations, particularly ones the involve a high level of stress. Overall, then, the results of emotional aging present a mixed image of possible strengths but also notable difficulties in the regulation of emotions.

7.6 Selected Empirical Findings: Later Life and the Integration of Emotional Knowledge

This section provides a selected review that highlights the diverse roles of emotional activation in later life. We begin with findings that suggest more integrative and positive results, and go on to findings that underline problems of vulnerability to negative emotional activation.

Throughout this book we highlighted a cognitive-developmental conception of emotions that potentially covers the total life span. Such a conception is a relatively latecomer to developmental psychology and was stimulated by an interest in how to

extend Piaget's notions of cognitive development into adulthood. In this endeavor, a number of theoretical proposals and research studies appeared that suggested that the integration of cognition and emotion appears to continue well into adulthood. However, a consistent emergent finding points to the conclusion that in the very old, integration becomes considerably more difficult.

7.6.1 Affect Complexity Decreases from Middle to Late Adulthood

In the specifically emotional realm, Labouvie-Vief and colleagues (Labouvie-Vief et al., 1989; Labouvie-Vief, Chiodo, Goguen, Diehl, & Orwoll, 1995) investigated the trajectory cognitive–emotional complexity across the life span. Affective complexity was measured by coding people's understanding of emotions and their description of their self and other people. Findings showed a reversed U-shaped function with a tremendous increase from adolescence to middle adulthood and a small decline thereafter: Middle-aged adults showed more insights into emotions, a more differentiated view of self and others, and were more able to integrate positive and negative emotions. Compared to middle-aged adults, older adults' level fell to those of adolescents. These cross-sectional findings about the developmental trajectory of affect complexity have been confirmed in longitudinal studies (Helson & Soto, 2005; Labouvie-Vief, Diehl, Jain, & Zhang, 2007).

In our own studies, older adults also reported consistently more positive and less negative affect (i.e., more affect optimization) than young adults did. At first glance, this seems to contradict the finding of decreased affect complexity in old age. However, increases in affect optimization may be a compensatory adjustment to declining resources. In particular, they were especially pronounced in a "self-protective" group that was characterized by high optimization but low complexity—quite in contrast to an "integrated group" that was *high* in both dimensions (Labouvie-Vief & Medler, 2002). The distribution of the patterns suggested significant increases in integration from adolescence and early adulthood to middle adulthood. Only about 14 % of the 10–30 age group was classified as integrated, compared to 43 % each of the middle aged and elderly. These integrated individuals generally displayed the most positive developmental outcomes. They scored high in positive but low in negative affect, yet were comfortable acknowledging negativity. They reported high well-being, empathy, health, and a secure relationship style. In contrast, self-protective individuals displayed a more mixed pattern. Compared with the integrated, they placed less emphasis on personal growth and scored higher on conformity, denial, and repression but very low on doubt and depression—and especially low on empathy.

Self-protective individuals were most likely to be elders; they and the integrated were least likely to be young. Thus, our research agrees with studies showing high levels of negativity in youth and adolescence, but adds that this likely reflects a developmental transition in which integration remains difficult.

As far as the dramatic increases in the more simplifying, self-protective style of elders is concerned, one interpretation is that this is a self-protective style that is initiated with increasing vulnerability in regulating homeostatic processes, including emotions. Indeed, research evidence (see Labouvie-Vief, Grühn, & Mouras, 2005) suggests that high complexity puts some elders at risk, as challenges to integrative capacity induce a more global style. Hence the increase in affect optimization may reflect a simplification of emotion schemas in old age as an attempt to protect the self from overactivation.

Longitudinal data provide direct support for the compensatory interpretation (Labouvie-Vief et al., 2007). Over a 6-year period, decreases in affect complexity were significantly related to increases in affect optimization. Consistent with the compensatory interpretation, this effect was only evident among older adults. Also in agreement with our findings, research on age-related differences in attributions has also shown that, when older adults are asked to evaluate social relationships or social situations, they tend to rely more on stereotypical information than do younger adults (Blanchard-Fields et al., 1999; Mather, Johnson, & De Leonardis, 1999; von Hippel, Silver, & Lynch, 2000). This suggests that compared to younger adults, older adults—due to their reduced resources—tend to simplify their reasoning on emotional processes.

7.6.2 Symbolic Processing Is at Its Height in Later Life

At the same time as elders may simplify cognitive–emotion processing, the prevalence of the integrated along with the self-protective style points to the potentially vast individual differences among groups of elderly and warns against any simple generalization about one single pattern of emotional aging! Thus, whereas some elderly need to defend themselves against the emergence of emotions they have tended to ward off, it is possible that their very susceptibility is a gift to those that are well integrated. Those individuals are more likely to use the resulting activation towards a broadening of their inner lives and their understanding of the emotional condition—a movement Bernice Neugarten (1968) long ago referred to as an inward shift in later adulthood.

One sign of this inward shift is a general way in which individuals' relationship to information becomes restructured. For the young adult, information is seen as an outer given that one attempts to reproduce in a literal way. In contrast, middle and older adults turn more to the landscape of human motivations and intentions. Hence, they may become experts at the processing of information relating to subjective processes and inner dynamics. Although this symbolic processing style can result in deficits on the literal level, they may imply a richer psychological texture.

The shift from a more text-dependent mode to one that is more interpretive and subjective was shown in a series of studies (for review, see Jepson & Labouvie-Vief, 1992) about individuals' rendition and interpretation of narratives. For example, in one study adults in their twenties and their seventies were told to provide either a

detailed recall or a summary of a fable about a crane who put its neck down a wolf's throat to dislodge a bone stuck there, but who, when asking for the promised reward, was told to be glad to get away with its life. The young adults in both conditions produced detailed, almost verbatim, reproductions of the fable. But the older adults only did so if specifically instructed to recall as much as they possibly could. When asked, however, to provide a summary, they were concerned with a completely different kind of recall. One older adult, for example, gave this response: "The moral of the story as I understood it was that people should not seek a reward for their well doing, but to be content with having done a good deed…..Many times people who do good deeds receive only a spiritual reward for their well doing (Labouvie-Vief, 1994, p. 200)."

What was interesting about this style of responding was that it reflected little of the actual detail of the story. Yet, the essential meaning was coherently conveyed and meaningful related to the actions of the story protagonists. Moreover, meaning was framed in terms of an overall moral or spiritual meaning. Thus, these older individuals were not so much interested in the specific actions of each protagonist, but in what these actions had to say about the human condition in general.

7.6.3 Older Adults' Information Processing Is Dependent on the Presence of Emotional Integration

Research also suggests that older individuals' performance in more experimental cognitive tasks is enhanced if these settings permit them to call upon their inner orientation and that as a result, typical age-related differences may be reduced if older adults can work with tasks that are personally meaningful or relevant. For example, older adults are more accurate in making trait inferences and recall more information about a target that is similar in age (Hess, Rosenberg, & Waters, 2001) or demonstrate particularly enhanced cognitive abilities such as comprehension or text processing under personally relevant condition. In the same vein, assessing younger and older adults' memory Rahhal, May, and Hasher (2002) showed that older adults' deficits are reduced when they have to deal with affective or value-based information such as truth or moral character. More recently, studies on age-related differences on everyday problem solving tasks found that in specific situation such as interpersonal or emotionally salient problems older adults can be even more effective than those of young adults. Indeed, older adults are capable of a greater flexibility and adaptability in the choice of the strategy that best match the context of the problem than younger adults.

Taken together, these results suggest that performances of the elderly improve significantly when they can rely on their knowledge and experience. We suggest that one interpretation for these improvements is that performance of the elderly is particularly dependent on facilitation effects or more precisely on the emotional activation that in turn produces such facilitation. The burden of processing is then

no longer placed on the effortful conscious processing system, which is impaired in later life. In contrast, younger individuals with their stronger executive functions are less dependent on such facilitation effects. This interpretation is in line with the well-known increase of age differences in free recall tasks compared to recognition tasks: whereas recognition relies on external activation (i.e., experimental presentation of stimuli), free recall depends exclusively on internal production of stimuli. Free recall tasks usually lead to an increase in age-related differences in memory performance. Such results suggest that the elderly may have difficulties in encoding representations, or generating already available ones, unless any external activation is provided. Thus, at low and suboptimal levels of activation, age differences are more obvious than at optimal levels of activation.

7.6.4 High Activation Is More Problematic for Older Adults

In contrast to the findings just discussed that suggest that integration with personal experience can be an asset for older individuals, there is, nevertheless, also growing evidence that the tighter integration of the cognitive and affective systems in later life can put elders at a disadvantage. This is particularly so if stimulation is very strong and rather negative; in those cases, one would predict that high and very high levels of activation are more problematic for older adults than for young adults, and that they make great demands on the capacity to regulate tension. Thus in such situations, one should in general find that elders increasing problems with downregulating activation can become debilitating especially in tasks that require inhibitory activities. Below, evidence of these debilitating effects in a variety of domains is listed.

7.6.5 High Arousal Information Is Judged More Negatively by Elders

Recent evidence suggests that older adults perceive high activation as negative, and that they judge it as more negative than young adults do. Grühn and Scheibe (2008) investigated young and older adults' evaluations of 504 emotional pictures and reported that older adults rated negative pictures as more negative and arousing and than young adults did, and positive pictures as more positive and less arousing. Overall, they found strong linear association between valence and arousal—an association that was higher for older adults ($r = -0.95$) than for young adults ($r = -0.85$). Gilet et al. (2009) examined the evaluations of young, middle-aged, and older adults for 835 French adjectives. These authors also found a strong linear association between valence and arousal that increased from young to middle to late adulthood ($r = -0.63$, $r = -0.78$, and $r = -0.85$, respectively). Interestingly, these findings suggest earlier reports by Bradley and Lang (1999) that older women judged high arousal positive stimuli as negative. These findings are consistent with

previous results reported by Cuthbert, Bradley, and Lang (1988). They showed that rather than forming a curvilinear relation, pleasure, and arousal ratings formed a more linear relationship, older women judging high arousal stimuli as negative. In the latter case, the high-arousing stimuli were erotic in nature but in the Grühn and Scheibe and Gilet et al. studies the effect appeared to be a more general one and independent of specific content. These studies highlight that high-arousing material is generally perceived as more negative by older adults, although a weaker trend exists for younger adults, as well.

7.6.6 High Arousal + Reduced Resources Disrupt Information Processing in Elderly

If older adults find strong activation more disagreeable, one would also predict that they are more strongly affected by manipulations that vary the arousal level of the material. In a study using an Emotional Stroop paradigm,[4] Wurm et al. (2004) investigated the effects of low- and high-arousing word material on response latencies. Older adults showed significant increases in response latencies for high-arousing but not for low-arousing words. Young adults, in contrast, did not show any differences at all in response latencies between low- and high-arousing materials. Since emotional Stroop tasks require that individuals inhibit the highly automatic semantic word meaning in favor of the color of the word, the results indicate that high arousal disrupts the processing for older individuals. Somewhat converging evidence was reached in two studies by Grühn and colleagues who investigated age differences in emotional memory. One experiment used relatively low-arousing word material (Grühn, Smith, & Baltes, 2005), whereas the other one used high-arousing emotional pictures (Grühn, Scheibe, & Baltes, 2007), as to-be-remembered material. In both studies, negative material was better remembered than positive and neutral information. However, when comparing young and older adults' memory performance for specifically emotional material, age-related differences emerged only in the pictorial but not the verbal stimuli: Young adults recognized more negative than positive and neutral pictures whereas older adults showed hardly any difference in recognizing positive, negative, and neutral pictures. One interpretation for the difference in age-related patterns relies on differences in levels of activation, especially for negative information. Thus, arousal may have different effects for young and older adults' memory. This interpretation is also supported by examining the association between at memorability scores for individual pictures and their associated arousal levels (Grühn & Scheibe, 2008): Whereas young adults showed no specific associations between memorability and arousal levels

[4] Individuals are presented the words of colors (e.g., "green,") but in colors that do not correspond with the semantic meaning of words presented. Because semantic meaning is strongly crystallized in the elderly, it is expected to interfere with the task requirement—i.e., to just label the color of the word.

(partial correlations controlled for valence: $-0.04 \leq r \leq 0.02$), older adults showed a small, but consistent and significant negative relation (partial correlations controlled for valence: $-0.10 \leq r \leq -0.18$). Thus, older adults' performance is hindered by high levels of arousal.

7.6.7 *Polarization and Stereotypical Thinking Is Increased in Some Older Adults*

One specific way in which emotion processing tends to be disrupted in elders is that individuals' capacity to coordinate positive and negative information in self and others is likely to be lowered dramatically if they need to work in situations of high arousal (Labouvie-Vief & Medler, 2002; Paulhus et al., 1989; Paulhus & Lim, 1994, also refer back to Chap. 3 for the relationship between stress and performance). Such coordination is a skill of high computational and developmental complexity (Harter & Monsour, 1992), and lowering of cognitive resources and/or the activation of strong emotion is often related to an increase in self-protectiveness as well as of stereotyping. Further, as already indicated, self-protective elders report high positive and low negative affect in the presence of low emotional complexity; yet these same individuals are particularly low in empathy, suggesting that negative traits are projected outward onto others. As a result, some older individuals relied more strongly than college students on stereotypes in a source-monitoring task that contrasted Republican versus Democrat and writer versus athlete schemas (Mather et al., 1999). Stereotype reliance was enhanced for both young and old adults when instructed to focus on their feelings; further, susceptibility to stereotyping was related to measures of prefrontal cortical control, supporting the hypothesis of a reflective control deficit. In a similar fashion, von Hippel et al. (2000) reported that elderly individuals, when compared with younger individuals, relied more strongly on stereotype processing even when instructed to inhibit their stereotypic association.

7.6.8 *Persons Under High Activation, Especially Elders, Are More Susceptible to Stereotypes*

Further evidence for older adults' difficulties maintaining balanced self-and-other representations has been reported from Blanchard-Fields et al.'s (1999) research on attribution styles across the life span. In a series of studies, participants were given a variety of vignettes and were asked to make a causal attribution about the main character's role in a negative outcome. Blanchard-Fields and colleagues consistently observed that older adults and adolescents made less differentiated or "dialectical" attributional explanations than did young and middle-aged adults. This was

especially true in negative relationship outcomes, where the elderly tended to attribute the cause of negative outcome more to internal characteristics of the primary agent than young adults did (Blanchard-Fields et al., 1999).

One of the specific ways in which emotional processing is disrupted is a reduced capacity to integrate the tension between attributes of opposing valence. For example, young adults tend to react to situations of high activation or reduced resources by increasing the positivity and decreasing the negativity of self-reports (Paulhus et al., 1989). Persons under high activation show also a more negative representation of others and they are less resistant against stereotypes (e.g., Paulhus & Lim, 1994).

7.6.9 Preexisting Regulation Difficulties Affect Performance of Elders More Strongly

The studies just cited varied arousal levels experimentally, but another way to examine the relationship between arousal and cognition is to make use of individual differences in empirical evidence dimensions that are related to emotion regulation. For example, older adults with high cognitive-specific anxiety recalled fewer words than older adults with low cognitive-specific anxiety. Young adults, in contrast, performed well irrespective of their anxiety level (Andeoletti, Veratti, & Lachman, 2006). Similarly, older adults showed significant negative associations between anxiety, depression, and withdrawal on the one side and word recall on the other side. Young adults showed slightly positive but nonsignificant correlations between these ratings and word recall, thus offering empirical evidence that arousal has a negative effect on memory performance for older adults but not for young adults Young adults showed slightly positive but nonsignificant correlations between these ratings and word recall (Deptula, Singh, & Pomara, 1993); see, however, (Cavanaugh & Murphy, 1986; Whitbourne, 1976). In a similar vein, Hogan (2003) investigated young and older adults' performance in a divided attention task. In this study, greater anxiety was related to poorer performance for older but not for younger adults. In sum, these studies suggest that high activation degrades performance in older adults, but less so in young adults for whom anxiety may even work to raise performance levels.

7.6.10 Stronger Physiological Reactivity to High Stress Situations

Empirical evidence on age-related differences in physiological reactivity is somewhat contradictory. On the one hand, research on emotional stimuli suggests an age-related decrease in physiological reactivity (Levenson, Carstensen, Friesen, & Ekman, 1991; Tsai, Levenson, & Carstensen, 2000). For example, older couples showed less physiological reactivity during marital conversations than young couples

(Levenson, Carstensen, & Gottman, 1994). However, in contrast to the assertion that low levels of physiological reactivity represent age-related increase in emotion regulation abilities is research on stress that suggests an age-related increase in physiological and especially, cardiovascular reactivity (Jennings et al., 1997; Uchino, Holt-Lunstad, Bloor, & Campo, 2005). For example, Jennings et al. (1997) examined cardiovascular reactivity to mental challenge in 902 men ranging from 46 to 64 years. Despite the small age range, the authors found a clear age-related increase in cardiovascular reactivity. This cross-sectional pattern was also supported by a longitudinal study. Uchino et al. (2005) examined cardiovascular reactivity during acute stress in middle-aged and older adults. Independent from other demographic or health-related factors, they found an age-related increase in some indicators of cardiovascular reactivity (systolic blood pressure and respiratory sinus arrhythmia) over a 10-month period.

In line with the interpretation here proposed, these seemingly contradictory patterns may reflect differences in the degree to which situations are stressful or activating. In line with this argument Uchino, Berg, Smith, Pearce, and Skinner (2006) argued for a threshold effect: Older adults, in contrast to young or middle-aged adults, show lower reactivity at lower levels of activation (i.e., stress) but stronger reactivity at higher levels of activation. This argument is also consistent with results from Kunzmann and Grühn (2005), who investigated age-related differences in emotional reactivity by creating clips of films that dealt with topics highly significant for aging adults, such as confrontation with Alzheimer's disease and found that older adults' reactivity as measured by subjective, self-report measures was higher than that of young adults.

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ERRATUM TO

Chapter 3
Expansion and Reorganization in Development: Neurobiological Mechanisms

G. Labouvie-Vief, *Integrating Emotions and Cognition Throughout the Lifespan*, DOI 10.1007/978-3-319-09822-7_3

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On page 30, the citation Fig. 5.1 in the paragraph "Neurons come in a variety…in the form a neurotransmitter" is incorrect.

The correct citation should read as follows.

These are indicated in the prototype of a neuron in Fig. 3.1: *first* is an input region (a), *second* a region that triggers a nerve impulse (b); *third*, the nerve impulse is then propagated along a projection serving impulse conduction called *axon* (c); this region of conductibility is subdivided into different subregions by the *nodes of ranvier*.

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