Advanced Review

The development of emotion

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Given that they are responsible for much of the meaning that we attribute to our existence, emotions could be said to have a central role in the psychological life of humans. But given this fundamental level of significance, the construct of emotion remains poorly understood, with the field of emotion research being full of conflicting definitions and opposing theoretical perspectives. In this review, one particular aspect of research into emotion is considered: the development of emotion in infancy and early childhood. The development of the emotional life of the child has been the focus of a vast amount of research and theorizing, so in a brief review it is only possible to scratch the surface of this topic. Rather than any attempt at a comprehensive account, three perennial questions in theorizing and research on early emotional development will be considered. First, what develops in emotional development? Second, what is the relation of cognitive development to emotional development? Third, how has the study of early individual differences in emotion expression typically been approached? In relation to the first question, four theoretical approaches to emotional development are described. For the second question, the focus is on the relation of self-awareness to the development of emotion. Finally, for the third question, the use of temperament theory as a framework for understanding individual differences in emotion expression is examined. *WIREs Cogn Sci* 2010 1 417–425

In the space of the first 3 years of life, the developing human undergoes very dramatic changes across all domains of development. Physically, a typical infant doubles its length and quadruples its weight. Among many other developments, he or she typically also develops the capacities to independently locomote, to use and understand spoken language, and in the process become an active participant in his or her cultural community. In everyday observations of children's psychological development, one other particularly striking change concerns the emotional life of the infant. As a neonate, an infant appears to have an organized but relatively limited range of emotional expressions from contentment and interest to distress. By the third birthday, the emotional repertoire of the young child has become much more elaborate. As well as expressing a wider range of 'basic' emotions such as anger, fear, sadness, or joy, the young child has now developed the capacity for more complex emotions, such as embarrassment, pride, shame, and guilt. These simple observations raise many important and difficult questions which lie at the intersection of the developmental, affective, and cognitive sciences. Of these questions, three will be briefly considered in this selective review: (1) What develops in emotional development? (2) How does emotional development relate to cognitive development? (3) How has the study of individual differences in infant emotion typically been approached?

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WHAT DEVELOPS IN EMOTIONAL DEVELOPMENT?

Above and beyond the description of which kinds of emotions may be observed in infancy and the age ranges and contexts in which these emotions begin to be expressed, developmental models of emotion concern the processes through which the emotional life of the infant might unfold. At the heart of such models lies a question that was framed by Mascolo and Griffin[1] as 'What develops in emotional development?' One starting point for addressing this question is to categorize theories of emotion according to their theoretical assumptions, and then to examine how developmental considerations relate to these assumptions. There are four main contemporary metatheoretical paradigms

under which the construct of emotion has been studied: structuralist, functionalist, sociocultural, and dynamical systems approaches.[2,3] Although the latter two have seen the most applications to developmental theory, all four are briefly considered here.

Structuralist approaches focus on the form of emotions, and as such are mainly concerned with emotions as discrete combinations of overt behavior (e.g., facial expressions), physiological states, and emotional experience. This theme is reflected in the structuralist emphasis on classifying single, discrete emotions as particular combinations of objective (overt behavioral and physiological) and subjective responses. The subjective component of emotion is usually seen as first-person experience of emotion, as accessed by having individuals report on which the emotion they are experiencing. From a structuralist perspective, the subjective component of an emotion is a product of perceiving the bodily movements and physiological changes that comprise the objective component of the emotion. The objective aspects of an emotion (i.e., the expression) are therefore posited to be tightly linked to the subjective (i.e., experiential) components.

In terms of structuralist approaches that have included developmental considerations, the primary model is Izard's Differential Emotions Theory (DET; see Refs [4,5]). In this model, discrete emotion states reflect innately specified combinations of objective (i.e., expressive and neurophysiological) and subjective (i.e., experiential) components. From this perspective, the expression of discrete emotions occurs in early infancy, following a period of neurological maturation in the first weeks of life. As is commonly seen in structuralist approaches, DET puts an emphasis on facial expressions of emotion as direct manifestations of the activity of the emotion system, and it posits a one-to-one correspondence between particular expressions and discrete emotion states across the lifespan.[6] The major developmental assumptions of DET also include the notion that the infant facial expressions share close similarities with corresponding expressions in adults, and that specific expressions are reliably elicited by infants in appropriate contexts.[7] For the application of DET to emotional development, Izard developed particular coding systems for identifying facial expressions of emotion in infants.[8]

As noted by Camras and Fatani,[2] the original formulation of DET has been challenged on a number of fronts, including a questioning of its key assumptions such as the universality of facial expressions of emotion and the correspondence between objective and subjective aspects of emotion. DET has also faced questions from developmentalists. For instance, rather than showing differentiated facial expressions of anger, it has been suggested that young infants tend to produce more undifferentiated expressions of distress.[9]

Returning to the question of what develops in emotional development, it could be said that in proposing a relative invariance in the form of emotions across the lifespan, DET is not a particularly developmental theory. A more nuanced, structuralist approach comes from differentiation theories of emotional development, which have their origins in the work of Bridges.[10] Broadly construed, differentiation theories see discrete emotions as emerging from simpler precursors, such as distress or pleasure. The primary contemporary example of such a proposal comes from Sroufe.[11] While his account could still be considered to have structuralist overtones, it is more developmentally sophisticated, is more oriented toward a systems approach, and differs from DET in a number of important respects. For instance, compared with DET, Sroufe proposes a much looser developmental correspondence among facial expressions, the situational factors that elicit emotion, and the other behavioral and experiential components of emotion.

Although related accounts such as that of Sroufe[11] do not emphasize a tight linkage between emotion components in early development, in many ways the coherence of the classical structuralist account of emotion depends on a convergence between the subjective and objective components of emotion. However, it is widely agreed that this dependence has not received wide-empirical support, a problem which promoted the emergence of *functionalist* approaches that diminish the importance of the form of an emotion and instead place particular explanatory value on the function that the emotion fulfills for the individual in their particular context.[12] Evaluation of the function of an emotion involves a consideration of how the emotion fits within the activity of the individual, and how it relates to his or her goals or motives. Such an examination of function necessarily entails examining the broader contexts in which emotions are expressed or experienced, and as such it calls for a more systems-oriented view. While functionalist approaches do allow for the possibility that particular emotions may be more likely to be linked to particular patterns of responding than others, these links are posited to vary according to the specific context—with the response being primarily tailored to meet the individual's goal.[13] In functionalist approaches, a comparison or appraisal of the individual's situation with their goals results in a readiness to act and adjust the relation

between the individual and the environment in an attempt to meet those goals. From a developmental perspective, a functional approach would view facial expressions of emotion in infancy as fulfilling a primarily communicative function rather than representing the observable component of a discrete emotion.[14] It should be added, however, that the specific implications of functionalist approaches for developmental theory have not been fully explored.[15] In this sense, the question of what develops in emotional development needs to be further elaborated from a functionalist perspective.

The third metatheoretical category considered here concerns approaches that have emphasized *sociocultural* influences on emotion and emotional development. In these approaches, what develops in emotional development is the nature of the participation of the infant and young child in cultural scripts and practices concerning emotion. Such approaches open up the study of emotion to include broader contexts from interpersonal interaction through to broader cultural themes related to the expression and regulation of emotion. As noted by Holodynski and Friedlmeier[3] 'culture... provides scripts and patterns of meaning regarding which emotions have to be discriminated on the basis of which forms of expression, and which means of regulation are available and appropriate' (p. 37). Contrasts between sociocultural approaches to emotion and other metatheoretical perspectives (particularly structuralism) have been the subject of much debate in the literature. However, virtually all developmental theorists include a consideration of sociocultural influences on emotional development, including the structuralist DET approach, which acknowledges the role of culturally generated display rules in the expression of emotion.[7] Similarly, in differentiation approaches, one key question concerns the factors that determine the way in which the range of emotions become differentiated from a more generalized starting point. Although some theorists have proposed that this differentiation occurs mainly through maturational processes,[16] others put more emphasis on early interactions with caregivers in driving the elaboration of children's emotional lives.[11] For instance, in Holodynski and Friedlmeier's[3] internationalization model of emotional development, the developmental coordination of facial expressions of emotion with other behaviors indicative of specific emotions and the characteristics of emotion-eliciting situations occurs through socialization experiences with caregivers in infancy. This model also draws on a developmental literature documenting the mirroring of infant expressions by caregivers, and the association of this mirroring with particular contexts as well as with other appropriate emotion-related behaviors.

The final metatheoretical perspective on emotional development comes from theorists working in the area of dynamic systems theory (DST). This approach is closely aligned with developmental systems theory[17] in emphasizing development as a product of 'complex systems involving multiple components or subsystems at multiple levels of analysis'[15] (p. 629). Although there are a number of flavors of DST, all share an emphasis on the relations between parts of a system rather than assigning developmental or mechanistic primacy to any one particular part of that system.[18] In this respect, DST goes against purely maturational theories of emotional development or theories which see the development of emotion as being primarily dependent on socialization or on the development of certain cognitive abilities (see below). As a metatheoretical approach, DST holds great promise for developmental science in general,[19,20] and with its emphasis on self-organizing processes, it has found a good deal of utility in the study of emotional development.[15] The DST approach also provides for a fairly detailed picture of what develops in emotional development and as such is perhaps the most developmentally oriented theoretical approach of those considered here. However, space limitations preclude a detailed description of DST approaches to emotional development here, and the reader is referred to accounts which relate recent progress in this area.[18,21,22]

HOW DOES EMOTIONAL DEVELOPMENT RELATE TO COGNITIVE DEVELOPMENT?

The relation of cognition to emotion has been one of the most hotly contested issues in the field of affective science. This issue came to the forefront in the latter part of the 20th century with the elaboration of cognitivist theories proposing that emotions are not the discrete states proposed by structuralism, but are instead a product of cognition.[23,24] The ensuing debate about the relation of cognition and emotion was partly reflected in a series of exchanges concerning the status of so-called 'basic' emotions,[25–29] a debate which recently resurfaced in a slightly different context.[30–35]

Although classical cognitivist theories of emotion did not say much about how emotions as cognitions might develop, developmental psychologists have given a fair amount of consideration to how the expression and experience of emotion depends on the cognitive capacities of the child.[36] Such considerations are part of Michael Lewis' influential account

of the development of complex emotions, which will be taken as a starting point for the present discussion of emotion–cognition interactions.

In the theorizing of Lewis,[16] emotional expression in the first months of life is characterized by the appearance of contentment or joy, distress (which can be further broken down into sadness, disgust, anger, and fear), and interest or surprise. For Lewis, the expression of the emotions in early infancy reflects the infant being in a particular kind of emotional state, without the infant being aware of or perceiving that he or she is in that state. Lewis therefore makes a distinction between being in an emotional state and experiencing an emotion, with the latter seen as being dependent on the child's cognitive capacities. In defining emotion experience, Lewis does not tie experience to either an internal state or a cognitive construction, but instead takes a moderate line that emotion experiences 'occur through the interpretation and evaluation of states, expressions, behaviors of others, and beliefs about what ought to be happening' (see Ref [37], p. 312) and as such they must depend on cognitive abilities, such as recall, discrimination, and learning. This approach naturally leads to the suggestion that the emotional experience of infants is likely to be quite different from the emotional experience of older children and adults. Furthermore, in Lewis' model the development of a certain emotion is seen to be dependent on the emergence of particular cognitive capacities that support the experience of that emotion. This point has been particularly elaborated in the context of the dependence of complex emotions on the development of the capacity for explicit self-awareness.[38]

Much work over the last three decades has framed the capacity for self-awareness as the ability to recognize oneself in a mirror, which has typically been assessed using the well-known 'rouge test'.[39] In this experimental protocol, an infant's nose is surreptitiously marked prior to exposure to a mirror. Between 18 and 24 months of age, most infants begin to show signs of self-recognition in this task through touching their nose to investigate the mark, although the development of an individual infant's performance on this task is somewhat chaotic.[40] Lewis has proposed that along with other indicators (e.g., beginning to use personal pronouns), the development of self-recognition as indexed by success on the rouge task indicates the development of self-awareness or self-consciousness toward the end of the first 2 years of life.[41] From this perspective, the development of self-awareness opens up new emotional vistas for the infant or young child. At around 2 years of age, it initially allows for the emergence of nonevaluative 'complex' emotions, such as exposure embarrassment, jealousy, and empathy. Over the course of the following year, it then allows for the experience of emotions associated with the comparison of one's behavior with the socially expectable norms established by the cultural community. These emotions, which depend on the acquisition and retention of standards and rules, include evaluative embarrassment, pride, shame, and guilt.[42]

The model of Lewis raises a number of particular questions. For instance, if the development of complex emotions is indeed driven by cognitive developments related to self-recognition, what mechanisms might then underlie the development of self-awareness? Lewis himself takes a specific perspective on this question, attributing the emergence of self-recognition to the maturation of a particular brain region, the temporal parietal junction (TPJ; see Ref [43]). Evidence for this proposal comes from a novel structural neuroimaging study of infants aged between 15 and 30 months,[43] which is the time period within which children typically begin to show self-recognition in the rouge test. The sample under study had been recruited from a population of families whose infant was receiving a structural brain scan to rule out neurological problems. The families consented to having the magnetic resonance imaging (MRI) data used along with further measures of their child's capacity for self-recognition or self-awareness. In addition to performance on the rouge test, these measures included the extent of personal pronoun usage and the frequency that the child engaged in pretend play. Brain maturation, as assessed by the relative amounts of gray and white matter, was assessed in various cortical regions of interest, but the only brain region where maturation related to a composite measure of self-representation was the left TPJ. Although Lewis and Carmody[43] favor a maturational account, they acknowledge that their findings do not preclude a role for experiential factors in the relation between TPJ development and self-representation abilities. While delineating this role will be a challenge, some would argue that it needs to be done, because a strictly maturational account is not entirely satisfactory as a developmental explanation (see Ref [44]).

Another fascinating question is what kind of emotional experience might be possible in the absence of explicit self-awareness as defined by Lewis. This question rapidly leads to a number of others, including the question of what infants might 'know about themselves' prior to the onset of mirror self-recognition (i.e., in the first 18 months of life). The notion that young infants express, but do not experience, emotion presents a somewhat barren picture of the emotional

life of children in the first year and a half of life. But it would seem that to address this from an alternative perspective, the concept of experience could be broken down. To do this, let us return to the construct of experience itself. For Lewis,[37] 'Emotional experience is the interpretation and evaluation by individuals of their perceived emotional state and expression' (p. 272) and as such emotion experience reflects a combination of attention to physiological states, situational factors, other's behavior, and one's own expressions. So what would experience be without the capacity for such interpretation and evaluation? One way to approach this is to make a distinction between reflective and prereflective experience. This approach to different types of experience in infancy is exemplified in a different context by Gallagher,[45] who distinguished between an innate body schema, or a 'system of sensory-motor capacities that functions without awareness or the necessity of perceptual monitoring' (p. 24), and a more cognized body image which is the product of conscious reflection about one's own body. For Gallagher, the intermodal connections between perception and action that comprise the body schema do not need to be cognized or reflected on. This relates closely to notions of a prereflective self-awareness that could be considered part of what Neisser[46] termed the 'ecological self', which is essentially present from birth, in contrast to the more representational self that Lewis sees emerging late in the second year of life. These selves are not mutually exclusive. Self-development can be seen as beginning with an implicit ecological self in the physical and interpersonal domains, which is later joined by an explicit self, which is capable of conscious reflection. However, the mechanisms by which the explicit self emerges remains a matter of open speculation and the focus of much debate.[47]

Of course, these issues also relate to an extensive debate concerning the distinction between procedural/implicit and declarative/explicit processes in cognitive development in infancy. For some theorists, language is the key to the emergence of explicit thought (including self-awareness), propelling the infant from the implicit sensorimotor existence of the first 2 years into the realm of abstract thought.[48] In the context of emotion experience, if more complex emotions are indeed dependent on self-awareness, which in turn is dependent on language, this brings up the question of what kind of self-awareness can be present without language. In an interesting exploration of this question, Bermúdez[49] tied the ability to 'think about thoughts' to the 'ability to think about words' (p. 151) but he also acknowledged that nonlinguistic processes can have a fairly wide scope in human life. For instance, he notes that 'the mutual control of attention and resource allocation in coordinated social activities does not require the intervention of language' (p. 152). These kind of activities have a good deal of significance in infancy, as exemplified by the 'affect attunement' between infants and caregivers that was characterized by Stern.[50] Such affective coordination could be seen as the communication of emotional states, a process which (while it may be considered 'intentional') should not be considered reliant on language or other symbols.[49] As emphasized by Noë,[51] the facial expressions and vocalizations in these interactions could be considered as enactments of emotional states, not symbols of them. Such a view is related to theoretical accounts stressing the intersubjective nature of early interactions between infants and caregivers.[52]

Although the concepts of prereflective awareness, enactment, or intersubjectivity may not be particularly popular among mainstream developmental psychologists, they may have more to contribute to the study of emotion than a first glance might suggest (see Ref [53]). However, these issues remain controversial and there is relatively little interplay between opposing accounts. But perhaps this may change with the increasing visibility of alternative perspectives in developmental science which emphasize interactions and activity over representation in a conventional sense.[54] It is suggested here that a change in focus may also help to clarify the relation of bodily and cognitive processes in emotion (see Ref [55]). Although this aspect has not been the focus of much developmental work, Colombetti and Thompson[56] noted that the study of emotion has been dominated by a split between cognitive and bodily processes, and that a focus on enactive processes could provide a way forward in reuniting them (for a different but related position, see Ref [57]).

HOW HAS THE STUDY OF INDIVIDUAL DIFFERENCES IN INFANT EMOTION TYPICALLY BEEN APPROACHED?

Although it has been somewhat neglected in the major theories of emotional development, the study of individual differences in children's tendencies to express particular emotions has produced a steady stream of findings over the last four decades. Much of this work has been carried out under the banner of temperament theory, which, although it has deeper historical roots, is usually associated with the seminal work carried out by Alexander Thomas and Stella Chess in the 1960s and 1970s.[58,59] As with the construct of emotion, a satisfactory specific definition of temperament is elusive, although most theorists would likely

agree on a general (i.e., vague) description of temperament as biologically based, early appearing, and stable behavioral tendencies.[60] While the research on infant temperament does not solely focus on emotion, one productive line of research has come through the examination of early individual differences in the tendency to produce positive- versus negatively valenced reactions in response to novel or discrepant stimuli in the first months and years of life. The foundational work in this regard comes from the research program of Jerome Kagan and colleagues, who developed laboratory procedures for assessing the reactions of infants and young children to unfamiliar and discrepant stimuli.[61,62] Although the continuous versus categorical nature of temperament has been the subject of some debate,[63] Kagan's approach is explicitly categorical. For instance, according to Kagan around 15% of infants have a trait-like tendency to respond to unfamiliarity or discrepancy with high levels of negative reactivity, with these infants being likely to show continued withdrawal reactions to novel stimuli throughout childhood[64,65] and even into adolescence.[66]

A perennial question in this area of emotional development is whether temperamental tendencies have primacy over caregiving influences in determining developmental outcomes, or vice versa.[67] Although the nature of this question raises serious conceptual and methodological problems, it is still at the heart of many discussions of temperament, and there remain simmering embers from vigorous debates in the 1990s between opposing theorists. The debate appears to have lessened since that time, in part through empirical data suggesting a rapprochement between attachment and temperament.[68,69] The quieting of this debate may also reflect the resurgence of models which stress a transactional approach,[70] as well as the growing influence of ideas from developmental systems theories that behavioral development cannot be easily partitioned into components that reflect the influence of either the individual or the environment. Indeed, one major problem with pitting temperamental tendencies versus the caregiving environment is that it echoes the nature–nurture dichotomy, which has been long discredited as being 'not only false, but sterile' (see Ref [71], p. 426). A developmental systems perspective also does not support such a dichotomy, and instead views the individual as being deeply embedded in an environment, with the boundary between the two being somewhat porous.[44]

One relatively recent addition into this debate concerns findings from the comparative literature suggesting that early caregiving experiences have long-lasting effects on social development through the modification of gene expression.[72] These findings and their translational potential have been of much interest to developmental psychologists who study early social and emotional development. For instance, the epigenetic model of Meaney[73] provided the background for a study by Hane and Fox,[74] who found that the quality of mother–infant interactions was more important than prior temperament in determining affective reactivity to stress at 9 months of age. In some ways, such findings could be taken to reinforce a somewhat one-sided emphasis on the importance of socialization for defining developmental trajectories (see Ref [75]), as exemplified by certain models of social development.[76] On the other hand, models of development based on epigenetic processes may point the way to a potentially powerful successor to the nature–nurture debate, an approach that can be seen as promoting a 'nature through nurture' approach. The work of Meaney and colleagues is the most prominent example of this approach, and there is no doubt that epigenetic models related to early caregiving, which have primarily been eludicated in the rodent literature, provide a fascinating direction for understanding early social and emotional development. However, there remain a number of important challenges for translational work, including the issue that epigenetic alterations in gene expression are tissue-specific and can therefore only be assessed through invasive methods (or in humans, postmortem brain samples; see Ref [77]). So while this approach appears to hold much promise, it remains to be seen how well comparative models of epigenetic influences on social and emotional development can be translated to human work.[78]

CONCLUSION

The study of emotional development is full of fascinating questions, which bridge a variety of disciplines within the cognitive sciences. While the crosscutting nature of these questions should be viewed in a positive light, it could also be said that key questions are addressed in somewhat disparate literatures, and there is a need for truly integrative work, which would bring together scientists across the subfields of social, cognitive, and emotional development as well as researchers and theorists in other domains of cognitive science, such as philosophy of mind, cognitive neuroscience, and phenomenology. Achieving such integration is a notably difficult task, although taking up this challenge is key to pushing the boundaries of our understanding of early emotional development.

Related to the previous point is the observation that in a brief review it is difficult to do justice to

the diversity of the field of emotional development, and as a result only a select few questions have been considered here. It is certainly the case that each question may only be relevant to a small part of human emotional experience, a point that has also been made with regard to the myriad theories of emotion across the entire field of affective science.[79] Of the many other questions concerning the development of emotion, other areas for consideration include the way in which children perceive and understand the emotional expressions of others, how they come to regulate the expression (and possibly the experience) of their own emotions, and how contemporary research in neuroscience relates to theories of emotional development. These areas were not really touched on here, but could be the subject of entire reviews in themselves. For more information on these areas, the reader is referred to other reviews in *WIREs Cognitive Science* as well as the excellent series of developmental chapters in the Handbook of Emotions.[80]

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