

How Are Developing Social Relationships Relevant to Risk and Resilience in Youth Mental Health?

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Abstract

This chapter provides a comprehensive overview of the impact of social context factors, conceptualized as both risk and resilience factors, on the emergence of youth (age 15–24 years) mental health problems. The influences of cultural background (i.e., individualism vs. collectivism) and recent societal developments (e.g., digital media use) are explored, as are innovative technological advances which may aid reliable measurement of such factors in future studies. It critically discusses the concept of a second sensitive period for social experiences to impact youth development starting in adolescence (age 10–19 years). It is argued that goals in social development may undergo systematic shifts across the life span and that social experiences in each developmental phase are interdependent insofar as their effects cascade into successive periods. To further understanding and improve treatment of youth psychopathology, conceptual models need to be broadened to include multiple, interdependent sensitive periods of social development. The timing of social experiences may play a central role in the efficacy of different types of interventions.

Introduction

The transition from childhood to adulthood is a developmental period that is highly influenced by social and cultural contexts. In addition to coping with dramatic changes in their physical appearance, adolescents must master changes in their social environment and accomplish a variety of social tasks as they prepare for adult responsibilities (e.g., productivity or fertility). In parallel, many mental disorders have their onset during this developmental period (Paus

et al. 2008). Most adolescents, however, cope successfully with the transition from dependence on a caregiver to being a self-sufficient member of society, which demonstrates large individual differences with respect to adolescent vulnerabilities.

The adolescent transition period as well as the prevalence of mental disorders may also differ dramatically, depending on cultural context (Lund et al. 2018). An examination of how cultural and societal differences may impact adolescent development is thus crucial if we are to understand how social contexts and experiences may shape and impact youth mental health and well-being. To date, our understanding of how these social contexts influence individual development (i.e., interact with individual differences such as genetic variation) and generate or moderate the emergence of psychopathology is still limited.

In this chapter, we focus primarily on adolescent social and cultural contexts and explore how social experiences may influence youth mental health and the emergence of psychopathology. Specifically, we address the following questions:

- What are the most important social risk and resilience factors to youth mental health? Are these factors influenced by cultural backgrounds and recent societal change (e.g., digitalization, increased use of digital media)?
- How can we characterize and/or quantify social and cultural contexts of psychopathology?
- Is there really a (second) sensitive period for social influences during adolescence? Are the effects of social experiences particularly strong during adolescence?
- How do adolescent precursors, risk, and resilience factors to youth mental health evolve over time? How do they interact and what possible mechanisms underlie the associations between social risk factors and the development of psychopathology?

General Background

Eissler (1958) described adolescent patients as “neurotic at one time and almost psychotic at another.” Although not literally true, this quote demonstrates the markedly fluctuating mental changes that are characteristic of individuals during this developmental period.

Many mental disorders emerge in adolescence. The earlier the disorders manifest in life, the worse the prognosis, its symptom chronicity, and the poorer the treatment response (Paus et al. 2008). Before the age of 25 years, 75% of individuals with mental illness experience their first symptoms (e.g., Kim-Cohen et al. 2003). According to the World Population Prospects, the estimated

lifetime prevalence for any mental health disorder in this age group is around 45%, with a worldwide pooled point prevalence of 13%; this means that currently about 96 million youth worldwide are affected by mental health problems (Erskine et al. 2015). In addition, a higher prevalence of mental health problems is often reported for particular groups: for individuals with lower socioeconomic status or who belong to minority ethnic groups, as well as those living in more rural or remote areas (WHO 2012). Mental health problems in youth increase the risk of negative outcomes, such as lower educational achievement, higher likelihood of engagement in risky behaviors, higher rates of self-harm and suicide, as well as loss of productivity and reduced involvement in the community later in life. The most prevalent and impairing psychiatric diagnoses among children, adolescents, and youth are depression, anxiety, disruptive behavior disorders, attention deficit hyperactivity disorder, and substance use disorders. Risk-taking behavior (e.g., substance abuse, delinquent behavior) and self-harm—both considered early risk markers for psychopathology—are common among youth. In 2010, mental disorders were responsible for ~55.5 million disability-adjusted life years in individuals aged 0–24 years, thus accounting for ~5.7% of total disease burden in this age group (WHO 2012). Given the dramatic increase and chronic course of youth-onset mental disorders, together with the significant individual and societal costs (de Girolamo et al. 2012), it is critically important to enhance resilience and to increase youth mental health through preventive or early interventions. To date, however, appreciation of this increasing global burden of youth mental disorders has been based mainly on epidemiological studies conducted in Europe and North America. In developing countries, youth mental health issues have largely been neglected and the demographics of the global population poorly represented, yet up to 80% of youth worldwide live in low- and middle-income countries (see UN 2003; Atilola 2015).

The transition from childhood into adulthood involves a multitude of developmental tasks that are predominantly of a social nature. These age-specific developmental tasks vary according to the individual, the peer group, the family of origin, and the individual's role in society. Further, the formation of interpersonal relationships, individual interests, and ethical values shape personality development and may have long-term consequences on physical and mental health. Youth are confronted with social norms and societal (i.e., legal) rules that require decision making in accordance with individual goals and perspectives. Parents and the broader family context lose some of their significance as the peer group takes on greater influence. In Western societies, the peer group is particularly influential with respect to clothing, leisure activities, and attitudes toward school and education. Nonetheless, youth often join, at least initially, peer groups whose values resemble those of their parents. In addition, according to recent surveys in Germany, most youth reported that they had good relationships with their parents; only 9% reported that they could hardly get along with their parents (Herpertz-Dahlmann et al. 2013).

Social Risk and Resilience Factors in Youth Mental Health

What are the most important social risk and resilience factors to youth mental health? Previous research provides support for the premise that resilience may be protective against the development of mental health problems (Luthar and Cicchetti 2000; Dray et al. 2017). Despite recent growth in the field of resilience research, the terminology that is used to describe the concept of resilience, as well as the qualities and processes that may offer protection against negative outcomes, continues to vary greatly; to date, there is no universally employed operational definition (Luthar and Zelazo 2003; Davydov et al. 2010). Resilience is commonly referred to as a dynamic and multidimensional concept that comprises a collection of protective factors that are internal to the individual (e.g., personal resources, abilities and assets such as self-efficacy, coping skills, effective problem solving) as well as external. The latter include characteristics of the individual's broader social context, such as resources in the family, social, and community environments, family and peer relationships, support and meaningful participation within the home, school, and community environments. When these protective factors are strengthened and used by an individual during times of disadvantage or adversity, they promote a desirable outcome, such as the maintenance of or return to positive mental health or the prevention of a negative mental health outcome (Luthar and Zelazo 2003; Davydov et al. 2010).

In different studies, a number of nonspecific resilience and risk factors to mental health over the life span have been identified (for a comprehensive overview, see WHO 2012). Table 5.1 and Figure 5.1 provide an overview of nonspecific resilience and risk factors to mental health over the life span. In adolescence (age 10–19 years), key protective factors include supportive parenting, a secure home life, and a positive learning environment in schools. Overall, existing studies have found the presence of multiple protective factors (e.g., personal and social competence, perceived level of family cohesion, and social resources) to be associated with positive mental health outcome in adolescents, such as reduced symptoms of depression, anxiety, stress, and obsessive-compulsive disorder (Hjemdal et al. 2011). Adolescents with a parent who has a mental illness or substance use disorder, on the other hand, are at high risk of experiencing adverse social experiences, and thus more likely to have mental health problems themselves (Patel et al. 2007; Merikangas et al. 2009). Risk to youth mental health, more broadly, is related to similar adverse social experiences, conditions, and environments that impact mental health of children. Family violence or conflict, stressful life events, and a low sense of connection to schools or other learning environments constitute key risk factors (WHO 2012). Additionally, a number of other risks to youth mental and physical health are pertinent to emotional instability, which characterizes this formative developmental period in an individual's life. Emotional instability during adolescence is considered to be a continuum of normative development, yet out

Table 5.1 Overview of nonspecific risk and resilience factors to mental health over the life span (adapted from WHO 2012).

Context	Risk Factors	Resilience Factors
Personal	Low self-esteem Cognitive and emotional immaturity (e.g., difficulties in emotion regulation) Difficulties in communicating Medical illness, substance use	Self-esteem, self-worth, confidence Ability to solve problems and regulate stress and adversity Communication skills Physical health, fitness
Social	Loneliness, bereavement Neglect, family conflict Exposure to violence, abuse Low income or poverty Difficulties or failure at school Work stress, unemployment	Social support of family and friends, close confidants Supportive parenting (e.g., parental warmth), positive family interactions and relationships Physical security and safety Economic security Educational achievement Satisfaction and success at work/school
Environmental	Poor access to basic services Injustice and discrimination Social and gender inequalities Exposure to war, civil conflict, or natural disasters	Equality of access to basic services Social justice, tolerance, integration Social and gender equality Physical security and safety

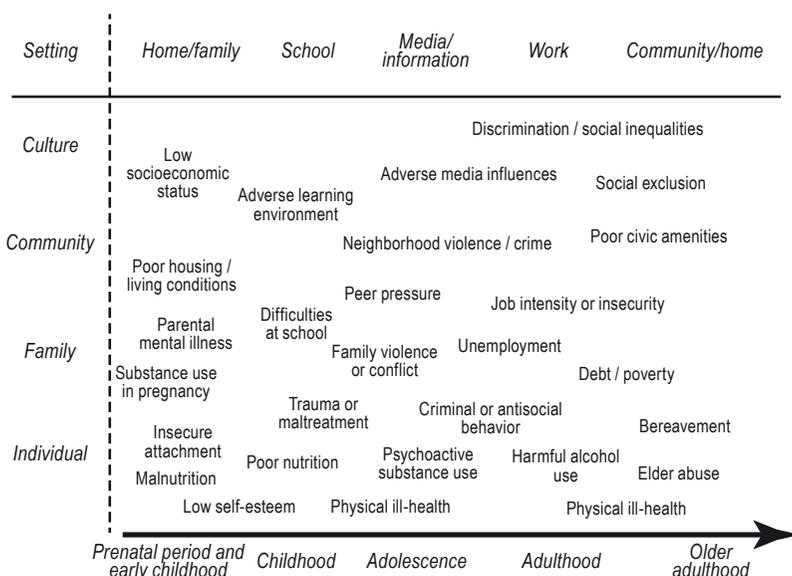


Figure 5.1 Schematic overview of risks to mental health over the course of the life span (used with permission from WHO 2012).

of the majority of adolescents who experience phases of emotional instability, only a few develop clinical psychopathology. The WHO report (2012) specifically highlights that adolescents tend to show an increased likelihood to engage in tobacco/alcohol/drug use and other risk-taking behaviors (e.g., related to sexuality, delinquency/criminality) and that the onset of substance abuse or substance-related mental disorders typically occurs during adolescence. At the same time, adolescents become increasingly susceptible to peer pressure and (social) media influences, which may promote substance use and risk-taking behaviors in general. Substance use is particularly dangerous as it can be harmful to neural and physical development. In addition, risk-taking behaviors, such as substance use, in adolescence are negatively associated with professional development trajectories, such as poorer educational achievement (WHO 2012).

In addition to nonspecific risk factors, the importance of disorder-specific factors needs to be stressed. Depression in adolescence—one of the most common mental health disorders that manifests during or shortly after adolescence (Merikangas et al. 2009)—is thought to arise due to the influence of both specific and nonspecific risk factors. Specific risk factors include a family history of affective disorders, a negative cognitive style, or a major loss experience (e.g., death of a parent, separation or divorce of parents, or household relocation). Negative cognitive styles are characterized by hopelessness, low self-confidence, and pessimistic attributions (“I’m no good at anything,” “Nobody likes me”), among other features. Nonspecific risk factors include poverty, experience of violence, other negative life experiences (e.g., major conflicts in the home, neglect), and social isolation (Shaikh and Kauppi 2010). A review of disorder-specific risk and resilience factors for every psychiatric disorder that is prevalent in adolescents/youth exceeds the scope of this chapter. However, gender differences in the emergence of psychopathology during adolescence prompt the question as to whether risk and resilience factors may differ between genders (Dray et al. 2017). Moreover, the majority of existing concepts of resilience have failed to distinguish between different mechanisms that might underlie the capacity for, and process of, resilience as well as the use of protective factors. Lau and Waters (2017) offer an intriguing perspective on the context of the emergence of affective disorders (i.e., depression and anxiety) during childhood and adolescence. They find that proximal factors, such as information-processing mechanisms, could mediate effects of distal factors (e.g., genetic and environmental influences, temperament characteristics, and brain circuitry functioning) on symptomatology, and thus might account for an individual’s increased risk for negative mental health outcomes (Lau and Waters 2017).

Societal and Cultural Influences

Are social risk and resilience influenced by cultural backgrounds and societal change (e.g., digitalization, increased use of digital media)? Although it

has been broadly suggested that the Industrial Revolution caused adolescence to emerge as a concrete, formative period in development, ethnographic data from more than 170 preindustrial societies indicate that almost all societies possess a notion of adolescence. In many societies, the beginning of adolescence is marked by initiation ceremonies, or rites of passage, often celebrated as major public events and thematically consistent with eventual adult responsibilities (e.g., productivity or fertility). By contrast, in industrialized societies, few formal initiation ceremonies exist (cf. discussion on the universality of adolescence as a distinct life period in Chen and Farruggia 2002). Nevertheless, across societies many adults would agree, in retrospect, that adolescence was a challenging developmental period in their lives.

In line with Bronfenbrenner's system theory (Bronfenbrenner 1994) and more recent multisystemic concepts of resilience (e.g., Ungar et al. 2013), we argue that risk and resilience to mental health, in both childhood and adolescence, are impacted by context-dependent factors. Family and peer relationships as well as school, neighborhood, and community environments are deeply embedded within the local culture, practices, and policies (on multiple scales), and affect childcare and protection. These "macro-contexts" might affect the "micro-contexts" within which adolescents live out their daily lives—with their peers and their families, in their homes, at work settings, schools, and in local communities. This, in turn, can affect the mental health and well-being of adolescents. Importantly, adolescents are not only passive partakers in this process; they play an active role in selecting and interacting with the contexts in their immediate environment (Call and Mortimer 2001). However, experimental tests remain to be conducted on the capacity for, and process of, resilience. Since the use of protective factors embedded in these social contexts is at least partially culture specific (Lund et al. 2018), could this explain the putative differences in the emergence of psychopathology seen in adolescents across cultures? To date, cross-cultural research on this and related questions has been compromised by a predominantly Westernized understanding of the pertinence of different developmental periods, particularly childhood and adolescence, and universally applied to developmental tasks that ought to be accomplished during such formative periods (Atilola 2015). Importantly, cross-cultural research has yet to overcome methodological challenges inherent to the discussion on universality versus uniqueness of current (predominantly Westernized) definitions of mental health; left unaddressed, cross-cultural comparability and validity are reduced (Zheng 2013; Atilola 2015). Thus, findings from existing cross-cultural studies should be interpreted in the context of these limitations.

Aside from cultural influences per se, it is important to consider how more recent developments in modern societies impact adolescent mental health. Today, young people are growing up in contexts of rapid urbanization, increased educational demands, globalization, and access to worldwide information through the internet and social media (e.g., Blum et al. 2012). One recent societal change could be of great significance to risk and resilience processes in youth: digital

communication. The shift from face-to-face to online communication may be one of the most obvious societal changes of the twenty-first century. Proximal to adolescents' everyday life, digitalization allows any individual to feel connected to others, independent of distance (e.g., Quinn and Oldmeadow 2012), yet powerful and harmful dynamics can arise in resulting social relationships (e.g., cyberbullying, harassment). Meta-analytic data provide compelling evidence that cyberbullying is associated with adolescent depression (Hamm et al. 2015). More recently, however, a study of British population-based data demonstrated that cyberbullying accounted for only a small share of variance in mental health outcomes in adolescents, when data were controlled for traditional forms of bullying and other covariates (Przybylski and Bowes 2017). In addition, time spent with digital media also appears to reduce physical activity dramatically in adolescents (Finne et al. 2013), which is considered an important protective factor for reducing stress and improving mood.

Social and Cultural Contexts of Psychopathology

How can we characterize and/or quantify the social and cultural contexts of psychopathology? Social development in adolescence is a process clearly driven by the maturation of specific social-cognitive functions, yet these functions do not develop in isolation: they are shaped by interpersonal relationships within an adolescent's social and cultural context. As research investigates the social and cultural influences on adolescent brain and behavior development, it faces a major challenge: How can assessment tools which adequately quantify complex environmental contexts and individual experiences within these contexts be integrated into studies grounded in neurobiology and neuroscience (see also Tost et al. 2015)? Recently, innovative methods have become available to permit better characterization of the changing social environments in adolescence, which we briefly describe below.

Ecological momentary assessment (EMA) is a promising technique that uses a smartphone app to obtain psychological data in real-time, real-life contexts. It allows for the assessment of social behaviors and social experiences in daily life without the bias that results from retrospective reflection. As adolescents are digitally savvy, smartphone-based assessments are generally well accepted. EMA studies can be broadly categorized according to time- or event-based sampling methods:

- A time-based strategy aims to acquire representative characteristics and patterns of behaviors as well as an individual's experiences across time through prompts at random points in time.
- An event-based strategy aims to examine antecedents and consequences of specific experiences through, for instance, self-initiated self-reports in response to specific events (e.g., an individual's location via GPS or physical activity via an accelerometer).

On the basis of the study rationales, different approaches to both methods of sampling have been used (see Ebner-Priemer and Trull 2009). EMA can also be combined with context-dependent social-cognitive tests or with psychophysiological assessments. Sliwinski et al. (2018), for example, demonstrated that electronic diaries combined with brief smartphone-based cognitive assessments in uncontrolled naturalistic settings provided measurements with a degree of reliability comparable to assessments collected in controlled laboratory environments.

Social network analyses provide another important tool that can be used to characterize and/or quantify social behaviors and experiences during adolescence. Individual attributes shape an individual's social network through a process called social selection. Conversely, characteristics of the network as well as an individual's position in the network influence individual attributes, such as attitudes or behavior (de Klepper et al. 2010). This occurs, for example, when individuals adjust their behavior to their close friends. Key network processes involved are homophily (the preference for relationships with individuals with similar characteristics), reciprocity (the tendency to reciprocate relationships), and transitivity (the tendency for triads to form a closed network) (McPherson et al. 2001). Recent progress in statistical modeling of longitudinal network data (i.e., stochastic actor-based models) allows us to disentangle the effects of social selection and social influence (Snijders et al. 2010). Using this approach, longitudinal studies of networks and individual behaviors have revealed that selection is more important than influence in explaining similarity in adolescent smoking behavior, whereas both processes impact adolescent academic performance similarly (Mercken et al. 2010). One interesting study combined social cognitive tests and social network analysis in adolescents and found higher self-reported mirroring in adolescents to be associated with a more central network position (Wolfer et al. 2012). Social network data can be collected using surveys in which individuals nominate their friends or describe other relations.

Another exciting development is *mobile sensing*, which uses the ubiquity of mobile phones and their increasing functionality to study social relationships based on directly observable behavior in real time (Eagle et al. 2009). Using mobile sensing, social network data has been inferred from physical proximity and communication patterns. These data complement established survey methods.

Finally, *geographical maps* have become available that quantify certain environmental conditions (e.g., household income, ethnic diversities, average educational levels, air pollution, traffic noises). When combined with location tracking, geographical maps enable a more detailed characterization of an adolescent's socioenvironmental context on a daily basis. Such measures of neighborhood contextual factors, however, do not include an adolescent's perception or information on influential ongoing social processes. Nearly two decades ago, Tienda emphasized the importance of assessing the social impact of neighborhoods (Tienda 1991). More recently, the life sciences, in general, have acknowledged the importance of including more *participatory approaches* in

quantitative research activities. This was recently done in a study by Landstedt et al. (2009), who investigated the gender-specific influence of social processes on adolescent mental health using a grounded theory approach based on focus groups with adolescents.

How, then, can the impact of complex social and cultural contexts be *reliably* assessed? Unfortunately, cross-cultural research lacks a thorough taxonomy of important cultural characteristics that might impact mental health.¹ Methods in cultural neuroscience vary across levels of analysis and include behavioral surveys, open-ended interviews, or ethnography to explore cultural values, practices, and beliefs. Such approaches could be combined with recent advances in *population genetics* that have indicated significant variations in allele frequencies across the globe as a function of population structure due to multiple evolutionary factors, including natural selection, genetic drift, mutation in gene expression, and gene flow (Chiao and Blizinsky 2013). With respect to adolescent social development, in particular, cross-cultural comparisons of societies that reflect more collectivist values (where self is defined as the connection to others or the social situation) versus individualistic values (where self is autonomous from others) might be particularly promising. The same holds for cross-cultural comparisons of adolescents who grow up in societies/cultures where there are large differences in initiation rites that mark the adolescent transition period, as well as comparisons of adolescents with and without experiences related to the promises and challenges of globalization (e.g., using data from current vs. historical cohorts).

Sensitive Period(s) for Social Influences during Adolescence

Is there really a (second) sensitive period for social influences during adolescence? Are the effects of social experiences particularly strong during adolescence? The sentiment “no man is an island,” by the poet John Donne, offers a pertinent perspective. By nature, humans are social creatures, but throughout their development, are there particular periods that are sensitive or critical for social development to occur? Can we assume that adolescence constitutes a second sensitive period for social development, comparable to one when early caregiver influences shaped the maturation of infants’ social-affective neural circuitries?

A sensitive period is defined as a period in which an organism “expects” to be exposed to a particular stimulus (Greenough et al. 1987). Originally referred to as “critical periods,” this term is now used less often when referring to human development, as some recovery of functions may be possible outside of the time window of highest sensitivity (Takesian and Hensch 2013). Sensitive

¹ An exception to this is Hofstede’s cultural dimensions theory, which describes the effects of a society’s culture on the values of its members, and how these values relate to behavior, using a structure derived from factor analysis (Hofstede 2015).

period models of brain development generally regard neural circuit maturation as a confluence of endogenous maturation and experiential sculpting. When neural systems begin to mature, they are weakly responsive to a wide scope of stimuli and generate diffuse patterns of activation within and across neural circuitries. Over time, brain responses become stronger, more efficient, and automatic as the boundaries of relevant stimuli become narrower and responses to non-experienced stimuli are dampened (Greenough et al. 1987; Werker and Hensch 2015).

As outlined above, adolescence has been proposed to be a time of particular environmental susceptibility, and the impact of puberty on the brain makes adolescents particularly sensitive to their social environments (Crone and Dahl 2012). Adolescents go through a period of social reorientation, as the opinions of peers become more important than those of family members. In one study, for example, adolescents aged 13 to 17 years reported that peer evaluations affected their feelings of social or personal worth (O'Brien and Bierman 1988). Although adolescents aged 10 to 13 years felt that peers provided companionship and support, they did not report that peer acceptance negatively impacted their self-evaluation. Blakemore and Mills (2014) suggest that increasing abilities of abstract thinking, together with an increasing motivation for positive peer acceptance, might account for peer influences on self-evaluations in adolescence. A recent behavioral study investigated the effects of social exclusion in the lab. After being excluded by other players in an online game (Cyberball), young and mid-adolescents (11–15 yr) reported lowered overall mood whereas young adolescents (11–13 yr) reported higher state anxiety compared to adults (Sebastian et al. 2011). In addition, Brumbach et al. (2009) showed that socioenvironmental conditions experienced during adolescence impact attitudes toward health and reproduction in young adulthood. Adolescents within socially unpredictable environments not only experienced decreased physical and mental health over the short term, they also showed decreased health and less sexual restrictedness over time.

Despite evidence for adolescence as a sensitive period for social processing from rodent studies (Marco et al. 2011; Foulkes and Blakemore 2016), it is critical to acknowledge that evidence for sensitive periods in human adolescence is scarce. A number of researchers argue that there is evidence for other periods of social reorientation beyond adolescence (e.g., Nelson et al. 2016). They suggest that there are at least five distinct social phases in development, each of which can be largely defined by the social target and type of social behavior expressed:

1. During infancy, sociality consists of engagement with the primary caregivers.
2. In the juvenile phase, between weaning and puberty, the caregiver–infant dyad is gradually replaced by peer-focused play behavior, but the caregiver is retained as a base.

3. In adolescence, between puberty and full maturity, social behavior becomes more important as individuals strive to become fully integrated into larger groups of peers.
4. The reproductive/intimacy phase is accompanied by social bonding and reproductive behavior.
5. The mature adult phase is characterized by social interactions within a relatively stable multigenerational group, along with expression of intimate relations and directed care of offspring.

Although this pattern of multiple phases in social development is not universal, it is widely expressed among most primates and in many socially living mammalian species (e.g., Zhang et al. 2012). Overall, this concept is in line with models that assume sensitive periods in social development to be related to changes in brain development; however, it broadens the concept of sensitive periods from one to multiple sensitive periods in social development across the life span. During these periods, although such social experiences are particularly important, there is as yet no evidence that they constitute sensitive periods for brain development, in which a specific input from the environment is expected. Each of these developmental periods, however, might sensitize neural structures to forthcoming social experiences. For example, it has been shown that individuals experience distress if a social target is absent: highly motivated social engagement is directed at caregivers in infancy, at playmates during the juvenile phase, at integration with peers during adolescence, at potential mates during early adulthood in the social intimacy phase, and at offspring and stable group members in the mature adult phase (e.g., Hostinar et al. 2015). Once new targets of social behavior emerge, motivational response to previous social categories typically diminishes. In a number of species, the duration and intensity of distress caused by maternal separation declines across infancy while play behavior increases (Zhang et al. 2012). Also, attention to a peer group becomes less important for adolescents once romantic engagements are established (Collins et al. 2009). Taken together, these data provide evidence for the idea that expected goals in social development undergo systematic shifts across the life span, and that these shifts are accompanied by changes in motivation to obtain or maintain specific types of social experiences. The social experiences in each phase are interdependent insofar as their effects spill over into successive periods. For instance, early experiences with a caretaker in infancy can moderate social behavior with peers in adolescence (Puetz et al. 2014), and parenting style can be redirected toward one's own offspring in adulthood (Olsavsky et al. 2013).

Precursors, Risk, and Resilience Factors to Youth Mental Health

How do adolescent precursors, risk, and resilience factors to youth mental health evolve over time? How do they interact, and what possible mechanisms

underlie the associations between social risk factors and the development of psychopathology?

It has been suggested that the heightened vulnerability to mental disorders during adolescence is related to genetically or experientially preprogrammed neural development, triggered by acute stressors or adversities experienced in the current environment (Andersen and Teicher 2009). The desire to be accepted by one's peers and the importance of social reward and avoidance of social rejection could constitute particularly acute stressors in adolescence, and may result in extreme stress, if the desire is not adequately met. During adolescence, the cortico-striato-limbic circuitries are reorganized, and increases in pubertal sex hormones interact with the developing hypothalamic-pituitary-adrenal stress axis and glucocorticoids (for a review, see McCormick et al. 2017). Adolescents show increased sensitivity to stress-induced levels of glucocorticoids in parallel to an increase in glucocorticoid regulation in the prefrontal cortex (Perlman et al. 2007). Therefore, social isolation during this period, for example, may increase the likelihood of depressive-like behaviors as well as alterations in the structure of the prefrontal cortex (Leuissis et al. 2008). Long-lasting effects of increased stress exposure in adolescence might disrupt social as well as reproductive behavior.

Recently, Suleiman et al. (2017) pointed out that the importance of sexual relationships during adolescence has been largely neglected. Rather than being sequential and distinct phases, the development of peer relationships, romantic relationships, and sexual relationships might occur simultaneously and interact. Early romantic and sexual relationships are shaped by the characteristics of the adolescent's peer group as well as by the quality of parent-adolescent relationships. At the same time, growing interest in sexual and romantic relationships introduces a new dimension to peer group dynamics. Suleiman and colleagues suggest that data from adolescent real-world experiences, especially those related to romantic and sexual relationships and behaviors, should be included in future studies to increase understanding of the social neuroscience of adolescence.

Furthermore, detailed study is needed into how social behaviors and experiences from earlier phases of development impact the responsivity of neural circuitries. Such experiences may have long-term effects on the organism's sensitivity toward risk and resilience factors present in subsequent phases in social development. Future models should thus consider incorporating interactive influences of changes in the adolescent social environment and adolescent neurobiology. Such models need to account for influences driven by stable individual traits (i.e., genetic variations) that determine timing, responsivity, and plasticity of neural network development. In addition, a better understanding of *genetic nurturing effects* (i.e., how nontransmitted alleles can still affect a child through their impacts on the parents and other relatives) is needed to improve understanding of social influences on adolescent development (Kong et al. 2018).

Interestingly, while the timing of the opening and closing of sensitive periods itself has generally been considered to be an internally mediated process with predetermined timing parameters, under some conditions, environmental experiences can also affect the timing and pace of sensitive periods. Several factors (e.g., body weight, life stress) influence the timing of puberty onset (e.g., Lee and Styne 2013). Recent findings suggest that the timing of neural circuit organization may also be susceptible to differences in environmental conditions, in particular in extreme variations, such as when brain maturation is accelerated by adversity (Gee et al. 2013).

Concluding Remarks

Broader concepts that assume “multiple sensitive periods of social development” may have important clinical implications for understanding and treating psychopathology. The phase of social development and the timing of social experiences may most likely play a central role in the efficacy of different types of intervention.

Although the extent to which environmental influences affect timing parameters of brain development has not been extensively tested, particularly in human development, existing data suggest that both timing and environmental influences should be considered in future studies. Advances in research on molecular effects in developmental plasticity may further inform our understanding of factors that contribute to the onset and offset of sensitive periods during early life and later development. For instance, recent studies indicate that changes in the plasticity of local circuits are dependent on the maturation of local inhibitory connections, which may regulate sensitive periods at a molecular level by shifting the local excitatory-inhibitory balance within local circuits (Takesian and Hensch 2013; Werker and Hensch 2015). Isolating regionally specific markers for heightened plasticity across sensitive periods in development may help us understand how neural organization influences specific social functions during different phases of development. This, in turn, may provide an avenue for pharmacologically based interventions, to allow previously closed critical periods to be reopened through targeted pharmacotherapy (Gervain et al. 2013). This might be particularly important for future preventive approaches, as the degree to which different experiences affect the developmental trajectory depends to a large extent on the timing of experiences (i.e., when during the course of development experiences occurred).