RaY

Research at the University of York St John

Understanding Adolescents

Beth T. Bell

Abstract   Adolescent development is complex; involving the interaction between fundamental biological and cognitive developmental processes, and the unique environment inhabited by the adolescent. This chapter draws on contemporary research from the social and behavioural sciences to outline the key features of the biological and cognitive changes occurring during adolescence, which serve to differentiate adolescents from both children and adults. The contextual factors that influence the developmental trajectory of adolescents will be discussed, with particular emphasis on the role of media and technology, which is becoming an increasingly prominent developmental context and is of particular interest to the readers of this book. The chapter also discusses prominent themes in adolescent development that are product of this interaction between developmental processes and the environment, including identity, sexuality, intimacy, autonomy and achievement. It ends with a discussion of how this knowledge may be utilised by researchers working in the field of Teen-CI to inform their approach to working with adolescents.

2.1 Defining Adolescence

Although discussions of adolescence may be traced back to Ancient Greece and the works of prominent philosophers, Plato and Aristotle, it was not until the turn of the 20th century that adolescence became recognised as a unique developmental period (Petersen, 1988). Seminal work by Hall (1904) identified adolescence as a period of "storm and stress", claiming that struggles and difficulties during adolescence were not a normative feature of the adolescent experience, but an essential part of healthy development. However Hall's understandings of adolescence were purely theoretical; the *empirical* study of adolescence did not begin until the latter half of the 20th century, whe0re a boom in the social and behavioural sciences literature pertaining to adolescent development can be observed (Petersen, 1988; Steinberg & Lerner, 2004). Early empirical studies of adolescence were heavily influenced by Hall, and tended to focus on the problematic aspects of adolescent development. However, the notion that adolescence is inherently a period of storm and stress has been challenged as researchers increasingly recognise the malleability and opportunity created by the developmental processes at work during adolescence (Arnett, 1999; Blakemore & Mills, 2014; Steinberg, 2014b). In 2014, Lawrence Steinberg coined the term "Age of Opportunity" to describe adolescence, and characterise this new approach towards understanding adolescents that is focused on recognising potential, rather than problems (Steinberg, 2014b).

Within the HCI literature, the terms "teenager" and "adolescent" are often used interchangeably. Whereas the former may be concretely defined in terms of biological age, specifically referring to individuals aged 13-19 years old, the latter is more difficult to define in terms of age-related boundaries. Instead, adolescence is defined as a developmental period straddling the transition from childhood to adulthood, which may be characterised by the biological, cognitive, psychological and social changes that occur during this time

(Steinberg, 2014b). Assigning age-related boundaries to adolescence is problematic since the developmental processes underpinning the transition from childhood to adulthood begin and end at different times for different individuals (e.g. Dorn & Biro, 2011), and do not always follow the same sequence (e.g. Peterson, 1988). There is also increasing evidence that the developmental processes underpinning adolescent development stretch beyond the teenage years. Recent neuroscientific research, for example, has suggested that brain development is not complete until one has reached their mid-20s (Blakemore & Mills, 2014). Furthermore, there are also important cultural variations in terms of how adolescence is defined, particularly surrounding societal conceptions of how and when adult status is achieved. Many traditional societies view marriage as the marker signifying the end of adolescence, and many adult privileges are not afforded to an individual until marriage is achieved (Grant & Furstenberg, 2007). In contrast in industrialised societies, where marriage typically happens much later (if at all), achieving financial independence is more readily recognised as the defining marker of adulthood (Horowitz & Bromnick, 2007). Consistent with the teen-centric focus of this book, this chapter will focus primarily on understanding the aspects of adolescent development occurring during the teenage years, though some aspects of development beyond these years will also be considered.

2.2 Changes in Biology

During adolescence, fundamental biological changes - known as puberty - occur within the body, which transform a child into a biological adult capable of sexual reproduction. Puberty is a gradual and sequential process that spans across the adolescent years, and encapsulates multiple and complex biological processes (Dorn & Biro, 2011). Puberty triggers rapid increases in height, size and capacity of the heart and lungs, muscle mass, and body fat. Adolescents become stronger and more physically able than children and gender differences in physicality emerge; males will typically grow taller with larger heart and lung capacities, and develop more muscle mass and less body fat, than their female counterparts (Rogol, Roemmich, & Clark, 2002). Male pubertal development also includes the deepening of the voice, changes in male genitalia and increases in androgen hormone production. In contrast, female pubertal development includes the growth of breasts, changes to female genitalia and increases in estrogen hormone production. Thus puberty serves to exacerbate sex differences and make them more visually salient. The dramatic changes in the physical appearance of young people triggered by pubertal development can lead individuals to treat adolescents differently; expecting more adult, and often more gender typical, behaviour from them (Bumpus, Crouter, & McHale, 2001; Hill & Lynch, 1983).

Pubertal hormones have an interesting impact on adolescent behaviour, including sexual behaviour, sleep and mood. In terms of sexual behaviour, first feelings of sexual attraction towards potential romantic partners are triggered by pubertal hormones at the very start of adolescence, normally at the age of ten (McClintock & Herdt, 1996). Adolescents will then progressively engage in sexual behaviour involving others throughout the course of puberty, and by the end of adolescence most will have their first experience of sexual contact and most will have experienced their first romantic relationship (Collins, Welsh, & Furman, 2009). In terms of sleeping behaviour, melatonin - the hormone which regulates sleep and increases with feelings of sleepiness - has been found to increase later in the day in older adolescents, than younger adolescents (Millman, 2005). The result is that adolescents going through puberty display a preference for going to bed later, and waking up later, than children (Carskadon, 2011). In terms of mood, rapid increases in hormones at

the start of puberty seem to be associated with fluctuations in mood in early adolescence, and as these levels stabilise, so too do mood fluctuations (Buchanan, Eccles, & Becker, 1992). However research examining the link between puberty and moodiness in adolescence has yielded mixed results, leading researchers to conclude that environmental factors must also play an important role in mood regulation (Schnieders et al., 2006).

Finally, puberty triggers important biological changes in brain development during adolescence. Though the brain reaches its adult size around the age of ten (Dekaban & Sadowsky, 1978), it continues to develop throughout adolescence in terms of structure and function (Blakemore & Mills, 2014). Biological processes of synaptic pruning (removal of unnecessary brain circuitry) and mylenation (insulation of brain circuitry in myelin) in specific brain areas, lead to changes in the efficiency of these areas (Blakemore, 2012). Brain regions affected by these processes include (1) the prefrontal cortex, which is responsible for complex thought processes, such as planning, consideration of risk and reward, and impulse control, (2) the parietal cortex, which is responsible for memory, and (3) the temporal cortex, which is also responsible for memory and thinking about others (Blakemore, 2012; Blakemore & Mills, 2014; Steinberg, 2014). These changes in brain structure are responsible for many of the changes in thinking patterns that are observed during the adolescent years, which will be outlined in the following sections.

2.3 Changes in Thinking Patterns

The changes in thinking patterns (cognitive development) that occur during the adolescent years have important implications for how Teen-CI researchers engage with teenagers at all stages of the research process; informing the nature of their research questions, the types of methods employed when working with this population and the way in which these are communicated to the adolescent. It is important therefore to understand how the ways in which an adolescent thinks – and subsequently behaves - are qualitatively different to the ways in which a child thinks and behaves. These differences include the development of the abilities to:

- Think Logically: Logical reasoning skills begin to develop between the ages of eleven and thirteen (Zimmerman, 2000). During this time, adolescents develop the ability to engage in hypothetical reasoning (using logical thinking to anticipate possibilities) and deductive reasoning (the ability to draw logical conclusions from a set of premises), which they are unable to perform as a child (Keating, 2011). These skills are evidenced in the mathematics classroom, where advanced logical reasoning capabilities are a necessary prerequisite for complex problem-solving tasks (such as algebra), which individuals are typically only able to solve from adolescence (Luna, 2004).

- Think Abstractly: A child typically thinks in ways that are concrete and bound to observable real-world objects and events (Inhelder & Piget, 1958). In contrast, an adolescent is much more capable of thinking about abstract concepts such as political issues, social issues, religion and morality (Steinberg, 2014a) and independent political and religious beliefs may also emerge during this period (Flanagan & Tucker, 1999; Koening, McGue & Iacono, 2008). We can see evidence of this in everyday settings, including the conversations adolescents become capable

of maintaining, the arguments they are capable of forming and the school-work tasks they may be expected to complete.

- Think in Complex Ways: The ability to think about things in multidimensional ways is an important dimension of adolescent thinking that sets them apart from children. Sarcasm is an example of complex thought as a sarcastic comment (e.g. "That's a nice dress") has both a literal meaning (that dress is nice) and an inferred meaning (dependent upon tone, this comment could be intended as an insult). It is only during the early – mid teenage years that adolescents are able to appreciate the multidimensionality, or multiple meanings, of such remarks and so find them humorous (Demorest, Meyer, Phelps, Gardner & Winner, 1984). Adolescents are also likely to practice their new found complex thought abilities: there are few parents who have not been on the receiving end of their teen's sarcastic commentary!

- Think about Thinking: A further skill that adolescents develop is that of metacognition: the ability to think about thinking. Metacognition may also underpin, to an extent, self-consciousness during adolescence, as adolescents are prone to believing that because they are thinking about their own thinking processes, everyone else must be thinking about them too (Vartanian, 2000). The novelty of this ability as experienced by adolescents may explain why some start to believe the uniqueness of their own experiences (Vartanian, 2000), which can lead to feelings of isolation (e.g. beliefs such as "no one understands me") and beliefs that the negative possible consequences of risky behaviour won't happen to them (Alberts, Elkind, & Ginsberg, 2007).

These qualitatively different ways of thinking are likely underpinned, in part, by the development of more efficient information processing skills during the adolescent years. Adolescents have been found to have greater attentional skills than children; they are much more efficient in paying selective attention to one stimuli in the presence of others and are much more efficient at paying attention to multiple sets of stimuli at the same time (Huang-Pollock, Carr, & Nigg, 2002; Pool, Koolstra, & van der Voort, 2003). They also display larger working memory capacity (the ability to remember to temporarily retain information) and more efficient long-term memory skills (the ability to recall previously learned information and personal life experiences) (Keating, 2011). The speed at which adolescents can perform tasks and process information also improves (Kail & Ferrer, 2007). Collectively, these improved information processing skills may underpin the more abstract and complex ways in which adolescents think relative to a child.

In general, research has shown that adolescent information processing skills steadily improve up until the age of fifteen, after which point they begin to stabilise, suggesting that these basic skills have reached adult status (Luciana Conklin, Hooper & Yarger, 2005). However this does not mean that by age 15, an adolescent thinks in the same way as an adult. More sophisticated cognitive capabilities such as planning ahead and weighing up the costs and benefits of decisions, seem to be linked to the development of the prefrontal cortex in the brain, and continue to develop until an individual has reached their mid-20s (Blakemore & Robbins, 2012). Neuroscientific research also suggests that a developmental mismatch occurs during adolescence, where the parts of the brain responsible for sensation-

seeking (i.e. impulsive behaviour) develop before the parts of the brain responsible for these more sophisticated aspects of cognition (Steinberg, 2007; Strang, Chein, & Steinberg, 2013). This may explain the well documented link between adolescence and increased risk-taking behaviour, as the adolescent struggles to engage in logical decision making ("I must drive carefully as I am new a driver") in anticipation of the positive emotive consequences associated with risky behaviour ("Driving fast feels good. It is exciting and I look cool in front of my friends"). This mismatch is not rectified until an individual reaches their mid-20s, when the development of advanced cognitive brain systems 'catches up' with the development of the more impulsive brain systems (Steinberg, 2007; Strang et al., 2013).

2.4 Changes in Social Thinking

Adolescents are intensely social creatures. Teens spend a substantial amount of their time in the presence of their peers both in school and out of school - including in the virtual presence of their peers (boyd, 2014) - and also spend an increasing amount of time thinking about peer relationships (Richards, Crowe, Larson, & Swarr, 1998). Research has demonstrated that adolescent friendships are more complex than childhood friendships and involve greater intimacy, trust and reciprocity (Laursen & Hartup, 2002). The increased complexity and importance of adolescent friendships are likely to be underpinned by changes in social cognition, i.e. the way we think about other people and process social information. This includes changes in adolescents' ability to:

- Understand Others: The ability to understand others (known as *mentalizing* within psychology) becomes more nuanced and sophisticated during adolescence. In particular, adolescents develop a more complex theory of mind; the understanding that others have beliefs, intentions and knowledge that are different from their own. Importantly, adolescents also develop the ability to alter their behaviour in response to their understanding of others (Dumontheil, Apperly, & Blakemore, 2010) and further develop their skills to judge the appropriateness of the emotions shown by others (Keulers, Evers, Stiers, & Jolles, 2010).

- Understand Relationships: As a consequence of their increased socio-cognitive capacity to understand others, adolescents also begin to think about relationships in similarly nuanced and sophisticated ways, becoming more aware of intragroup and intergroup dynamics. Adolescents develop a more intricate understanding of social group membership (Leets & Sunwolf, 2005) and more complex social networks develop (Brown & Klute, 2003). Consider the complex clique structure of your own school experiences during adolescence, compared to during childhood, and think of all the different groups and social hierarchies that existed. Adolescents also develop a more complex understanding of their relationships with authority figures, such as parents and teachers, which may lead them to question some of the decisions these authority figures make (Darling, Cumsille, & Martinex, 2008).

- Understand Social Rules & Structure: During the early teen years, adolescents start to realise that many social norms and conventions (such as raising their hand before answering a question in class or keeping their bedroom tidy) are just expected behaviours and so may question whether or not they should comply with them (Smetana & Bitz, 1996). This more complex understanding of social rules may

explain why teenagers are often perceived as rebellious. Adolescents are more able to understand social concepts such as rights and freedoms (e.g. freedom of speech) and are more likely to express beliefs about their perceived entitlement to them (Steinberg, 2014a).

More recently, neuroscientific research has linked changes in social cognition during adolescence to changes in brain structure and functioning; suggesting that adolescents may process social information in their brain differently to both children and adults (Blakemore & Mills, 2014). Adolescents also display an increased sensitivity to peer rejection and social exclusion, and again, this seems to be reflected in brain functioning; the areas of the brain activated during social exclusion show increased activation in experiments that aim to trigger feelings of exclusion among adolescents, in comparison to adults (Sebastian, Viding, Williams, & Blakemore, 2010). Social information may also impede rationale decision making behaviour during adolescence, and the mere presence of peers in the adolescent years has been demonstrated to increase risky decision making, whereas adults seem unaffected (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). Taken in sum, this evidence appears to suggest that the brain is hot-wired to focus on social information during adolescence and try to understand it, in ways that the brains of children and adults are not. This has important implications for the adolescent behaviour in social situations, including their behaviour in group research situations (such as focus groups). Teen-CI researchers should be mindful that and adolescents' behaviour in a group environment may not be a reflection of their true self, though this may be a desirable outcome if the focus of the group-based research is to understand teen attitudes and behaviours in social contexts.

2.5 Contextualising Development

The differences between adolescents are as striking as the similarities between them, and the environmental context in which development occurs is at least as important as biological processes in shaping the nature and course of each adolescent's developmental trajectory (Bronfrenbenner, 1979; Lloyd 2002; Smetana, Campione-Barr, & Metzger, 2006). According to the ecological model of human development (Bronfrenbenner, 1979), there are multiple layers of contextual factors influencing the developmental course of humans. In close proximity to the adolescent, the first layer – the *microsystem* - encompasses relationships and interactions that directly influence the adolescent, including school, family, peer-groups and community. The next layer - the *mesosystem* - encompasses the interactions between different agents in the microsystem which may influence the adolescent, such as parent interactions with teachers. The adolescent has no direct contact with the third layer of context - the *exosystem* - which includes factors that influence agents in their microsystem, such as how changing conditions in the parent's workplace may influence their availability in the adolescents life. The final layer, the *macrosystem,* encompasses broader cultural attitudes and ideologies shaping adolescent development, such as governmental ideology and laws. These developmental contexts influence each other and the adolescent in multiple complex and overlapping ways, leading to the vast individual differences observed amongst adolescents in the world today.

Relevant to the HCI focus of this book, media and technology are becoming increasingly important sociocultural factors shaping adolescent development, at all of Bronfrenbenner's contextual layers. In terms of the microsystem, media and technology have infiltrated many of the relationships and interactions that directly influence adolescent

development, changing the nature of adolescents' experiences and interactions within them. For example, the widespread use of the internet and computers in schools has influenced teaching styles, classroom activities, and lesson content, thus changing the nature of adolescents' schooling experiences (Bentley, 2012). Alternatively, since media and technology transcend the boundaries of physically distinct everyday environments, such as home and school, they may be conceptualised as creating an important microsystem within their own right. Adolescents increasingly turn to media and technology as a source of socio-cultural information to guide their attitudes, beliefs and behaviours in a variety of domains (Lloyd, 2002; Mitchell, Ybarra, Korchmaros, & Kosciw, 2014), much in the same way they may have traditionally turned to family, teachers and peers (Strasburger & Wilson, 2002).

Media and technology have also influenced mesosystems. Social media - for example – can facilitate greater communication between parents and an adolescent's peers, including through profile monitoring practices (such as snooping). Media and technology also serve as exosystems that influence microsystems and mesosystems, such as the way in which mobile technologies have impacted upon parents' working patterns allowing more opportunity to work from home and thus potentially impacting upon the nature of the adolescent-parent relationship (Hilbrecht, Shaw, Johnson, & Andrey, 2008). Lastly, media and technology may also be seen as part of the macrosystem shaping cultural norms and values. In particular, the ability of the Internet to connect diverse and geographically-distant cultures, and facilitate content co-creation across these cultures, has led to the development and proliferation of new cultural norms, values and practices (Reed, 2014). Understanding how media and technology influence and interact with adolescent development is an important research question within the Teen-HCI community and there is a growing body of literature in this area (e.g. boyd, 2014; Lloyd, 2002).

2.6 Psychosocial Developmental Challenges

During adolescence, the complex interaction between fundamental bio-cognitive developmental processes and environmental context create issues – or developmental challenges - for adolescents, which are both psychological (internal within each adolescent's individual psyche) and social (bounded by external social constraints) in nature. Adolescents must negotiate, or make sense of, these issues in order to prosper. According to Steinberg (2014a) there are five important psychosocial developmental challenges during adolescence: identity, sexuality, intimacy, autonomy and achievement. In this section, these challenges are briefly described:

- _Identity._ Identity refers to the way we see ourselves. It is our sense of who we are, how we fit into the world, and encompasses our beliefs about ourselves in relation to others (Lloyd, 2002; Waterman, 1999). Identity formation is widely regarded as the primary psychosocial developmental task faced by adolescents (Erikson, 1968) and has been the fixation of many adolescent focused books, films and TV series. The quest for identity may be more salient for some adolescents than others: some adolescents will invest vast amounts of time and energy exploring possible identities, whereas others may adopt an identity (usually one similar to their parents) without much exploration (Waterman, 1999). In addition to negotiating a personal identity, adolescents must also negotiate their social identities (i.e. their sense of identity based on the social groups they belong to). Gender and ethnic identity are two very important identities that adolescents must negotiate. For many adolescents, being

able to express group membership is as important as being able to express their individuality (Manago, Graham, Greenfield & Salimkhan, 2008). Social media currently provides an excellent tool for the development of both personal and social identities (boyd, 2014; Manago et al., 2008).

- Sexuality. As the adolescent, through the biological processes of puberty, becomes an adult capable of sexual reproduction, they must learn to understand and express their sexual feelings. Sexual behaviour follows a remarkably similar developmental trajectory across cultures: first feelings of sexual attraction generally emerge at the age of ten, engagement in autoerotic sexual behaviours will follow shortly afterwards, and then adolescents will begin to engage in sexual contact with another individual in a gradually intimate manner (e.g. kissing, touching) until they finally engage in oral sex and/or sexual intercourse (Collins et al., 2009; Diamond & Savin-Williams, 2009; McClintock & Herdt, 1996). Despite the seeming universality of this pathway, gender, ethnic and cultural differences can be observed in the age at which adolescents engage in sexual activity (Browning, Leventhal, & Brooks-Gunn, 2004; Madkour, Farhat, Halpern, Godeau, & Gabhainn, 2010). There are multiple risks associated with sexual behaviour, including sexually transmitted infections and unwanted pregnancy. An adolescent must learn to behave responsibly in sexual encounters to prevent unwanted outcomes; behaviours that may be especially difficult to control, given how the adolescent brain is programmed to behave more riskily in the presence of others (Chien et al., 2011). Recent developments in media and technology may also influence adolescent sexual development in modern society and there are many pressing research questions surrounding the influence of sexting, Internet pornography and dating apps (such as Tinder and Grinder) in this domain. There is also positive potential for technology to improve teen sexual health. A number of digital interventions have been developed with some success in this domain, though more robust evaluation of such interventions is needed (Guse et al., 2012).

- Intimacy: Adolescents are more able to appreciate the complexities and value of intimate relationships – characterised by a sense of closeness and emotional attachment (Montgomery, 2005) - than children, due to the development of increasingly sophisticated socio-cognitive skills during this time. Friendships change during adolescence and become more based on mutual values than shared activities, than in childhood (Gifford-Smith & Brownell, 2003). Adolescents become more aware of different types of friendships and show greater loyalty, trust and self-disclosure in close friendships than casual friendships (Leets & Sunwolf, 2005). Female adolescents will typically develop intimate relationships earlier than males and typically display more intimacy within these friendships - though some have argued that girls are more concerned about intimacy or more likely to talk about relationships than boys, rather than more intimate per se (Johnson, 2004; Radmacher, & Azmitia, 2006). Negotiating intimacy in romantic relationships is also important during adolescence. Research indicates that the quality of adolescent romantic relationships is related to self-esteem, social competence and wellbeing; though it is likely these relationships are bidirectional (Collins et al., 2009). Social technologies that facilitate communication, such as smartphones and social media

applications, have been widely adopted by adolescents and may have implications for the development of intimacy during adolescence (boyd, 2014; Peter, Valkenburg, & Schouten, 2005).

- Autonomy: A child is highly dependent upon adults to guide their decision-making and inform their attitudes, beliefs and behaviours. However, in the adolescent years, individuals gradually move towards becoming autonomous, independent and self-governing adults. This quest for autonomy involves becoming gradually less reliant on parents for practical assistance and emotional support (Rueger, Malecki, & Demaray, 2008; Steinberg, 2001). It also involves the establishment of an independent set of values, opinions and beliefs, and as this occurs, adolescents may become more questioning of parental rules and decisions (Darling et al., 2008). Parents can find allowing adolescents to behave autonomously very difficult and many disputes in the teen years stem from an adolescent's desire to become more autonomous, and an authority figure's struggle to accept this (Jensen & Dost-Gozkan, 2015). However research has shown that conflict and distancing within parent-adolescent relationships does not necessarily diminish closeness; many adolescents and their parents still report getting along during the teenage years (Laursen & Collins, 2009). Developing a sense of morality is also an important component of autonomy, and in late adolescence, individuals are more likely to define morality in terms of their own moral principles, rather than relying on societal norms and rules (Eisenberg et al., 2005; Killen & Smetana, 2005). However, as the adolescent brain is susceptible to social influence, it may be that adolescents do not always behave in ways congruent with their beliefs in the presence of peers. Technology has been successfully used to facilitate the development of autonomy during adolescence, including among youths with long-term health conditions (e.g. diabetes) who have traditionally struggled to establish independence as a consequence of the demands of their condition (Harris, Hood, & Mulvaney, 2012).

- Achievement: Adolescents, through the performance of positive behaviours and the experience of positive feelings in evaluation settings (Steinberg, 2014), begin to develop a sense of achievement during the teen years. Though achievement is valued in school settings throughout childhood, it is only during adolescence that individuals come to appreciate the value and implications of this. This is partially due to cognitive development; the logical, abstract and metacognitive thinking abilities that mature during the teen years enable adolescents to think about their future in more tangible terms. It is also partially due to the looming prospect of adulthood and the changes in social role that adulthood brings, as unlike children, adults must make important decisions about their role within society, including choosing an occupation, which can be highly dependent upon their achievements (particularly their academic achievements) during the adolescent years (Mello, 2008). Thus adolescents generally become more aware of the importance of achievement, though there are large individual differences in the extent to which they are motivated towards achievement (e.g. Accordino, Accordino & Slanely, 2000), and also begin to cultivate beliefs about their own abilities to achieve (Schunk & Meece, 2006). Parents, peers and teachers play an important role in shaping adolescents' achievement-orientated motivation and achievement-related beliefs about the self (Bouchey & Harter, 2005; Schunk & Meece, 2006). There are many ways in which technologies may be used to

facilitate development of achievement in adolescence. For example, technologies have been successfully used to support reading achievement among dyslexic adolescents (Cheung & Slavin, 2011). However most research into adolescent achievement (in Teen-CI and the social and behavioural sciences more broadly) has centred on educational settings, yet there are other settings in which an adolescent's sense of achievement may be fostered, including in leisure based activities, such as performing with a band for the first time, and in occupational settings, such as achieving promotion in a part-time job. The Teen-CI community should consider how it can understand and facilitate adolescent achievement in non-academic domains also.

These five psychosocial challenges should not be regarded as mutually exclusive as considerable overlaps exist between them. For example, sexuality may be an important aspect of identity, particularly among sexual minority youth (Hammack, Thompson, & Pilecki, 2009). Sexuality may also intersect with intimacy; research indicates that sexual minority youth report lower levels of companionship than their heterosexual peers (Williams, Connolly, Pepler, & Craig, 2005). There are also some complex issues that commonly affect adolescents, which straddle the multiple aspects of adolescents' psychosocial development and further blur the lines between them. For example, the experience of negative body image (defined as the experiences of negative thoughts and feelings towards one's own body) during adolescence may affect sexual behaviour and intimacy within romantic relationships (Woertman, & van den Brink, 2012). The way in which developmental challenges intersect within each adolescent's own unique experiences should not be overlooked.

It is also important to note that these psycho-social developmental themes do not exclusively manifest during adolescence. That is, individuals will continue to develop their sense of identity, sexuality, intimacy, autonomy and achievement throughout the life span. Consider how important life events, such as motherhood may affect an individual. A new mother may have to negotiate a renewed sense of identity to incorporate her new social role as a mother, a renewed sense of intimacy as she bonds with the baby, and a renewed sense of sexuality as she re-engages in sexual activity post-partum. Motherhood may also influence her sense of autonomy as her feelings of independence are altered by her new found responsibilities as a mother, and her sense of achievement as her new role encourages her to re-evaluate her sources of self-worth. Thus prominent themes in adolescent development may become salient once again in life, particularly following prominent life event and during periods of transition. However the way in which identity, sexuality, intimacy, autonomy and achievement are experienced in adolescence may be regarded as unique due to the novelty and newness of the experience during these formative years.

2.7 Reflecting on Teen-Computer Interaction (Teen-CI)

Teenagers are highly complex and diverse group, which must be considered very carefully in the context of HCI research. Unfortunately many researchers mistakenly believe that they are experts on what it means to be a teenager because they were once teenagers themselves. Instead, this chapter has drawn on contemporary research from the social and behavioural sciences to outline the core developmental processes occurring during adolescence. It has explained the fundamental and universal biological and cognitive

processes shaping adolescent development, and how differences in the sociocultural environments of adolescents mould each individual's unique developmental trajectory. Understanding how (and why) adolescents think and behave differently to both children and adults crucially builds a rationale to support the importance of studying teenagers in their own right. In particular, Teen-CI researchers may wish to consider:

- <u>The cognitive sophistication of teenagers, relative to children, while acknowledging that teenagers' cognitive capacities are still not as sophisticated as adults.</u> Teenagers think in more abstract, logical and complex ways than children, and these abilities steadily improve with age. However, in situations where emotional impulses must be regulated (such as when controlling impulses to engage in risky behaviour) or situations that simply involve other people, teenagers do not necessarily think and behave in ways that are consistent with their new found cognitive abilities.
- <u>The heightened sensitivity of teenagers to social information</u>. Teenagers spend large amounts of time engaging with peers, both offline and online, and are often pre-occupied with thoughts and concerns about peer relationships. They are typically more susceptible to peer influence and more sensitive to peer rejection, than adults, and these differences seem to be reflected in brain function.
- <u>The self-orientated nature of the teenage experience.</u> Understanding the self in relation to others is a common theme overarching all aspects of psychosocial development (i.e. identity, sexuality, intimacy, achievement and autonomy) during adolescence. The teenage years are characterised by self-orientated cognitions, and teenagers may seem self-conscious - or even self-obsessed - as they focus on understanding who they are and how they fit in.
- <u>The differences amongst teenagers are as striking as the similarities between them</u>. Teenagers are not a homogeneous group. The rich and unique socio-cultural environment, in which adolescent development occurs, fosters the development of unique individuals. The potency and plurality of contextual factors shaping adolescence may explain why participatory research approaches, such as those outlined in the chapters of the present book, are becomingly increasingly used with this age group. Group-based differences (such as age, gender and ethnicity) should also be considered.
- <u>The commonalities between teenagers and other populations</u>. Teenagers are not wholly distinct to other demographic groups and some insights gleaned from research with teenagers may be transferrable to other populations, and vice versa. For example, basic cognitive skills, such as information processing, seem to plateau during the teenage years, suggesting that there is little differences between adults and teenagers in terms of these basic skills. Similarly, concerns about identity, sexuality, intimacy, autonomy and achievement are commonplace amongst adults also.

It is hoped that the brief overview of adolescent development provided in the present chapter will provide useful foundational knowledge to researchers in the Teen-CI community. This knowledge should be used to inform research approaches, research questions, and research methods when working with teenagers in Teen-CI research, ultimately contributing to a more comprehensive interdisciplinary understanding of teen interactions with technology.

References

Accordino, D. B., Accordino, M. P., & Slaney, R. B. (2000). An investigation of perfectionism, mental health, achievement, and achievement motivation in adolescents. *Psychology in the Schools, 37*(6), 535-545. doi: 10.1002/1520-6807(200011)37:6<535::AID-PITS6>3.0.CO;2-O

Alberts, A., Elkind, D., & Ginsberg, S. (2007). The personal fable and risk-taking in early adolescence. *Journal of Youth and Adolescence, 36*(1), 71-76. doi: 10.1007/s10964-006-9144-4

Arnett, J. J. (1999). Adolescent storm and stress, reconsidered. *American psychologist, 54*(5), 317-326. doi: 10.1037/0003-066X.54.5.317

Bentley, T. (2012). *Learning beyond the classroom: Education for a changing world.* Oxon, UK: Routledge.

Blakemore, S. J. (2012). Imaging brain development: the adolescent brain. *Neuroimage, 61*(2), 397-406. doi:10.1016/j.neuroimage.2011.11.080

Blakemore, S. J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing?. *Annual review of psychology, 65*, 187-207. doi: 10.1146/annurev-psych-010213-115202

Blakemore, S. J., & Robbins, T. W. (2012). Decision-making in the adolescent brain. *Nature neuroscience, 15*(9), 1184-1191. doi: 10.1038/nn.3177

Bronfenbrenner, U. (1979). Contexts of child rearing: Problems and prospects. *American Psychologist, 34*(10), 844-850. doi: 10.1037/0003-066X.34.10.844

Boyd, D. (2014). *It's Complicated: the social lives of networked teens.* Yale University Press.

Brown, B. B., & Klute, C. (2003). Cliques, crowds, and friendships. In G. R. Adams & M. Berzonsky (Eds.),*Handbook of Adolescent Development (*pp. 330-348*).* London: Blackwell.

Browning, C. R., Leventhal, T., & Brooks-Gunn, J. (2004). Neighborhood context and racial differences in early adolescent sexual activity. *Demography, 41*(4), 697-720. doi: 10.1353/dem.2004.0029

Buchanan, C., Eccles, J., & Becker, J. (1992). Are adolescents the victims of raging hormones? Evidence for activational effects of hormones of hormones on mood and behaviour at adolescence. Psychological Bulletin, 111, 62-107. doi: 10.1037/0033-2909.111.1.62

Bumpus, M. F., Crouter, A. C., & McHale, S. M. (2001). Parental autonomy granting during adolescence: exploring gender differences in context. *Developmental Psychology, 37*(2), 163-173. doi: 10.1037/0012-1649.37.2.163

Carskadon, M. A. (2011). Sleep in adolescents: the perfect storm. *Pediatric Clinics of North America, 58*(3), 637-647. doi: 10.1016/j.pcl.2011.03.003

Chein, J., Albert, D., O'Brien, L., Uckert, K., & Steinberg, L. (2011). Peers increase adolescent risk taking by enhancing activity in the brain's reward circuitry. *Developmental science, 14*(2), F1-F10. 10.1111/j.1467-7687.2010.01035.x

Cheung, A. C., & Slavin, R. E. (2011). The Effectiveness of Education Technology for Enhancing Reading Achievement: A Meta-Analysis. *Center for Research and Reform in Education*. Retrieved from: http://eric.ed.gov/?id=ED527572

Collins, W. A., Welsh, D. P., & Furman, W. (2009). Adolescent romantic relationships. Annual review of psychology, 60, 631-652. doi: 10.1146/annurev.psych.60.110707.163459

Darling, N., Cumsille, P., & Martínez, M. L. (2008). Individual differences in adolescents' beliefs about the legitimacy of parental authority and their own obligation to obey: A longitudinal investigation. *Child Development, 79*(4), 1103-1118. doi: doi: 10.1111/j.1467-8624.2008.01178.x

Dekaban A. S., Sadowsky D. (1978) Changes in brain weights during the span of human life: Relation of brain weights to body heights and body weights. Annals of Neurology, 4, 345–356. doi: 10.1002/ana.410040410

Demorest, A., Meyer, C., Phelps, E., Gardner, H., & Winner, E. (1984). Words speak louder than actions: Understanding deliberately false remarks. *Child Development, 55*, 1527-1534. doi: 10.2307/1130022

Diamond, L. M., & Savin-Williams, R. C. (2009). Adolescent sexuality. In R. Lerner & L. Steinberg (Eds.), Handbook of adolescent psychology.. New York: Wiley. doi: 10.1002/9780470479193.adlpsy001015

Dorn L D, Biro F M (2011). Puberty and its measurement: A decade in review. Journal of Research on Adolescence, 21(1), 180-195. doi: 10.1111/j.1532-7795.2010.00722.x

Dumontheil, I., Apperly, I. A., & Blakemore, S. J. (2010). Online usage of theory of mind continues to develop in late adolescence. *Developmental Science, 13*(2), 331-338. doi: 10.1111/j.1467-7687.2009.00888.x

Eisenberg, N., Cumberland, A., Guthrie, I. K., Murphy, B. C., & Shepard, S. A. (2005). Age changes in prosocial responding and moral reasoning in adolescence and early adulthood. *Journal of research on adolescence*, *15*(3), 235-260. doi: 10.1111/j.1532-7795.2005.00095.x

Erikson, E. (1968). *Youth: Identity and crisis.* New York: Norton.

Flanagan, C., & Tucker, C. (1999). Adolescents' explanations for political issues: Concordance with their views of self and society. *Developmental Psychology, 35*, 1198-1209. doi: 10.1037/0012-1649.35.5.1198

Gifford-Smith, M. E., & Brownell, C. A. (2003). Childhood peer relationships: Social acceptance, friendships, and peer networks. *Journal of School Psychology*, *41*(4), 235-284. doi:10.1016/S0022-4405(03)00048-7

Grant, M., & Furstenberg, F. (2007). Changes in the transition to adulthood in less developed countries. *European Journal of Population, 23,* 415-428. doi: 10.1007%2Fs10680-007-9131-9

Guse, K., Levine, D., Martins, S., Lira, A., Gaarde, J., Westmorland, W., & Gilliam, M. (2012). Interventions using new digital media to improve adolescent sexual health: a

systematic review. *Journal of Adolescent Health, 51(*6), 535-543. doi:10.1016/j.jadohealth.2012.03.014

Hall, G. S. (1904). *Adolescence: Its psychology and its relation to physiology, anthropology, sociology, sex, crime, religion and education.* Englewood Cliffs, NJ: Prentice-Hall.

Hammack, P. L., Thompson, E. M., & Pilecki, A. (2009). Configurations of identity among sexual minority youth: Context, desire, and narrative. *Journal of Youth and Adolescence, 38*(7), 867-883. doi: 10.1007/s10964-008-9342-3

Hilbrecht, M., Shaw, S. M., Johnson, L. C., & Andrey, J. (2008). 'I'm Home for the Kids': Contradictory Implications for Work–Life Balance of Teleworking Mothers. *Gender, Work & Organization, 15*(5), 454-476. doi: 10.1111/j.1468-0432.2008.00413.x

Hill, J. P., & Lynch, M. E. (1983). The intensification of gender-related role expectations during early adolescence. In *Girls at Puberty* (pp. 201-228). Brooks-Gunn, J., & Peterson, A. C. (Eds). Springer US. doi: 10.1007/978-1-4899-0354-9_10

Harris, M. A., Hood, K. K., & Mulvaney, S. A. (2012). Pumpers, skypers, surfers and texters: technology to improve the management of diabetes in teenagers. *Diabetes, Obesity and Metabolism, 14*(11), 967-972. doi: 10.1111/j.1463-1326.2012.01599.x

Horowitz, A. D., & Bromnick, R. D. (2007). Contestable adulthood: Variability and disparity in markers for negotiating the transition to adulthood. *Youth and Society, 39*, 209-231. doi: 10.1177/0044118X06296692

Huang-Pollock, C. L., Carr, T. H., & Nigg, J. T. (2002). Development of selective attention: Perceptual load influences early versus late attentional selection in children and adults. *Developmental Psychology, 38,* 363-375. doi: 10.1037/0012-1649.38.3.363

Inhelder, B., & Piaget, J. (1958). *The growth of logical thinking from childhood to adolescence.* New York: Basic Books. doi: 10.1037/10034-000.

Jensen, L. A., & Dost-Gözkan, A. (2015). Adolescent–Parent Relations in Asian Indian and Salvadoran Immigrant Families: A Cultural–Developmental Analysis of Autonomy, Authority, Conflict, and Cohesion. *Journal of Research on Adolescence, 25*(2), 340-351. doi: 10.1111/jora.12116

Johnson, H. D. (2004). Gender, grade, and relationship differences in emotional closeness within adolescent friendships. Adolescence, 39(154), 243-255,

Keating, D. (2011). Cognitive development. In B. Brown, & M. Prinstein (Eds.), Encyclopedia of adolescence (Vol. 1, pp. 106-114). New York: Academic Press.

Kail, R. V., & Ferrer, E. (2007). Processing speed in childhood and adolescence: Longitudinal models for examining developmental change. *Child development, 78*(6), 1760-1770.

Killen, M., & Smetana, J. (Eds.). (2005). *Handbook of moral development.* Psychology Press.

Koenig, L. B., McGue, M., & Iacono, W. G. (2008). Stability and change in religiousness during emerging adulthood. *Developmental psychology, 44*(2), 532-543. doi: 10.1111/j.1467-8624.2007.01088.x

Laursen, B., & Hartup, W. W. (2002). The origins of reciprocity and social exchange in friendships. *New Directions for Child and Adolescent Development,95,* 27-40. doi: 10.1002/cd.35

Leets, L., & Sunwolf. (2005). Adolescent rules for social exclusion: when is it fair to exclude someone else?. *Journal of Moral Education* 34, 343-362. doi: 10.1080/03057240500211618

Lenhart, A. (2015, April). Teens, social media & technology overview 2015. Retrieved from http://www.pewinternet.org/2015/04/09/teens-social-media-technology-2015/

Lloyd, B. T. N. (2002). A conceptual framework for examining adolescent identity, media influence, and social development. *Review of General Psychology*, *6*(1), 73-91. doi: 10.1037/1089-2680.6.1.73

Luciana, M., Conklin, H. M., Hooper, C. J., & Yarger, R. S. (2005). The development of nonverbal working memory and executive control processes in adolescents. *Child Development, 76,* 697-712. doi: 10.1111/j.1467-8624.2005.00872.x

Luna, B. (2004). Algebra and the adolescent brain. *Trends in Cognitive Sciences, 8,* 437-439. doi: 10.1016/j.tics.2004.08.004

Madkour, A. S., Farhat, T., Halpern, C. T., Godeau, E., & Gabhainn, S. N. (2010). Early adolescent sexual initiation as a problem behavior: a comparative study of five nations. *Journal of Adolescent Health, 47*(4), 389-398. doi:10.1016/j.jadohealth.2010.02.008

Manago, A. M., Graham, M. B., Greenfield, P. M., & Salimkhan, G. (2008). Self-presentation and gender on MySpace. *Journal of Applied Developmental Psychology, 29(*6), 446-458. doi:10.1016/j.appdev.2008.07.001

McClintock, M. K., & Herdt, G. (1996). Rethinking puberty: The development of sexual attraction. Current Directions in Psychological Science, 5(6), 178-183. doi: 10.1111/1467-8721.ep11512422

Mello, Z. R. (2008). Gender variation in developmental trajectories of educational and occupational expectations and attainment from adolescence to adulthood. *Developmental Psychology*, *44*(4), 1069-1080. doi: 10.1037/0012-1649.44.4.1069

Millman, R. P. (2005). Excessive sleepiness in adolescents and young adults: causes, consequences, and treatment strategies. *Pediatrics*, *115*(6), 1774-1786. doi: 10.1542/peds.2005-0772

Mitchell, K. J., Ybarra, M. L., Korchmaros, J. D., & Kosciw, J. G. (2014). Accessing sexual health information online: use, motivations and consequences for youth with different sexual orientations. *Health Education Research, 29(1),* 147-157. doi: 10.1093/her/cyt071

Montgomery, M. J. (2005). Psychosocial intimacy and identity from early adolescence to emerging adulthood. *Journal of Adolescent Research, 20*(3), 346-374. doi: 10.1177/0743558404273118

Peter, J., Valkenburg, P. M., & Schouten, A. P. (2005). Developing a model of adolescent friendship formation on the Internet. *CyberPsychology & Behavior*, *8*(5), 423-430. doi: 10.1089/cpb.2005.8.423

Petersen, A. C. (1988). Adolescent development. *Annual Review of Psychology*, *39*(1), 583-607. doi: 10.1146/annurev.ps.39.020188.003055

Pool, M. M., Koolstra, C. M., van der Voort, T. H. A. (2003). The impact of background radio and television on high school students' homework performance. *Journal of Communication, 53*, 74-87. doi: 10.1111/j.1460-2466.2003.tb03006.x

Radmacher, K., & Azmitia, M. (2006). Are there gendered pathways to intimacy in early adolescents' and emerging adults' friendships?. *Journal of Adolescent Research*, *21*(4), 415-448. doi: 10.1177/0743558406287402

Richards, M. H., Crowe, P. A., Larson, R., & Swarr, A. (1998). Developmental patterns and gender differences in the experience of peer companionship during adolescence. *Child development*, 154-163. doi: 10.2307/1132077

Rogol, A. D., Roemmich, J. N., & Clark, P. A. (2002). Growth at puberty. Journal of adolescent health, 31(6), 192-200. doi: 10.1016/S1054-139X(02)00485-8

Rueger, S. Y., Malecki, C. K., & Demaray, M. K. (2008). Gender differences in the relationship between perceived social support and student adjustment during early adolescence. *School Psychology Quarterly*, *23*(4), 496.

Schneiders, J., Nicolson, N. A., Berkhof, J., Feron, F. J., van Os, J., & deVries, M. W. (2006). Mood reactivity to daily negative events in early adolescence: relationship to risk for psychopathology. *Developmental Psychology*, *42*(3), 543-544. doi:10.1037/0012-1649.42.3.543

Schunk, D. H., & Meece, J. LD. (2006). Self-efficacy development in adolescence. In Pajares, F. & Urdan, T. C. (Eds). *Self-efficacy beliefs of adolescents*, *2*, 29-52. Greenwich, Connecticut: Information Age Publishing.

Sebastian, C., Viding, E., Williams, K. D., & Blakemore, S. J. (2010). Social brain development and the affective consequences of ostracism in adolescence. *Brain and Cognition*, *72*(1), 134-145. doi: 10.1016/j.bandc.2009.06.008

Smetana, J. G., & Bitz, B. (1996). Adolescents' conceptions of teachers' authority and their relations to rule violations in school. *Child Development*,*67*, 1153-1172. doi: 10.1111/1467-8624.ep9704150189

Smetana, J. G., Campione-Barr, N., & Metzger, A. (2006). Adolescent development in interpersonal and societal contexts. *Annual Review of Psychology,57*, 255-284. doi: 10.1146/annurev.psych.57.102904.190124

Steinberg, L. (2001). We know some things: Parent-adolescent relationships in retrospect and prospect. *Journal of research on adolescence*, *11*(1), 1-19. doi: 10.1111/1532-7795.00001

Steinberg, L., & Lerner, R. M. (2004). The Scientific Study of Adolescence A Brief History. *The Journal of Early Adolescence*, *24*(1), 45-54. doi: 10.1177/0272431603260879

Steinberg, L. (2007). Risk taking in adolescence new perspectives from brain and behavioral science. *Current Directions in Psychological Science, 16(2),* 55-59. doi: 10.1111/j.1467-8721.2007.00475.x

Steinberg, L. (2014a). *Adolescence* (10th Edition). New York: McGraw Hill.

Steinberg, L. (2014b). *Age of opportunity: Lessons from the New Science of Adolescence.* New York: Houghton Mifflin Harcourt.

Strang, N. M., Chein, J. M., & Steinberg, L. (2013). The value of the dual systems model of adolescent risk-taking. *Frontiers in Human Neuroscience,7.* 223. doi: 10.3389/fnhum.2013.00223

Strasburger, V. C., & Wilson, B. J. (2002). Children, Adolescents & the Media. Beverly Hills, CA: Sage Publications

Vartanian, L. R. (2000). Revisiting the imaginary audience and personal fable constructs of adolescent egocentrism: A conceptual review. *Adolescence, 35* (140), 639-662.

Vetter, N. C., Altgassen, M., Phillips, L., Mahy, C. E., & Kliegel, M. (2013). Development of affective theory of mind across adolescence: disentangling the role of executive functions. *Developmental Neuropsychology, 38*(2), 114-125. doi: 10.1080/87565641.2012.733786

Waterman, A. S. (1999). Identity, the identity statuses, and identity status development: A contemporary statement. *Developmental Review, 19*(4), 591-621. doi: 10.1006/drev.1999.0493

Williams, T., Connolly, J., Pepler, D., & Craig, W. (2005). Peer victimization, social support, and psychosocial adjustment of sexual minority adolescents. *Journal of Youth and Adolescence, 34*(5), 471-482. doi: 10.1007/s10964-005-7264-x

Woertman, L., & van den Brink, F. (2012). Body image and female sexual functioning and behavior: A review. *Journal of Sex Research, 49*(2-3), 184-211. doi: 10.1080/00224499.2012.658586

Zimmerman, C. (2000). The development of scientific reasoning skills. *Developmental Review, 20*(1), 99-149.doi: 10.1006/drev.1999.0497