Working with Teenagers within HCI Research: Understanding Teen-Computer Interaction

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There has been limited consideration of teenagers (defined as 12-19 year olds in this work) as participants and end-users in Child-Computer Interaction and mainstream HCI communities. Teenagers reside in a fascinating and dynamic space between childhood and adulthood, and working more closely with teenagers within HCI may bring great insights and benefits. This paper provides an overview of teenage development from a psychological perspective, and then reviews existing work considering teenagers within HCI. Teenagers have long been identified as unique and studied within the field of developmental psychology, and the overview we provide in this paper highlights key understandings that should be carefully considered when working with teen participants. The paper concludes by presenting a set of key research questions that need to be explored in order to effectively work with teenagers within the field of HCI and provide a roadmap for future research within the Teen-Computer Interaction area.

Teenagers. Design. Teen-Computer Interaction.

1. INTRODUCTION

The HCI community has been designing and evaluating with adult users since its inception and more recently the Interaction Design and Children (IDC) community has developed specific understandings and methods to work with child users. Teenagers, residing in the space between childhood and adulthood while overlapping both, have received comparatively little attention, and a need to develop and explore Teen-Computer Interaction (TeenCI) as a research area has been identified Fitton et al (2013). Teenagers are most usefully defined as individuals between the ages of 12 and 19 (though there is debate surrounding these age boundaries, as summarised in Fitton et al (2013)): they are often termed adolescents in literature (e.g. Poole and Peyton (2013), Steinberg (2008)). These 'digital natives' Prensky (2001) inhabit a world that is very challenging for adults to understand but working with this population when designing and studying technology can bring great benefits. As early adopters and appropriators of technology, insights into teenage technology-related attitudes and behaviours can be used to inform and guide the design of technologies for other user groups. Teenagers can combine the creativity of younger children with the articulation of adults, and can assist in the design and evaluation of technology for younger children. Teenagers have increasing spending power and can exhibit 'pester power' to influence parents' consumer

behaviour, making them an increasingly buoyant and lucrative market. Through understanding teenagers, we can also gain insights into the behaviours and preferences for the next generation of adults. It is therefore vital that we understand and engage teenagers in research within the HCI community. However, teenagers are not a homogenous group and any preconceptions or assumptions about them must be questioned, as teenagers inhabit a diverse and changeable world that is often alien to adults.

In Fitton et al (2013), a set of challenges specific to interaction design with teenagers were posed relating to use of methods, context in which to engage teenagers, cultural understandings, teen appropriation of technology, and ethics. The present paper aims to build on these ideas by considering teenagers from a developmental perspective, along with existing work with teenagers within the field of HCI, in order to expound key areas for exploration and opportunities within this emerging field. Firstly, drawing on the social and behavioural sciences literature surrounding teen development, we outline a holistic psychological framework for understanding the unique nature of the teen experience, which positions teens as both similar and different to fellow teens and other age-based groups. Next, existing HCI research that has involved teenagers is considered, with particular consideration of recent works exploring teenagers as participants in Interaction Design. Finally, key

questions for future research in the field of TeenCI are presented. It is hoped that these questions will guide the future direction of this extremely important, exciting and emerging area of TeenCI.

2. UNDERSTANDING TEENAGERS

2.1 Teen Development: A Psychological Perspective

A wealth of knowledge and understanding about teenagers may be garnered from the social and behavioral sciences, where the distinct nuances of the teen population have long been recognized. Perhaps the most useful framework for understanding teen populations originates in psychology, and organizes teen development around three distinct, yet overlapping, components: (1) fundamental changes (2) context, and (3) psychosocial development Steinberg (2008). The benefit of this framework is that not only does it offer a holistic and comprehensive account of teen development, but it also enables understanding of both homogeneity and heterogeneity amongst the teen population, and highlights the continuity and discontinuity of the teen experience relative to other age-based groups.

2.1.1 Fundamental Changes
There are three types of fundamental changes that occur universally during the teenage years: cognitive, biological, and social. These changes happen to teens in almost all cultures, in a *gradual* fashion, though there may be individual and cultural differences in terms of the age at which these occur. In terms of biological changes, puberty transforms a child into a reproductively functioning adult during the teen years, consequently creating marked changes in physical appearance and an increased interest in sexual partners Loomba-Albrecht and Styne (2009). Furthermore, as the teenage brain approaches physical maturation, a diverse range of cognitive developments occur, including an increase in memory function, increased speed of processing and the acquisition of abstract thought capabilities Steinberg (2005). Advances in developmental neuroscience, have enabled researchers to demonstrate how developing teen brains actually process information differently to both adults and children Steinberg (2005), particularly social information (Blakemore & Mills, 2014). Importantly, teenagers display a heightened sensitivity to reward, and an increased propensity to take risk: both of which have been attributed to the unique functioning of the teen brain Steinberg (2005), Steinberg (2008). The third fundamental change is social change, wherein teenagers are gradually no longer seen as children, and are consequently afforded the rights and responsibilities of adults. In developed countries, this is typically a socially-prescribed and progressive process, wherein teenagers are gradually afforded legal rights as they pass age-related milestones.

2.1.2 Context
Consistent with an ecological perspective of teen development Bronfenbrenner (1989), the fundamental changes of adolescence must be understood within the social environment or 'contexts', wherein the adolescent exists. These contexts, both proximal and distal, influence the way in which teenagers experience the fundamental changes associated with adolescence, and shape the course of their development. Four key contexts were identified by Smetana et al 2006) as being where adolescents spend their time: families, peer groups, schools, and work/leisure environments. Peer groups are perhaps the most influential and salient contexts shaping adolescent development and there is a wealth of literature demonstrating that teens are highly responsive to peer-related social cues, to both positive and negative effect Smetana et al (2006).

In modern society, media and technology heavily feature in all four contexts of teen development from Smetana et al and play an increasingly important role in shaping the nature of these developmental contexts. For example, social networking sites have changed the nature of teen peer groups by increasing the number of peers with whom teens can regularly communicate, the medium through which the typically communicate, and the style of their social interactions (e.g. Boyd, 2014). Increasingly, social scientists are recognizing the role that media and technology embedded within developmental contexts play in shaping the course of teen development Lloyd (2001). For example, internet access in classrooms has shaped the way in which teenagers learn by allowing access to an increasingly vast range of information. This means that information accessed by teens as they negotiate the fundamental changes of adolescence is increasing, and the impact of these technologies need to be understood more fully.

2.1.3 Psychosocial Development
The final component of teen development encompasses changes that are both psychological and social in nature. Five key psychosocial challenges that adolescents must negotiate during the teen years are: identity, autonomy, intimacy, sexuality and achievement Steinberg (2008). Interestingly, these challenges are not entirely unique to the teen population, and may be experienced by individuals at any stage of life where change is occurring, however the way in which they are experienced during the teen years is considered unique.

For example, negotiating identity is an important part of psychosocial development for teenagers, as most (but not all teens) will begin to develop a sense of self for the very first time during this stage, both in terms of understanding of who they are as an individual, and in terms of understanding how they fit into the broader social world (Erikson, 1968; Lloyd, 2001). However, this does not mean that identity is fully developed by the end of the teen years, since it is continually shaped throughout the lifespan through ongoing experience, and may be greatly impacted during times of change, e.g. following the birth of children (McMahon, 1995). However the negotiation of identity that occurs during the teen years may be understood as unique, since the relatively immature cognitive processing of a pre-teen brain mean that they cannot be explored prior to this point, and so identity development is perceived as a "novel" and intense experience by teens. Indeed, Erikson (1968) argued that identity formation is the single most important psychosocial task faced by adolescents, and that other psychosocial tasks, such as intimacy vs. isolation dominate in later years.

Members of the HCI community need to understand the unique way in which these psycho-social challenges are experienced by teens in order to understand the needs of teen technology users relative to other populations, design appropriately for them, and identify the possible impact that these technologies may have.

2.2 Related Work: HCI and Teens

This section provides an overview of existing HCI research involving teenagers, focusing on the purpose of the research, participants, and methods used.

2.2.1 Teen, Technology and Communication
One of the first papers this century involving teenagers and technology was "y do tngrs luv 2 txt msg?" Grinter and Eldridge (2001) where a logging study was successfully used to explore teen texting behavior among 11 UK teenagers aged 15-16 years. This work focused on teenage users as early adopters of SMS technology, the authors argued their findings informed on adult workplace practices and that current teenagers would bring their SMS messaging behaviors with them when entering the workplace. The motivation, therefore, for his work could be that of using teenagers to help predict future adult behaviors. In a similar way Bryant et al (2006) studied a group of 40 seventh-grade students in the US aged 11-13 years, using questionnaires exploring their use of SMS, instant messaging and other socially interactive technologies to support online and offline social networks. More recent work in this area such as Agosto et al (2012) has worked with larger groups

of teenagers (45 high school seniors in the US aged 18 or older) using focus groups to explore selection of social networking tools. In Fitton et al (2013) a tilt-based input method (intended for text input) for mobile devices was explored, this received a positive response to the new input method from teen participants in the experiment. These works highlight how teenagers, happy to embrace new technologies, can provide valuable insights into early adoption and appropriation.

2.2.2 Teens, Technology and Behavior Change
Teenagers have been involved in research exploring behavior change in a number of different domains. In particular, teens have been targeted with mobile health and fitness applications aimed at improving overall well-being. For example, in Macvean and Robertson (2012) a location-aware exergame was developed for 12-15 year olds and included expert interviews, observations and focus groups to inform the design of a set of games followed by an in-school evaluation study. Studies exploring energy used have also considered teenagers, in Gustafsson and Bång (2008) 6 teenagers participated involving a mobile game to reduce energy use in the home. Teenagers' propensity for accepting new technologies, coupled with the need to often encourage changes in behavior, enables exploration of a wide range of new and novel research possibilities with real world impact.

2.2.3 Teens as Design Partners
Other work has sought to meet specific needs of teenagers through involving them as participants or informants in a design process. For example in Mazzone et al (2008), disaffected teenagers (17 teenagers (aged 13-16) excluded from mainstream education in the UK were involved in the creation of an e-learning product to improve their emotional intelligence. Prolific use of mobile devices by teenagers has motivated the inclusion of teens in the design of new mobile technologies. In Berg et al (2003) ethnographic field studies conducted over 5 months in a college in the UK with students aged between 16 and 19 were used to inform the design of a new mobile phone concept to support MMS messages specifically for teen users. During the design phase small groups of teens provided feedback on various fidelities of prototypes. A similar teen-centric design approach was taken in Amin et al (2005) where an augmented SMS application was designed based on an initial participatory design workshop (with 9 teens aged 13-18). This was then evaluated in a user study, simulating use of the application through a prototype and included a questionnaire (with 8 teenagers aged 16-18). Younger teenagers have also been involved in the creation of wearable technologies to support social networking. In Labrune and Mackay (2006), participatory design

sessions were carried out with a small number of 10-14 year olds in order to inform the design of the 'telebead' concept and prototype. In these studies, the inclusion of teenagers is predominantly motivated by a need to design specifically for a teenaged user group.

2.2.4 Teens and Media

A study focusing on insights into new ways of sharing of digital music has focused exclusively on 'tween' users aged 11-13 Lehtinen and Liikkanen (2012), using a combination of interviews, diaries, questionnaires and other techniques. Focusing on the space of a teen bedroom, Odom (2012) explored, with 14 teenagers aged 14-17 years, design concepts conveying new forms of virtual possessions (music, photos etc). Teenagers generally spend significant amounts of time listening to music, this may be music with which their peer group identify or music chosen in response to their mood Miranda and Claes (2009). The medium through which music is consumed changes from generation to generation, with YouTube currently most popular for teenagers[1], these shifts in media consumption behaviour have important implications for service and device design.

2.2.5 Teens and Cool

Understandings of cool in a teen context have been developed as way to inform the design of teen appropriate technology. Personas were used in Horton et al (2012) in an activity to explore understandings of cool with teens (63 participants aged 16-17), the 'Cool Wall' Fitton et al (2012) was used for a similar purpose and collected insights into preferences for cool from 125 teenagers (aged 12-15). While positive associated with 'cool' are usually highly desirable for teenagers, cool is a complex concept to deconstruct and incorporate into the design of technologies. A model for cool in this context is presented in Read et al (2011) where cool is described as consisting of three components: 'being', 'doing' and 'having' elements. The authors also describe how the specific instances in each cool component may vary wildly between different age groups, peer groups, and locale, whilst also changing over time. Creating technologies that are considered cool by the target teen users, should this be possible, is almost certain to generate engagement.

2.2.6 Teen Methods

Recent research has begun to highlight the need for special consideration of teenagers as participants in interaction design. For example, in Iversen and Smith (2012), a traditional value-led participatory design approach was used to engage 7 teenagers throughout a project creating an interactive museum exhibit using a range of workshops and activities. In Read et al (2013) a variety of different materials were used to engage teenagers in design activities explore organic user interfaces for energy devices (28 participants aged 11-12 and 18 pupils aged 14-15 in a UK school); slime, pipe cleaners, PlayDoh, Lego bricks, fabric and sticky shapes to. In Poole and Peyton (2013) a number of methods used with teens in interaction design including interviews, focus groups and observation were discussed; the authors recommend videography as a valuable technique to gain insights into teens' daily lives. In Fitton et al (2013) a set of challenges specific to working with teenagers within interaction design were identified that included methods, context in which to engage teenagers, cultural understandings, appropriation of technology, and ethical considerations.

3. OPPORTUNITIES FOR TEEN-COMPUTER INTERACTION RESEARCH

In this concluding section, the authors present a set of interlinked research questions defining the areas where future research is needed within the TeenCI space. The questions have been formulated to address the current gaps in knowledge within the field of HCI research related to working with teenagers, informed from a developmental perspective and through consideration of existing HCI research. The questions have also been designed to form a roadmap that will lead to a mature understanding of teen populations and how to work with them within HCI research.

How can we gain insights into unknown teen populations? When working with such highly contextualized and diverse groups, there is a clear need for adults to gain understanding in order to effectively carryout research studies, i.e., in order to judge the ecological validity of research and appropriately interpret data collected.

What theory should be considered in work with teenagers? Work with teenagers in HCI has utilized a range of theories mainly from the domains of Psychology and Social Science. Use of theory in this space provides valuable tools and frameworks for gaining understandings and guiding research.

How do teen experiences persist and influence technology preferences and behaviors in adulthood? Understanding this area has great potential to give insights into future requirements for homes and workplaces in addition to requirements for future technology design.

What are the appropriate methodologies for engaging teenagers in HCI research? While there is some current and ongoing work adapting and creating research methods for teens (highlighted in the previous section) there is still much to learn in

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[1] http://www.nielsen.com/us/en/press-room/2012/music-discovery-still-dominated-by-radio--says-nielsen-music-360.html

areas such as effectiveness at exploiting teen creativity, appropriateness of use with different teen population, engagement with teen participants, and how to use insights gathered from teen participants (do we, for example, position them as expert or informant).

How can we design technology to be successfully adopted and appropriated by teenagers? As early adopters of technology heavily influences by peers and driven by factors such as cool and social connectedness, they represent the possibly the greatest opportunity and biggest challenge for designers.

How can teenagers inform the design of technology for adults and children? Situated in a unique space teens have the life experience and skills to inform the design of technology for children while also possessing the technology experience and creativity to inform the design of technology for adults.

What is the impact of technologies on teenagers and how can this shape teen development? It is imperative that TeenCI researchers develop an understanding of the acute and long term effects of technology use shaping teenagers social, emotional, cognitive and behavioral development. More experimental and longitudinal research, yielding a combination of both qualitative and quantitative data is needed to explore this largely unknown research space.

To what extent can developmental psychology influence teen HCI and to what extent can teen HCI influence developmental psychology? It is clear that there is much potential for the understanding of adolescence acquired by developmental psychologists to inform teen HCI. However, it may be that through understanding teen interactions will technology, we are able to develop a more nuanced understanding of teen development.

4. CONCLUSION

This paper has explored the gap in HCI research between the Child-Computer Interaction community (considering children) and the main-stream HCI community (considering adults), and has identified a wide range of opportunities and areas for exploration in the field of Teen-Computer Interaction. The paper began by discussing teen development from a psychological perspective to identify the key issues HCI researchers and practitioners should be aware of when working with teenage participants. This included the cognitive, biological, and social changes taking place through adolescence, the importance of teenagers' social context, and an overview psychosocial development. It is crucial that these developmental issues are considered if teenagers are to be

effectively engaged in HCI research, and furthermore, it may be argued that researchers have an ethical and moral responsibility to appreciate these developmental issues when working with teenage user group. The paper then summarised the existing work within the field of HCI considering teenage users. This section was divided into specific research areas and the specific motivations, rewards and opportunities related to each research area were highlighted. The paper then presented a set of key research questions for the field of Teen-Computer Interaction. Each of these questions presented a different direction for future work to take, in order to develop the field of Teen-Computer Interaction. Together these questions form a roadmap to guide the development and maturation of the Teen-Computer Interaction field. We hope that this set of research questions, coupled with the psychological framework for understanding the complexities of the teen experience, provide a strong foundation to inform and inspire work within the emerging TeenCI research area.

5. REFERENCES

Agosto, D.E., Abbas, J. and Naughton, R. Relationships and social rules: Teens' social network and other ICT selection practices. J. Am. Soc. Inf. Sci. Technol. 63, 6 (2012), 1108-1124.

Amin, A.K., Kersten, B.T.A., Kulyk, O.A., Pelgrim, P.H., Wang, C.M. and Markopoulos, P. SenseMS: a user-centered approach to enrich the messaging experience for teens by non-verbal means. In Proc. MobileHCI 2005. ACM Press (2005), 161-166.

Berg, S., Taylor, A. S. and Harper, R. Mobile phones for the next generation: device designs for teenagers. In Proc. CHI 2003. ACM Press (2003), 433-440.

Blakemore, Sarah-Jayne, and Kathryn L. Mills. "Is adolescence a sensitive period for sociocultural processing?." Annual review of psychology 65 (2014): 187-207.

Boyd, Danah. It's Complicated: the social lives of networked teens. Yale University Press, 2014.

Bronfenbrenner, U. The ecology of human development. 1979. Cambrdige, MA: Harvard University Press

Bryant, A. J., Sanders-Jackson, A., & Smallwood, A. M. IMing, text messaging, and adolescent social networks. Journal of Computer-Mediated Communication, 11, 2 (2006), 577-592.

Collins, W. A., Welsh, D. P. and Furman, W. "Adolescent romantic relationships." Annual review of psychology 60 (2009): 631-652.

Fitton, D., MacKenzie, I. S., Read, J. C., & Horton, M. Exploring tilt-based text input for mobile devices with teenagers. *Proceedings of the 27th International British Computer Society Human-Computer Interaction Conference – HCI 2013*. London: British Computer Society, 2013.

Fitton D., Read J. C., Horton M., Little L., Toth N., Guo Y. 2012. Constructing the Cool Wall: A Tool to Explore Teen Meanings of Cool. PsychNology Journal 10 ,2 (2012), 141-162.

Fitton, D., Read, J.C. and Horton, M. The challenge of working with teens as participants in interaction design. Ext. Abstracts CHI 2013. ACM Press (2013), 205-210.

Grinter, R. E. and Eldridge, M. A. y do tngrs luv 2 txt msg?. In Proc. ECSCW 2001. Springer Netherlands (2001), 219-238.

Gustafsson, A. and Bång, M. 2008. Evaluation of a pervasive game for domestic energy engagement among teenagers. In Proc. ACE 2008. ACM Press (2008), 232-239.

Horton M., Read J. C., Fitton D., Toth, N. and Little L. Too Cool at School – Understanding Cool Teenagers. PsychNology Journal 10, 2 (2012), 73-91.

Iversen, O.S. and Smith, R.C. Scandinavian participatory design: dialogic curation with teenagers. In Proc. IDC 2012. ACM Press (2012), 106-115.

Labrune, J-B. and Mackay, W. 2006. Telebeads: social network mnemonics for teenagers. In Proc. IDC 2006. ACM Press (2006), 57-64.

Lehtinen, V. and Liikkanen, L. The meanings of music sharing in tween life. Ext. Abstracts CHI 2012. ACM Press (2012), 1907-1912.

Lloyd, B. T. (2001). A conceptual framework for examining adolescent identity, media influence, and social development. Review of General Psychology, 6(1), 73-91.

Loomba-Albrecht, L. A., and Styne, D. M. Effect of puberty on body composition. Current Opinion in Endocrinology, Diabetes and Obesity 16, no. 1 (2009).

Macvean, A. and Robertson, J. 2012. iFitQuest: a school based study of a mobile location-aware exergame for adolescents. In Proc. MobileHCI 2012. ACM Press (2012), 359-368.

Mazzone, M., Read, J.C., and Beale. R.. Design with and for disaffected teenagers. In Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges (NordiCHI '08). ACM Press (2008).

McMahon, M. Engendering motherhood: Identity and self-transformation in women's lives. Guilford Press, 1995.

Miranda, D and Claes, M. Music Listening, Coping, Peer Affiliation and Depression in Adolescence, Psychology of Music. 37. (2009), 215-233.

Odom, W., Zimmerman, J., Forlizzi, J., Choi, H., Meier, S. and Park, A. Investigating the presence, form and behavior of virtual possessions in the context of a teen bedroom. In Proc. CHI 2012. ACM Press (2012).

Poole, E.S. and Peyton, T. Interaction design research with adolescents: methodological challenges and best practices. In Proc. IDC 2013. ACM Press (2013), 211-217.

Prensky, M. Digital Natives, Digital Immigrants Part 1, On the Horizon 9, 5 (2001), 1-6

Read, J. C., Fitton, D., & Horton, M. Theatre, PlayDoh and Comic Strips: Designing Organic User Interfaces with Young Adolescent and Teenage Participants. Interacting with Computers 25, 2 (2013), 183-198.

Read, J. C., Fitton, D., Cowan, B., Beale, R., Guo, Y., & Horton M. Understanding and designing cool technologies for teenagers. In CHI '11 Extended Abstracts on Human Factors in Computing Systems. ACM Press (2011), 1567-1572).

Smetana, J. G., Campione-Barr, N., and Metzger, A. "Adolescent development in interpersonal and societal contexts." Annu. Rev. Psychol. 57 (2006): 255-284.

Steinberg, L., "Cognitive and affective development in adolescence." Trends in cognitive sciences 9, no. 2 (2005): 69-74.

Steinberg, L., Adolescence, 8th Edition. New York: McGraw-Hill, (2008).

Steinberg, L.. A social neuroscience perspective on adolescent risk-taking. Developmental Review, 28(1), (2008) 78-106.