Motivating Teenage Girls' Take-up of Digital Opportunities: The Role of Peers, Programmes, and Parents



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ABSTRACT

As technology mediates more facets of teenage life, many worry about technology's impacts, particularly onto young adolescent women who are often depicted as vulnerable. However, by equipping teenage girls with the skills to constructively engage with digital content and to be resilient in their Internet use, we can prepare girls to be capable of seizing online opportunities and more resistant to online risks.

However, much literature on teenage technical empowerment, particularly for girls, models one aspect of the student's sociocultural environment, not the whole system in which they operate. Some studies focus on individual factors that might predispose a child to positive behaviours, such as technology access, demographic indicators, or individual psychopathology. Other research focuses on one aspect of the child's environment – whether their school environment, home environment, or social environment. Those studies that do explore the social system are not rooted within the psychological discipline. My thesis aims to bring their theories to hypothesis testing, using the methods associated with psychological inquiry. Moreover, existing literature on online opportunities focuses either on concrete measures of rewarding actions or on the psychological traits necessary for their take-up. No literature explores how actions and underlying psychology might be linked. The studies included in this thesis focus on how individuals' motivation for technology predicts socially-desirable outcomes.

Recognizing these two literature gaps, my thesis applies self-determination theory to assess how social settings influences the take-up of online opportunities and technical education. It consists of three discrete studies, each modelling one common method of the psychological inquiry. Study 1 utilizes existing representative datasets from cross-sectional surveys to explore hypotheses connecting individual-level predictors with online opportunity, showcasing that psychological factors are as impactful as demographic and social factors. Then, study 2 runs a field experiment at the Bit by Bit conference, showcasing how students' need satisfaction influences the take-up of academic study. Finally, study 3 pilots an SDT-based intervention with parents of teenagers to showcase how relatedness influences their decision to create supportive environments for their children's technology use.

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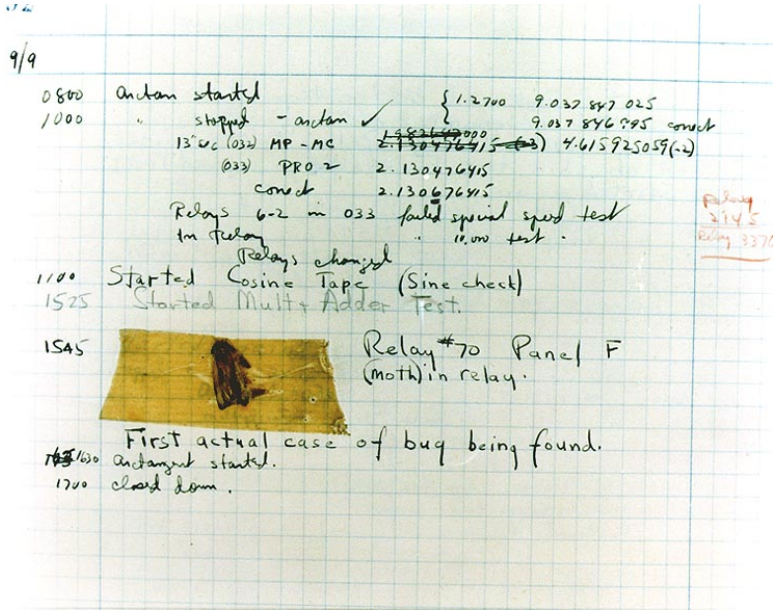
1 INTRODUCTION

1.1 Problem Statement

Computer legend tells that in the early 1940s, US Admiral Grace Hopper was programming Harvard's Mark II computer, when she discovered a moth in the machine. As computers of the time were room-sized machines prone to over-heating, this was a common occurrence. Moths, bugs, and other unexpected creatures could short-circuit the machines or break one of the switches that the (all-female) programmers used to input programs into the computers. Taking a pair of tweezers, Hopper carefully removed the bug from the computer and wrote in her notebook about "debugging" the machine. The term caught on. Moving forward, men and women in Hopper's lab would refer to the process of fixing mechanical and programmatic errors as finding bugs or debugging. And present-day coders now talk about debugging – or the process of removing errors from a computer program – unaware of the term's literal roots. Regardless of the veracity of the story – the term may have been in circulation before Hopper formally wrote it down – computer historians and popular media continue to perpetuate her role as the first 'debugger' and creator of the term (Shapiro, 1987).

Figure 1

Grace Hopper's Notebook



Despite the term's feminine origin, a new 'bug' has entered women's technological systems. Women are repeatedly victimized by and left out of the technological revolution. The numbers of teenage women pursuing computer science is in decline across the US and the UK (Beyer, 2014). Women do not feel that they belong in technical spaces, particularly because the dominant culture projects exclusive male-dominated views (Cheryan, Plaut, Davies, & Steele, 2009; Rattan et al., 2018). Not only are women left out of computing culture, but they are also typically seen as victims of, rather than the beneficiaries of, technical access. Popular media oscillates between criminalizing and victimizing young women, arguing they are simultaneously cyber bullies and victims of un-wanted 'sexting.' Reports oscillate between characterizing women in online communities as either predators (e.g. Sales, 2016) or prey (e.g. Jimenez, 2017; Marsh, 2017). When not implicated in the rhetoric, women are left out of it. Despite playing games in equal numbers, women are often excluded from video gaming communities, development, and culture (Paaßen, Morgenroth, & Stratemeyer, 2017). Finally, depictions of girls online focus on traditional gender norms, but girls are then criticized for portraying themselves as such (Bailey,

Steeves, Burkell, & Regan, 2013). These examples point to the negative discourse that surrounds young women's use of, and access to, digital tools.

This negative tone pervades the many digital spaces in which young women may participate. At the same time, young women's physical spaces may be equally hostile. Teenage girls' educational environments may exclude them from digital education (Cheryan et al., 2009). Parents often reinforce gendered stereotypes and roles, which then influences young women's take-up of opportunities (Lily, 1994; Tenenbaum & Leaper, 2002). Young women themselves demonize and critique how other girls present their digital identities (Bailey et al., 2013). It is troubling that girls may encounter this from each of their environments: physical, parental, and peer.

The assumptions and panics related to young women's use and study of digital tools blinds the public to the many benefits that these tools can offer (Byron, 2008). To 'debug' this perception, researchers need to identify how teenagers' spaces and communities can support their development as intrinsically-motivated and self-regulated users of technology.

Following the integrated thesis format, this thesis comprises three discrete academic studies on this topic that are united by a common theoretical approach – Self-Determination Theory (SDT). Each study presents one perspective on the question: How can communities support positive outcomes from young women's technology use? While each study explores the influence of a different stakeholder in adolescent women's lives, they all apply self-determination theory to concentrate on the role of psychological relatedness in supporting women's development. In this introductory chapter, I first briefly introduce self-determination theory, then outline the theoretical choices this thesis makes, and finally present the structure and connections behind the stand-alone studies.

1.2 Theoretical Overview

Why do we perform behaviours? Psychologists define the why behind actions in terms of an individual's motivation for them and classify types of motivation. Feeling no drive or impetus towards action defines amotivation. In contrast, a person who feels driven towards an action, event, or outcome is motivated towards it. Psychologists argue that this drive can be intrinsically or extrinsically motivated. When we behave based on rules, social norms, or a fear of consequences, we are extrinsically motivated to perform. Yet, when behaviour is motivated by internal drive, passion, or interest, it is defined as intrinsically motivated. Self-determination theory argues that intrinsically motivated behaviours are more likely to be sustained and emotionally healthy (Ryan & Deci, 2000a).

Put simply, an extrinsically-motivated teenage girl may teach herself to code because her mother suggests that the skill will look good on her resume but an intrinsically-motivated girl would teach herself to code because she finds the problem-solving enjoyable. It then logically follows that the girl who is learning because her mother told her to will stop learning when her mother stops suggesting it. Meanwhile, the girl who learns for learning's sake will continue the activity for the fun of it. And, the girl learning to please her mum will not find it as enjoyable as the girl doing it to please herself.

Self-determination theory thus focuses on motivational quality and motivational outcomes. The theory unites environmental predictors – such as demographics and parenting decisions – with motivational quality, and motivational quality with its subsequent results – such as the take-up of online opportunities. SDT focuses on the quality of motivation for engaging in a task. It argues that intrinsically motivated behaviours are more psychologically healthy and more sustainable. Research into self-determination theory links intrinsic motivation within a specific domain – such as education or work – to both psychological outcomes and concrete observable outcomes within it. As an example, when it is applied within the education domain,

self-determination theory links intrinsic motivation to both academic adjustment (a psychological outcome) and academic performance (a concrete outcome) (Soenens & Vansteenkiste, 2005). Self-determination theory allows the researcher to link observed outcomes with motivational quality. By adopting the motivational perspective, this thesis focuses on how to create motivational contexts to support and sustain young women's technological experiences. Additionally, in a world where expectations for women's behaviour are often driven by societal norms and expectations (Eccles, Jacobs, & Harold, 1990; Gunderson, Ramirez, Levine, & Beilock, 2012), it becomes critical to determine what will encourage women to use technology in line with their goals and desires.

Self-determination theory argues that intrinsic motivation develops out of an individual's basic needs for competency, autonomy, and relatedness (Deci & Ryan, 2000). Deci & Ryan (2000) argue that when individuals feel in control of their behaviour and choices (autonomy), effective at acting on these choices (competency), and connected to others (relatedness), they thrive. While much research, particularly in education, focuses on the importance of competency and autonomy, significantly less is known about the impacts that relatedness has onto the development of intrinsic motivation. This thesis responds to this gap by exploring relatedness' role in supporting young women's motivation and in the decisions that parents and children make around technology. Towards this, it identifies and establishes its central goal: *To apply self-determination theory to deepen our understanding of how to motivate the uptake of technological opportunities by teenage women.*

1.3 Definitional Boundaries and Goals

Scholars currently debate the bounds and legitimacy of online opportunities, gender constructs, and developmental periods (overviews in Bellanca, 2010; Cho, Crenshaw, & McCall, 2013; Steinberg & Morris, 2001). In response to these debates, this thesis creates bounds around

each category. Towards its stated goal of applying SDT to deepen our understanding of the uptake of technical opportunities by young women, this thesis offers the following definitions.

1.3.1 Online Opportunities

This thesis will define opportunities in two ways. Qualitative and quantitative analyses of teenagers' use of new media identifies concrete ways in which new technology may benefit their development. These categories include learning, self-improvement, socialising, civic engagement, and creativity. These opportunities present themselves on and through new devices as Mascheroni & Olafsson (2014) note, "Children are growing up in a convergent media ecology, whereby significant opportunities for sociability, self-expression, learning, creativity and participation are provided by online media and increasingly, mobile media" (p. 6). Consistent with rich literature documenting teenagers' uses of the Internet for their personal developmental needs (e.g. Ito et al., 2009; Kafai & Peppler, 2011; Livingstone & Helsper, 2010), this thesis recognizes and measures concrete categories of digital opportunities offered through the Internet and mobile connectivity.

In addition to opportunities offered to youth through Internet use, opportunities are available through the creation of digital content. The ability to code can grow students' agency, interpersonal skills, and higher-order problem solving abilities (Grover, Pea, & Cooper, 2015; Gruba & Søndergaard, 2001; Ryoo, Margolis, Lee, Sandoval, & Goode, 2013). Learning to code may also offer economic mobility (Kessler, 2017). While coding falls into the broader category of digital skills, it is set apart from them because it implies a mastery over and creativity towards machines. While some schools offer this instruction, many students are left to teach it to themselves (Brennan, Valverde, Prempeh, Roque, & Chung, 2011). Yet, while the formal categories explored through the above qualitative work all describe uses of technology, coding involves creating new technology and therefore I note a difference. Thus, this thesis studies both categorical consumption opportunities and general coding ability.

There are two critical ways in which young women are excluded from technology opportunities – they make limited use of online opportunities and they are less likely to learn to code and there exist consequences for both.

1.3.2 Gender

This thesis focuses on the gendered experience of technology opportunities. In adopting the psychological perspective, this thesis works within a traditional scholarly discipline to find commonalities amongst individuals along a gender binary and focuses solely on the role of gender. While this perspective ignores the influence of intersectionality, it speaks to dominant narratives within the technology industry and policy communities. In what follows, I outline the rationale behind the three studies' approach to gender.

As a research objective, intersectionality emerged to orient researchers from cultural studies to those left behind or left out of traditional feminist theories. While historical feminist movements championed the idea of 'woman-kind,' intersectional feminists argue that oppression depends on factors outside of one's gender, such as race, class, and ability. The term was first coined to chart the unique ways in which violence against women of colour is a direct product of their intersecting identities (race and gender) (Crenshaw, 1991). Since Crenshaw's original work, the theory has been reapplied and extended to explore the ways that an individual's intersecting identities can overlap to offer relative privilege or different experiences of womanhood (Cho et al., 2013). Researchers use the theory as a lens to explore how feelings of gender depend on one's other group identities (Shields, 2008). Yet, intersectionality emerged in qualitative research and complicates the work of feminist empirical research.

Intersectionality studies identifies the lived experiences of an individual resulting from and in response to cultural systems that may foreground or have been developed for other identities. Historically, intersectionality has focused on blurred lines yet, empiricists are forced to draw lines and categories to measure power structures. Empirical statistical tools are often

unable to measure the interdependence of identity categories (Bowleg, 2008). Therefore, researchers aiming to quantify the impacts of intersectionality must make sacrifices in how they represent identity – a research principle which stands in contrast to the stated goals of intersectional researchers (Shields, 2008). Psychologists are left without tools to address the overlapping concerns of 'race-class-gender' identified and advocated for by intersectionality researchers (Cole, 2009). Therefore, empirical psychologists can either obscure the nuance for which the theory advocates or avoid the intersectional approach. Given this choice, this thesis avoids intersectionality for two critical reasons, its research question and its goals.

This thesis restricts its purview to those that identify as young adolescent women but focuses broadly on factors that impact all who identify as women. In doing so, it allows for continuity with both SDT and children's technology literature. Much literature on young people's divides in access and opportunity focuses on mapping the differences between groups but still treat 'gender' as a monolithic identity (e.g. Beyer, 2014; Grant & Eynon, 2017; Helsper, 2010). Similarly, SDT scholars have historically treated gender as a possible predictor and avoided studying its intersection with other demographic factors (e.g. Black & Deci, 2000; Levesque, Zuehlke, Stanek, & Ryan, 2004). This thesis unites both fields through its investigation of SDT and teenage technology use. By continuing to focus on gender as a singular construct it can reflect on and effectively apply SDT towards understanding of young women's digital lives.

Not only might the psychologist's toolkit be inadequate for 'measuring' and validating the intersectional feminists' qualitative work, the intersectional approach is currently ignored by industry and policy makers. Many programmes, initiatives, and funding schemes support gender-related concerns and inequalities and separately focus on race-based or class-based interventions. Yet, without research on the efficacy of supporting young women, such programmes cannot have their maximum impact (True & Mintrom, 2002). The gendered experience is such that regardless of someone' identification with their gender, the current social structures will treat them differently because of it. Therefore, to address their need for solid evidence, this thesis

focuses on gender as a category that at least partially defines young women's experiences and whose implications must be addressed.

1.3.3 Adolescence

This thesis focuses on adolescents between 13-18, for three principle reasons.[1] In adolescence, children crystallize their identity (which technology may help them do), peer modelling becomes as influential as parents (which is why social support becomes of key importance), and children are granted more autonomy to access technology (Erickson et al., 2015; Kline & Short, 1991; Waterman, 1982).

Adolescence marks a dramatic shift in an individual's interpersonal and internal context. Through puberty, teenagers test their boundaries with their parents and the period is typically marked by changes in family relationships. Not only does the relationship dynamic shift, but individuals transition to spending more time with their peers than with their parents (Steinberg & Morris, 2001). Peers take on a modelling role, increasingly influencing their friends' behaviour and choices. Depending on her level of closeness with her parents, peers may also be more impactful than parents in steering a young woman's choices (Gauze, Bukowski, Aquan-Assee, & Sippola, 1996). This influence on both pro-social and risky behaviours is often due to the adolescent's admiration of her friends (Steinberg & Morris, 2001). Given theoretical shifts in adolescents' social structure, it becomes critical to focus on this life-stage and the role that social support plays within it.

Developmentally, adolescence marks a change in an individual's self-concept and identity. In adolescence, young people start to form their identity concepts. This includes ideas about their social, occupational, and interpersonal roles (Erikson, 1984). While scholars disagree about within which stage of adolescence this occurs or the developmental steps taken to create

[1] Throughout this thesis, the terms adolescents, teenagers, and 'young women' are used interchangeably for word choice and readability.

these self-concepts, there exists broad agreement that this process occurs during adolescence (Meeus, Iedema, Helsen, & Vollebergh, 1999; Steinberg & Morris, 2001). Through this process, individuals take on self-concepts that relate to their own belief systems and, while influenced by their peers, may vary and develop nuance across the contexts within which a teenager engages. Because adolescents are developing the ability to reason hypothetically about abstract concepts, they begin to relate these concepts to themselves and to develop conceptions about their role in the wider world. Increasingly, the Internet can help teenagers develop these concepts, explore new ideas, or extend these roles (Valkenburg & Peter, 2008). At the same time, it can present new risks and potentially harmful content to developing adolescents. This relationship is further complicated by teenagers' digital independence. When compared to other children, adolescents are much more likely to have their own Internet-accessing devices; this allows for unsupervised technology use, risk-taking, and digital autonomy (Anderson & Jiang, 2018; OfCom, 2017). It is therefore crucial to understand the factors that can contribute to positive technology outcomes in teenagers' lives.

1.3.4 Geographic Focus

This thesis restricts its focus to the United Kingdom (Study 1) and the United States (Studies 2 & 3). Despite their geographic difference, there are a number of similarities between the countries that allow for generalizations between them. Firstly, both countries show similar gender divides in computing (Blickenstaff, 2005; Camp, 1997; Powell, Dainty, & Bagilhole, 2012). Additionally, women in both countries hold the same technology-related gender stereotypes and insecurities (Beyer, 2014; Powell et al., 2012). Finally, as a universal framework, SDT's relevance has been demonstrated across cultural contexts. In comparisons of collectivist and individualist cultures and controlling versus non-controlling cultures, SDT's framework still governs and explains students' behaviours (Chirkov & Ryan, 2001; Chirkov, Ryan, Kim, &

Kaplan, 2003; Deci et al., 2001). As such, one can apply SDT in both US and UK cultures and compare and generalize findings between them.

1.4 Structure

Following this introductory chapter, chapter 2, the literature review, offers a deeper analysis of self-determination theory literature. The literature review situates self-determination theory amongst other approaches for exploring technology and child development to ground the subsequent studies and explore why SDT was selected as this thesis's theoretical framework. Additionally, chapter 2 showcases how SDT has been applied to broad domains including technology use, video game play, and educational settings. By demonstrating SDT's theoretical underpinnings, broad utility, and relevance for the populations in chapters 3-5, chapter 2 presents a framework that will be explored and applied through the later chapters.

Chapter 3 (Study 1) utilises secondary data analyses within two datasets collected four years apart to showcase how psychological processes and social connection support the take-up of online opportunities for teenage girls. While previous studies of these datasets primarily relate demographic variables to positive outcomes, this study builds on these by showcasing how SDT-related variables explain many of the observed outcomes. Specifically, within the 2010 EU Kids Online Dataset (dataset 1), this research will showcase how feelings of *social support* explains observed outcomes. These findings are then deepened with an investigation into the 2014 Building Online Resilience Dataset (dataset 2). In this dataset, built with SDT in-mind, analyses showcase how *social support* predicts *intrinsic motivation*, which in turn predicts the take-up of online opportunities. By doing so, this study illustrates the importance of relatedness in predicting positive outcomes from teenage technology use and extends principles from SDT to explain patterns of young women's technology behaviours.

Chapter 4 (study 2) focuses on a different class of technical opportunities – computer science study – and explores whether needs-support and needs-supportive interventions predict

motivation for study. Results from study 2 showcase that relatedness is significantly more predictive of motivation than other psychological factors. By doing so, it builds off of study 1's findings, by further demonstrating the importance of social support in predicting positive outcomes from teenage girls' technology use. Additionally, it continues to explicate the role that psychological processes (like motivation and relatedness) play in explaining the outcomes previously studied by communications and education scholars.

While studies 1 & 2 establish the importance of relatedness through cross-sectional datasets, chapter 5 (study 3) uses experimental methodologies to causally establish a link between relatedness and technical opportunities. In doing so, it validates the conclusions drawn by and the suggestions for further research from studies 1 & 2. Study 3 focuses on parents of teenagers and demonstrates how their feelings of relatedness influence the decisions they make surrounding their children's technology use. In doing so, it showcases how relatedness produces climates that studies 1 and 2 found optimal for teenage development.

Finally, chapter 6 reflects on the joint contribution from these discrete studies and develops conclusions based on these studies' combined implications.

Together, this structure lays out three discrete findings, united in theoretical goals that contribute jointly to our understanding of the motivational correlates and outcomes of teenagers' technology use.

1.5 Significance of this Research

This thesis focuses on the motivational correlates to the take-up of digital opportunities – not just on the opportunities themselves. Across motivational theories, the *why* behind behaviour has been linked with concrete outcomes and emotional well-being. Focusing on motivation allows the researcher to identify factors that encourage the maintenance of key behaviours. By taking this approach through an integrated format, this thesis offers theoretical and policy contributions.

Psychologists draw a distinction between universalist and relativist approaches to psychology. Emerging from cultural psychology, relativist approaches argue that our behaviours are culturally constructed and differ based on individual factors, while the universalist perspective believes that there are central behavioural tenets that are common across all people (Goodhart, 2003; Shweder & Sullivan, 1993). As a macro-theory, self-determination theory provides universal principles that it posits guide behaviour, while allowing space for relativist approaches. It acknowledges that the same values and needs may present differently depending on the culture (Soenens, Vansteenkiste, & Van Petegem, 2014). The universal framework is particularly well-suited for quantitative social-science, which brings theories to formal hypothesis testing. Together, the three studies in this thesis comprise the major quantitative tools available to psychologists: secondary data-analysis, quasi-experiment, experiment. Each applies one of these to SDT's universal framework in large data-sets to demonstrate the relevance of this theory.

By applying SDT towards the take-up of online opportunities, this thesis extends our understanding of SDT. At present, despite claiming to apply across domains, SDT has only been loosely applied towards the take-up of technology. Those that do focus on specific forms of technology adoption, such as e-learning software in professional and academic environments (e.g. Lee, Lee, & Hwang, 2015; Roca & Gagné, 2008), or use self-determination and self-determination theory as one of several theoretical framings (e.g. Chadwick & Fullwood, 2018). By extending SDT towards three discrete outcomes within the study of technology opportunities, this thesis demonstrates the broad applications of SDT and encourages psychology researchers to apply SDT towards studying the digital world. This both expands our understanding of SDT and of the psychological underpinnings of much of our technology-mediated activities.

In addition to its theoretical contribution, this research informs policy debates about children and technology use. Consistent with the children's rights perspective (e.g. Livingstone & Bulger, 2014), by focusing on positive outcomes from technology use this research contributes evidence to growing debates about children in a digital age and suggests the importance of harnessing social support. Specifically, study 1 looks at representative datasets collected four years apart to demonstrate the consistent motivational and concrete benefits to young women from social support and the missed opportunities that emerge when technology use is restricted. Following this, study 2 illustrates the importance of relatedness for young women in technology study. It also argues that interventions for this demographic require evidence and must tackle the psychological underpinnings of the gender divide. Finally, study 3 showcases how social support influences the decisions that parents make around their adolescents' technology use and demonstrates the consequences of media fear mongering onto parents' perceptions of technology. Together, these studies demonstrate the importance of relatedness for technology-related decision making. Additionally, by showcasing the psychological factors that underplay many parents' and adolescents' technological lives, this thesis showcases how policy narratives can be framed around psychological opportunities.

2 Literature Review

Popular culture and press depict modern teenagers as "digital natives" for growing up around and with modern digital tools. This stereotype assumes that early exposure to technology equips contemporary teenagers with refined skills, digital literacy, and new expectations for educational settings. Beyond media portrayals, many parents and teenagers believe that they are sophisticated Internet users (Fitton, Ahmedani, Harold, & Shifflet, 2013; Wineburg, Breakstone, McGrew, & Ortega, 2018). Yet, investigations of this phrase identify that it is often divorced from nuance and not supported by either theoretical or evidence-based examples (Bennett & Maton, 2010; Bennett, Maton, & Kervin, 2008; Jones & Czerniewicz, 2010). Indeed, recent scholarship indicates that a belief in skills based on generational lines leads researchers and practitioners to ignore the factors that actually predict digital nativity (as it is defined). In comparing generations, education, gender, race, socio-economic background, and breadth of uses were found to be as predictive as age in leading towards digital literacy (Hargittai, 2010; Helsper & Eynon, 2010; Kennedy, Judd, Dalgarno, & Waycott, 2010; Pearce & Rice, 2013). The contrast between these findings on digital skills and teenagers' assumptions of their own abilities suggests that digital sophistication can and should be taught and that it must be socially encouraged. Indeed, in a study of digitally excluded youth in the UK, Eynon & Geniets (2016) argue that social support systems and direct educational training are necessary to foster digitally engaged youth across socio-economic and gender lines.

This thesis takes this argument as its central focus and looks at *how* social support and educational settings may help adolescent females foster self-determined relationships with technology. It views a self-determined relationship with technology as the ideal outcome from teenage technology use but focuses on different aspects of this relationship – whether through

uses of tools, building these tools themselves, or parents' relationships with these tools. Yet, this thesis will demonstrate the common theoretical underpinnings of all positive relationships with technology.

Despite the academic value in investigating the role of social support systems in encouraging positive technology behaviours across genders, there is an acute need to focus on females. This need is driven by the economic and social realities facing young adolescent women. New technology increasingly drives economic growth (Fagerberg, 1987) and more jobs require technological understanding (The White House, 2016). Yet, research from the United States suggests that although girls perform as well as or outperform boys on achievement and social tests before adolescence (Herbert & Stipek, 2005), as puberty hits, girls begin to underperform and question their own academic ability (Good, Aronson, & Inzlicht, 2003). While girls report early interest in STEM careers, this too changes in adolescence across the US and the UK (Dasgupta & Stout, 2014; Webb & Miller, 2015). Not only do academic relationships to technology begin to shift, but teenage girls appear to use different technological tools and use tools in their own ways as they approach adolescence (Barker, 2009; Jackson et al., 2008; Li & Kirkup, 2007). Thus, encouraging self-regulated technology use, an understanding of how to help oneself online, and STEM[2] education can better prepare young women for the professional skills needed to compete economically.

Just as young women develop their own gendered relationships with technology, their social and emotional developmental phase necessitates a psycho-social focus. Additionally, as girls' and boys' peer group structure (Legewie & DiPrete, 2012) and preferred educational formats (Countryman, Feldman, Kekelis, & Spertus, 2002) begin to diverge in adolescence, there is extra urgency in identifying the role that these may play in supporting constructive

[2] Science, Technology, Engineering, and Math. A common educational acronym referring to these subjects as one group because of their shared focus on ways of approaching problem solving.

relationships with technology. Social groups often suggest ways of using technology (Van Cleemput, 2010), but these can also develop from an internal drive. Self-resilience can give girls the edge necessary to succeed at or above boys' levels (Duckworth & Seligman, 2006). Thus, the proposed focus on psychological and positive outcomes can identify the dual supports necessary to promote constructive technology use. Most literature focuses on both genders and thus, in what follows, I review studies of both. However, given the importance of preparing women to be digital citizens, my individual studies will narrow the focus to explore whether any dimensions of the psychosocial system are more pronounced for this demographic.

Following the integrated thesis format, this thesis consists of three discrete studies, each focused on one aspect of the relationship between social supports and technological outcomes and united by a common theoretical framework – self-determination theory. In what follows, I outline common theoretical approaches towards studying technology and child development, before explaining self-determination theory and arguing for its relevance in this field.

2.1 Theoretical Approaches to Studying Youth and Digital Opportunities

Most approaches to studying teenage girls' technology use either focus exclusively on one level of the teenagers' interaction (e.g. family, friends, etc.) or focus on outcomes divorced from an overarching theoretical framework. By uniting theory and a broader psychosocial framework, I can better situate teenage technology use and outcomes within adolescent women's daily lives and understand the nuanced factors that might impact outcomes. In what follows, I review common approaches towards studying technology adoption in children, their significant findings, and theoretical shortcomings. I then outline self-determination theory, a macro-psychological theory, that can be used to explore how a teenager's environment and interpersonal relationships interact with her individual psychology to produce technological outcomes.

2.1.1 The Relationship between Teenage Development and Technology

Building off of developmental theorists, a large body of literature focuses on how technology supports or intersects with the psychological goals of adolescence. Between roughly 12-18, teenagers develop more advanced logical, moral, and critical reasoning skills which leads to significant behaviour change. During the teenage years, adolescents develop their autonomy, identity, and ability to reason about abstract constructs (Erikson, 1984; Piaget & Inhelder, 2008). This can lead to intellectual and emotional shifts as teenagers experiment with this new ability. Robert Havighurst, an educational psychologist, noted that as children learn through this phase, they engage in what he termed 'developmental learning tasks.' These include "developing a personal sense of identity, establishing adult vocational goals, developing stable and productive peer relationships, adjusting to new intellectual abilities" (summary quotation from Hughes-Hassell & Miller, 2003, p. 149; Havighurst, 1948).

Developmental learning may take on different forms during adolescence. As their brains develop, teenagers often engage in risk-taking behaviour (Furby & Beyth-Marom, 1992). Friendships become more important as teens begin to define their identity through their friends' behaviours and focus more strongly on social capital (Vitaro, Boivin, & Bukowski, 2009). As they begin to focus on identity development, adolescents often try exploring the boundaries of relationships to parents and loved ones by pushing for independence (Collins & Steinberg, 2007). Finally, teenagers become increasingly egocentric and often struggle to differentiate between others' concerns and their own (Elkind, 1967). While these have long been viewed as adolescent processes, as teenagers spend increasing time on social media and other Internet resources, they now engage in these tasks through their online pursuits.

Noting parallels between these psychological changes and uses of technology, much literature focuses on how the Internet and social networking services can inform or support these adolescent developmental needs (e.g. Hughes-Hassell & Miller, 2003; Valkenburg, Schouten, & Peter, 2005). During adolescence, teenagers are faced with potentially harmful

information or risky choices, both online and off. Yet, they are also at a crucial stage of developing themselves, being presented new opportunities, and new sources for learning and development. It is therefore critical to encourage teens towards these digital opportunities.

Much literature from the psychological tradition makes an explicit value judgment on how technology influences teenage development. While early literature on teenagers and technology focused on the risks and hazards of new tools (Bennett, Maton, & Kervin, 2008; Cassell & Cramer, 2007), more recent studies note the opportunities that new media might have for adolescent development. Review articles have argued that much research from the early 2000's resembled a "moral panic" as researchers constructed a sense of exoticism around digital natives, feared Internet risks and predators, and took a determinist view that technology would destroy teens' academic ability (Bennett et al., 2008; Selwyn, 2009). While some of these assumptions have since been debunked, new academic moral panics focus on technology addiction, violent video games, and social media risks (Calvert et al., 2017; Hamm et al., 2015; Moreno, Jelenchick, & Breland, 2015; Sales, 2016).

While technology may carry risks for teenagers, these reports exacerbate the media and parents' concerns, particularly because they largely ignore the many benefits technology may offer. Indeed, these views contrast with more recent work that outlines how technology creates new opportunities for learning, skill development, and social engagement (Ito et al., 2009; Livingston & Helsper, 2010). Teenagers interviewed now argue that technology is central to their development and can recognize the importance of technology skills and uses of technology for their development (Fitton et al., 2013). As Livingstone & Haddon (2009) outline, increased access to opportunities also increases exposure to possible risks but that many activities in which teenagers engage may serve multiple purposes, depending on the individual. These studies are influential for debunking moral panic literature and showcasing how adolescents can access online opportunities to help their development.

Developmental psychologists implicitly endorse the social shaping of technology by viewing online and educational opportunities as shaped by teenagers' needs and influencing their development. Research on the interplay between teenage development and engagement with technology notes how the Internet creates new areas for developmental learning. These studies go beyond identifying broad benefits and focus on the specific ways that teenagers develop through their technology use. The way that they engage online influences teenagers' ethical development. The content they are exposed to and the ways that they engage with it may contribute to their moral decision making (Bradley, 2005). Teenagers may enact in group-reinforcing leadership, paralleling offline needs for social engagement (Cassell, Huffaker, Tversky, & Ferriman, 2006). As they engage online and push the boundary of the developmental need for autonomy, parents worry about what they may encounter, despite teenage protestations that it is valuable (Borca, Bina, Keller, Gilbert, & Begotti, 2015; Mathiesen, 2013; Shifflet-Chila, Harold, Fitton, & Ahmedani, 2016). In these and related studies, teenagers enact their developmental goals through the Internet, but, in doing so, may put themselves in harm's way.

These dual and possibly conflicting roles are exemplified in teenage social media engagement. For example, in their literature review on the role of social networking sites (SNS) in teenage development, Shapiro & Margolin (2014) note these dual narratives and outline the multiple perspectives within developmental theory on SNS use. Some researchers support a rich-get-richer approach to technology-based networking, where already sociable teens continue to improve their social development. Other scholars offer a social compensation hypothesis, arguing that the Internet and social networking services can help teenagers who have difficulty establishing connections offline by connecting them with other likeminded individuals or offering new mediated spaces for connection. In their review, Shapiro & Margolin (2014) argue that both hypotheses may be true – the majority of studies on SNS and friendship find that offline skills predict online relationships *and* that those who struggle offline may find

communities of support online. In both of these situations, youth enact their developmental needs through technology and in response to what new tools offer. Similarly, youth craft their identity through and in response to SNS affordances, sometimes choosing to selectively disclose or try on parts of their identity (boyd, 2007). These findings are significant because they highlight the nuanced role that new technologies may play in supporting adolescent development.

However, by showcasing the multiple ways that new information and communications technologies (ICT) interact with teenage development, these studies point to the need for more nuanced research that moves beyond connecting ICTs to concrete outcomes and towards identifying the broader social community that teenagers operate in and its environmental affordances. Therefore, this thesis takes this need as one of its central aims. By looking beyond the appearance of positive outcomes and towards the broader psychosocial setting that may predict positive outcomes, we may develop a more robust understanding of ICT use.

2.1.1.a Personality Psychology and Technology

Early research on how technology use intersects with psychology situated itself within personality psychology. The big five personality traits [Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism], a common approach to describing personality, are used to both predict and explore why individuals might use the Internet. For example, Amichai-Hamburger, Wainapel, & Fox (2002) found that personality types differentially predicted turning to the Internet for social interaction – extroverts find their identity through offline interaction while introverts and individuals high on the neuroticism scale are more likely to construct identities and interact online. This work is now dated, as currently almost all teenagers engage in online social interaction. However, it is an early example of how psychologists typically approach relating psychology to Internet use. It attempts to predict use through psychological descriptors. While the developmental approaches discussed above connect online outcomes to teenagers'

development, this and other personality-based approaches relate use to specific psychological predictors.

Following this model, more recent work extends this paradigm within a variety of psychological traditions. Building off of Amichai-Hamburger et al. (2002), researchers relate contemporary use patterns and sharing behaviour to personality types (Pociute & Krancaite, 2012; Liu, Ang, & Lwin, 2013). However, by focusing on explaining specific behaviours, such as decisions to share content, researchers understand a recent phenomenon, not human behaviour. This situates the work between psychological and communications traditions. Others move beyond this basic model into studying broader psychological correlates – including the strengths and difficulties questionnaire or psychiatric disorders (Nesi & Prinstein, 2015; Przybylski & Mishkin, 2016). Regardless of the psychological measures selected for inclusion, these studies often apply a dosage-effects model, assuming that media use is either a response to or cause of observed human behaviour. While valid as an explanation of the take-up of online opportunities, by assuming media use is innate based on personality type, policy responses become based on changing the person to facilitate behaviour change. By focusing on macro factors, such as social environment and demographics, one can begin to think about how to change an ecosystem to encourage participation in digital opportunities. Such strategies are more easily employed by institutions, governments, and firms and can paint a broader picture of how we develop technology use patterns.

2.1.1.b Media Effects Traditions

Dosage-effects models are theoretically similar to a host of theories on media effects and how communications technologies influence our beliefs and behaviours. Media effects theorists take a determinist viewpoint on technology and argue that the devices, websites, or tools themselves directly impact the take-up of online opportunities. These researchers question the teenagers' agency by assuming that technology, divorced from social setting, may influence

development and how teenagers' perform their identity development. As this thesis is directly concerned with how environments and internal factors may support development, I do not directly review blankly-deterministic works, but instead discuss pieces rooted in the media effects tradition that explore the negotiation between the teenager and her devices.

Within this subcategory, one strand of research notes how technology has created new spaces and rituals for teenage development. Rather than viewing use as responsive to the design of ICTs, such research focuses on how new tools support the performance of teenage developmental patterns. For example, a study of teenage 'promposals[3]' and the subsequent videos posted to YouTube notes how teenagers use the Internet and the act of promposing to construct a desirable social identity for themselves and that videos are used to forecast to the world that they are adults ready to leave school (Richardson, 2017). This research extends literature on how teenagers use online communities and user-generated content to construct identities (e.g. Gal, Shifman, & Kampf, 2016; Jordán-Conde, Mennecke, & Townsend, 2014). Together, these studies imply that technology fills a developmental need. While they do not make a value judgment on whether these technological uses are helpful or harmful for teenagers, by exploring teenagers' negotiation with new tools, they recognize the active role that individuals may play in their technological relationships. Borca, et al. (2015) argue that teenagers are aware of how technology supports their developmental goals and that teenagers employ this self-awareness when engaging with technology. However, by assuming that teenagers are actively shaping their media choices, these studies ignore the role that social settings may play in conditioning media choices. As such, while rooted in the psychological tradition, these studies apply a modified form of uses and gratifications theory.

Uses and Gratifications Theory emerged from sociological and media effects traditions on the value that media and early forms of mass communication offered to its users. It argues

[3] A portmanteau between prom and proposal, indicating a formal proposal to be someone's prom date. Promposals are often elaborately planned and executed, sometimes with the intention of 'going viral.'

that uses of media fill certain personal or developmental needs, and this *gratification* from media can explain the take-up of programmes or technological uses (Ruggiero, 2000). Therefore, when modelling the pursuit of online opportunities, these communications scholars focus on the need that the media fills and not on the factors that predict having this need. Thus, studies employing this theoretical framework largely ignore the psychological or sociological root or need that the media satisfied (Katz, Blumler, & Gurevitch, 1973). In response, some scholars merged uses and gratifications theory with expectancy-value theory, a related psychological framework (Palmgreen & Rayburn, 1982; Rayburn & Palmgreen, 1984). By merging these two approaches, these scholars argue that if we do not understand the psychology behind *why* an individual engages with a technology or how a new tool influences an individual, we cannot effectively design helpful solutions or encourage emotionally fulfilled technology use.

Originally a motivational theory, Expectancy-Value Theory emerged in mathematics education to explain differences in academic achievement across genders. The theory posits that children have an expectation of their success in a task, and a value placed on succeeding within or on that task itself. Together, expectations of success and the subsequent value placed on the task influence motivation within it (Wigfield, 1994). Motivation and expectation then explains observed differences in outcomes. Eccles et al. (1983) argued that children's decisions to engage and performance in a task depended on the extent to which they believed in their ability to succeed within it and the value that they place on being successful at it. The theory is primarily concerned with the child's lived experience. Students may develop ability beliefs and success values from external feedback, prior experiences, or broader sociocultural values (Simpkins, Fredricks, & Eccles, 2012; Wigfield & Eccles, 2000). Of significance to this thesis' goals, expectancy-value theory begins to merge the child's psychological experience (through focusing on her expectations) with the child's environmental outcomes (through focusing on values).

While the theory does not explicitly focus on how expectations develop, it provides a helpful framework through which researchers can explore and model online opportunities.

Consequently, researchers have used expectancy-value theory to model several of the outcomes this thesis explores. The theory and its applications focus on the role of the child's values and choices in predicting achievement and has been applied towards STEM education (Dickhäuser & Stiensmeier-Pelster, 2003; Wang & Degol, 2013) and teenage Internet safety (Chai, Bagchi-Sen, Morrell, Rao, & Upadhyaya, 2009). In these applications, expectancy-value theory is modified to focus on the value placed on the decision to keep oneself safe or to study and therefore the theory can model the individual's decision to engage in diverse domains. Although behavioural interventions modelled on expectancy-value theory have been carried out to improve teenage outcomes (e.g. Harackiewicz, Rozek, Hulleman, & Hyde, 2012), the theory does not include a framework for how to change a child's values or expectations. This gap is crucially missing for researchers interested in robustly modelling behaviour because it assumes that humans are static and, if we don't fully understand how to change expectations, we can't effectively encourage the societally-desirable outcomes. Moreover, to be effectively applied towards understanding the take-up of opportunities, the theory assumes that teenagers are aware of their own abilities and expectations, which much of the developmental work argues they may not fully be. While expectancy-value theory therefore proves helpful at explaining some uses of technology, it cannot fully model digital behaviour.

The perspectives reviewed above each carry within them an assumption of teenagers' rights and skills and imply a role for parents, guardians, and schools in preparing teenagers for the take-up of online opportunities. For example, if, relying on uses and gratifications theory, we believe that teenagers are aware of their use, then we may want to actively mediate or encourage them to explore online opportunities without fear of content or contact risks. On the other hand, if we believe that teenagers make conscious decisions to place value on online opportunities, interventions may focus on technology training to ensure that students have strong ability beliefs. By rooting their psychological research within a theoretical paradigm, these studies begin to connect their findings with a broader political and sociocultural environment. By

connecting outcomes to potential solutions for observed phenomena, researchers can create actionable outcomes, policy recommendations, or targeted interventions. Yet, as theories focused on internal factors, the theories themselves do not offer interventions or solutions.

While such reports offer valuable first-level insights into technological outcomes, psychological states and usage patterns are dependent on broader sociocultural forces. To explore the social and emotional benefits of teenage girls' technology use and education, this thesis recognizes that the extent to which technology use may influence a child depends on three factors: 1) individual psychology, 2) a child's sociocultural environment, and 3) individual rules and societal regulation.

2.1.1.c The Importance of the Psychosocial Framework

Early developmental theorists recognized that cultural forces shape how children learn from mediated and play experiences (Forman, Minick, & Stone, 1996). Systems theorists extend Vygotsky's concept of socio-cultural influence, noting how the various actors in a child's life from the parent to the school to the culture might influence the extent to which the child develops through media use (Forman et al., 1996). A "psychosocial risk" relates an individual's psychological development to interactions within a socio-cultural environment. This ongoing navigation between individual psychology and a social-circle defines "psychosocial development" (Erikson, 1984). This perspective argues that in understanding media's rewards, we need to recognize that they might be differentially accrued based on both micro and macro-level factors.

The framework encourages researchers to look holistically at the system within which the child operates, merging a psychological perspective with a sociologist's viewpoint. Looking at a comparative example across the United States and Israel, Salomon found that national culture influenced whether children learned from books or from television, but that learning effects could be slightly mediated by parental involvement or individual psychology (Salomon, 1994). This underscores how an individual's social relationship (here with a parent) and cultural system

(here viewed on a national level) might influence media use's impacts. Yet, while different layers of a child's social environment may predict or differentially support technical behaviours, the individual's subjective reactions to their environment are what actually cause behaviour change, like the adoption of a new technology or decision to study (Ryan & Deci, 2004). Therefore, it is critical to include a study of psychology and its focus on human experiences into the psycho-social model.

Self-determination theory, a macro-level theory of human motivation, addresses these multiple levels of interaction by linking individual motivation to the broader settings and relationships that can define it. Psychological, emotional, and social predictors have all been linked with motivational outcomes and motivation itself may predict outcomes. By focusing on how people perceive and internalize external stimuli and values, the theory relates the individual's macro environment to their internal functioning and to observed outcomes (Ryan & Deci, 2004). As such, self-determination theory uniquely links the development of human motivation with both observed behavioural and value-oriented outcomes *and* an individual's socio-cultural environment. Therefore, it was selected as a framework through which to view teenage technology use.

2.2 Self-Determination Theory

Self-determination theory (SDT) offers a framework through which researchers might evaluate ones' actions, decisions, and the relative sustainability of both. SDT broadly acknowledges that our actions may be motivated by internal forces – like interest, care, or alignment with values – or by forces external to the self – whether by reward systems, a sense of obligation, guilt, or concrete directions. When behaviour is intrinsically motivated, it causes feelings of well-being and better performance. Yet, the more extrinsically motivated the behaviour, the less likely the behaviour is to be sustained, performed well, or to have produced feelings of well-being (Ryan & Deci, 2000). However, motivation is not static or fundamental to

the self. SDT argues that individuals engage in ongoing growth through their relationships and experiences in the physical world and that one's values and actions may be shaped over time through environmental and interpersonal factors. By modelling relationships between the individual and her social settings and by recognizing the importance of behavioural sustainability, SDT effectively addresses the concerns of the previously reviewed theories and offers a robust framework that will guide this thesis.

Within psychology, organismic theories focus on the individual's inherent desire to move towards self-actualization while dialectical theories focus on how individuals negotiate their learning and behaviours through interactions with the environment and others. SDT is derived from both of these traditions and, as an organismic dialectical belief recognizes that humans are oriented towards growth and subconsciously try to integrate new experiences into an existing sense of self. They engage in dialogue and respond to stimuli, experiences, and feedback from their environment and it is this process through which motivational states may shift (Ryan, 1995). As such, self-determination theory and its sub-theories (described below) offer a lens through which the researcher can integrate the individual with their broader surroundings. Additionally, the theory argues that all observed behaviours are performed with a degree of motivation and that quality of outcome, regardless of the domain, is related to motivation within that domain (Deci & Ryan, 2000).

The above explanation offers a general overview from which six sub-theories emerged to relate the micro and macro views of individual behaviour, of which, three will be explored through this thesis. To describe the micro-level of human behaviour, SDT's Basic Psychological Needs Theory identifies three internal factors that support self-regulation and intrinsic motivation. Then, to unite the micro- and macro- levels, Cognitive Evaluation Theory and Organismic Integration Theory classify the role of the environment in supporting/thwarting the individual's basic needs and/or motivation. In what follows, I outline these sub-theories of self-determination theory that can be used to describe the individual and her relationship with her

broader surroundings. For each sub-theory, I begin by explaining its contents, move on to discuss how it relates to observable positive outcomes for individuals, and conclude by reviewing its applications to technology and my thesis' focus.

2.2.1 Basic Psychological Needs Theory

Self-determination theory has its roots in individual well-being. SDT believes that all humans have three innate needs: *autonomy*, *competency*, and *relatedness*. When satisfied, these three needs sustain intrinsic motivation for a task, which leads to positive outcomes within the task and psychological well-being for the individual. We might therefore expect that when individuals can satisfy these needs through their technology use, they will pursue positive online opportunities.

In what follows, I review the psychological definitions for these needs and their applications. Individuals may feel *competent* when performing certain activities or within environments where they feel effective. Environments or activities can make an individual feel competent while performing them. For example, relative to no feedback, positive feedback will improve feelings of competency, while negative feedback will reduce the sense of competency (Deci & Ryan, 1980). An individual's feelings of competency will lead her towards intrinsic motivation. This effect is particularly strong if she also recognises that she is in control of her decision-making and performance, namely, when she feels her act is *autonomous*.

The need for autonomy argues that when individuals feel that they are in control of their actions or outcomes, they are predisposed towards intrinsic motivation. While autonomy can develop internally, environments can support or thwart this need. Increasing an individual's sense of choice or acknowledging her inner rewards can increase feelings of autonomy. However, perceived threats, surveillance, evaluations, or deadlines increase feelings of an external locus of causality and therefore reduce feelings of autonomy (Deci & Ryan, 2000).

When specific goals or metrics are imposed, they can make an individual perceive an external locus of causality and therefore prevent autonomy from developing.

Finally, when environments give individuals a sense of social connection or sense of psychological safety, an individual satisfies the need for *relatedness*. Relatedness first emerged as a tenet of motivation when observing babies. While all small children evidence a strong intrinsic desire to learn and explore, researchers found that when babies showed strong attachment to a parent, they performed better than isolated babies (Ryan & Deci, 2000). Additionally, when older children worked in the presence of an adult observer they showed greater intrinsic motivation than when performing the same task with an adult who ignored them (Anderson, Manoogian, & Reznick, 1976). Relatedness may emerge when individuals engage in substantive discussions or feel empathy or appreciation from their partners or teachers (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). While individuals may not sense relatedness within a specific task, without a stable base of support elsewhere, they will be incapable of developing or sustaining intrinsic motivation (Deci & Ryan, 2000).

Individuals instinctively try to fill these three needs, which SDT views as objective requirements for well-being (Ryan & Deci, 2004). Therefore, regardless of cultural values or explicit endorsement by an individual, researchers can focus on assessing and improving individuals' needs satisfaction.

Multiple methods from the psychological research tradition identified needs' importance across settings and within specific domains. Basic needs theory first emerged through empirical lab-based studies that found that, across environments, when these basic needs were satisfied, individuals developed intrinsic motivation and sustained high performance across difficult situations (Ryan & Deci, 2000b). While these needs were first formulated after lab experiments measuring rewards, feedbacks, and performance, they were later verified in more externally valid formats, including large cross-sectional surveys and field experiments (Deci & Ryan, 1994; Levesque, Zuehlke, Stanek, & Ryan, 2004). The theory's validation across methodological tests

during the mid-1980s and 1990s led to broad acceptance of this micro-motivational psychological theory and points to its applicability across domains. Additionally, unlike media effects traditions, individuals do not need to explicitly endorse basic needs for them to predict motivation. Research has found that regardless of cultural values or individual belief in needs, they still universally predict motivation (Deci & Ryan, 2000). Together, these tests of reliability and stability across cultures and methods begin to justify its use in this thesis.

Psychological needs can be encouraged by environmental, personal, or social-contextual factors. When needs are met or supported, individuals develop intrinsic motivation and become self-determined in their performance. Variability in needs support explains many of the differences between intrinsically and extrinsically motivated actions and individuals (Deci & Ryan, 2000). And intrinsically motivated individuals perform better and reflect greater emotional well-being. Of particular note to this thesis, these three needs have been validated across genders, cultures, the age spectrum, and environmental settings (Deci et al., 2001; Chirkov, 2009; Chirkov, Ryan, Kim, & Kaplan, 2003). While different cultures have a range of practices and expectations, the more these expectations support basic needs, the more autonomously motivated the activity (Chirkov et al., 2003). Within children and adolescents, needs fulfilment has been linked with current and future states of well-being (Véronneau, Koestner, & Abela, 2005). This broad applicability suggests I may use needs satisfaction as a lens to understand motivation to enjoy online opportunities.

Basic Needs Theory argues that needs satisfaction predicts motivation to engage with and in activities. It can therefore be used as a proxy to understand the take-up of digital activities. We might assume that when needs are satisfied, individuals will feel capable of pursuing identity-supportive uses of technology whereas, if needs are thwarted, individuals are more likely to use technology either in non-supportive ways or in ways harmful to themselves or others. While little research has focused on the connection between basic needs and technology, basic needs have been related to a variety of offline opportunities.

2.2.1.a Basic Needs' Relevance for Adolescents and Virtual Environments

By encouraging intrinsic motivation, basic needs sustain both internal psychological states and the tangible outcomes produced by those states. In this section, I review relevant findings about needs support and its real-world outcomes, before briefly summarizing research on basic needs in digital environments.

On the most-micro level, satisfying the needs for competency, autonomy, and relatedness supports emotional well-being. The needs are the basic building blocks from which all humans seek fulfilment and gain comfort (Ryan & Deci, 2000). Through needs satisfaction, individuals develop intrinsic motivation for a task and this motivation sustains psychological well-being and optimal outcomes (Deci & Ryan, 2000). While these three needs emerged from US-based research, needs-satisfaction predicts well-being and human functioning across cultures and on a broad-level (Chen et al., 2015). Chen et al. (2015) used cross-sectional surveys with adolescents in four cultures to demonstrate a link between an individual's overall needs satisfaction and general well-being. However, when these needs were thwarted, individuals evidenced ill-being and poor performance. This study establishes needs satisfaction as a universal inclination to orient oneself towards well-being and establishes the crucial role that the basic needs for competency, autonomy, and relatedness play in establishing well-being. This study also extends early lab studies on need support (summarized in Deci & Ryan (2000)) and distinguishes between needs satisfaction and thwarting. Needs thwarting emerges in situations where external controls (like threats) or environmental design directly interferes with fulfilling one's needs. When needs are thwarted, individuals develop extrinsic motivation, psychologically suffer, and underperform. Indeed, an overview of needs support in educational environments found that when students' needs were thwarted by teachers or reward systems, they underperformed academically and showed less enjoyment for learning (Niemiec & Ryan, 2009).

Basic needs may be satisfied in a general sense, leading to an overall sense of well-being, or within a domain, such as school, work, home, etc., and predicting well-being, performance, and motivation in that area. For example, across six different forms of work environment, needs-satisfaction within the role correlated with enjoyment and negatively related to feelings of work obligation (Andreassen, Hetland, & Pallesen, 2010). Daily fluctuations in needs-satisfaction have been linked with changes in well-being (Reis et al., 2000). Needs-satisfaction predicts both levels of autonomous and intrinsic motivation and general well-being, across user-identified domains, such as family, friends, relationships, etc. (Milyavskaya & Koestner, 2011). Milyavskaya & Koestner (2011) allowed users to identify the domains important to them, and then, for each individual, measured needs-satisfaction within their personally relevant domains. This helps validate needs satisfaction across multiple life domains and within the areas that individuals were most intrinsically motivated. By identifying needs satisfaction within what is important to the study participant, the researchers demonstrate the universality of needs-satisfaction.

While Milyavskaya & Koestner (2011) identify how needs-satisfaction influences well-being across personally-relevant domains, researchers have also identified the importance of needs satisfaction in researcher-selected domains across disciplines. Needs satisfaction impacts well-being within diverse disciplines, such as physical education, work environment, and interpersonal relationships (e.g. Adie, Duda, & Ntoumanis, 2008; Sheldon & Bettencourt, 2002; Van den Broeck, Vansteenkiste, De Witte, Soenens, & Lens, 2010). Longitudinal survey analysis further identified that needs support and satisfaction predicts well-being during weight loss activities and needs-frustration predicted unhealthy dieting behaviours (Ng, Ntoumanis, Thøgersen-Ntoumani, Stott, & Hindle, 2013). In both Bulgaria, a former communist country, and America, a strongly capitalist nation, needs satisfaction in corporate employees predicted motivation, job satisfaction and performance (Deci et al., 2001). Employees evidencing high-levels of needs satisfaction were less likely to show predictors of job-burnout (Van den Broeck, Vansteenkiste, De Witte, & Lens, 2008). These studies across methodologies and cultures are

significant because they suggest that task engagement across areas must be precipitated by needs satisfaction in that area. And, viewing self-determined technology use as optimal, they point to the need for studies in this area.

Not only can needs-satisfaction predict concrete outcomes, it also links to emotional and process-related outcomes across broad communities. Needs satisfaction predicted the psychosocial transition to retirement (Houlfort et al., 2015). When compared to non-models, fashion models who have less well-being because of the superficial way they are validated for their work show lower levels of needs-satisfaction (Meyer, Enström, Harstveit, Bowles, & Beevers, 2007). While these studies initially appear unrelated to teenagers or to digital engagement, they demonstrate how needs satisfaction supports psychologically integrative processes across populations. Finally, on a relational level, needs satisfaction influences interpersonal relationship satisfaction. When both partners in a relationship had high satisfaction within it, the relationship was higher-functioning (Patrick, Knee, Canevello, & Lonsbary, 2007). The studies cited are just some of the evidence linking needs satisfaction with tangible and emotional outcomes and come from a variety of disciplines and psychological methodologies. This suggests that basic psychological needs theory can be used across contexts and the robust methodological support demonstrates the theory's validity. Together, this paints a compelling case for applying the theory towards new environments.

Of even more direct relevance to this thesis, additional research focuses on needs satisfaction within teenagers. While the complex relationship between psychological needs and teenage development is still emerging, existing studies demonstrate the symbiotic interplay between these two areas. Firstly, cross-sectional evidence suggests that family structure, functioning, and support influences needs satisfaction and intrinsic goals (Davids, Ryan, Yassin, Hendrickse, & Roman, 2016). A series of cross-cultural studies suggested that adolescents who experience needs satisfaction across their domains reflect better school adjustment and overall well-being (Deci, Vallerand, Pelletier, & Ryan, 1991). Just as needs satisfaction supports well-

being, perceived needs support leads to well-being. Adolescents who feel their parents support their basic needs show greater well-being (Niemiec et al., 2006). This study crucially begins to relate the teenagers' environment to their needs satisfaction. Adolescents who experience needs support across the contexts through which they are likely to engage – school, home, part-time jobs, and with friends – is balanced, show higher emotional well-being, school adjustment, and academic performance. These reports were validated both by the students and their teachers (Milyavskaya et al., 2009). As teenagers currently spend much of their leisure time engaging in online activities or socialising through new devices, it is critical to examine the role these devices may play in supporting or inhibiting needs satisfaction.

Furthermore, while needs satisfaction predicted interpersonal functioning and competence, when individuals' needs for competency, autonomy, and relatedness were thwarted, individuals were less able to relate to others when compared to just needs dissatisfaction (Costa, Ntoumanis, & Bartholomew, 2015). These results introduce a key distinction, just as environments and relationships can support needs satisfaction, they can also directly interfere with and thwart these needs. This further demonstrates the powerful impact that the macro-perspective brings to our understanding of environmental influences. This approach validates my ability to study needs satisfaction within teenage technology use, the domain of interest.

When environments and individuals are needs-supportive, intrinsic motivation flourishes. As such, researchers within the SDT tradition have focused on identifying autonomy supportive and competency supportive interpersonal styles and forces. Autonomy supportive teachers encourage their students to tap into inner motivational resources through techniques that include offering engaging activities, properly-scaffolded challenges, encouragement, providing rationale, and opportunities for action (Reeve & Halusic, 2009; Kusurkar, Croiset, & Cate, 2011). In these and other autonomy supportive teaching practices, educators focus on encouraging students' freedom and ability to organize how they apply inner goals, needs, and preferences towards their classroom work. These teachers refrain from prescriptive or

achievement-oriented teaching and are more likely to follow a constructivist paradigm. These supports are effective at facilitating the teacher-student relationship, and this high relatedness value then improves motivation and performance (Reeve, 2006). These teaching styles have also been associated with coaches and subsequent athlete performance (Amorose & Anderson-Butcher, 2007; Coatsworth & Conroy, 2009). Autonomy supportive parents also show greater needs-satisfaction within themselves and their children, leading to children's need satisfaction and overall performance (Grolnick, Friendly, & Bellas, 2009; van der Kaap-Deeder et al., 2015; Soenens & Vansteenkiste, 2005). These studies demonstrate how needs satisfaction can be encouraged by individual relationships at home and school, two key places where individuals learn about technology.

Emerging research also looks more deeply at how basic psychological needs theory interacts with the digital world. Within a game-based learning environment similar to Boggle, needs satisfaction and needs-supporting interventions were both found to predict in-game performance (Sheldon & Filak, 2008). This research merged correlational and experimental evidence, building off of previous SDT interventions and thereby improving its reliability and suggesting that SDT can be applied to digital environments. Early research also links online needs satisfaction with positive online experiences. In China, young students who were able to satisfy their basic needs online experienced positive feelings from their online use and spent more time online. Meanwhile, students who were satisfied offline spent less time online, presumably because they were satisfied by their offline interactions (Shen, Liu, & Wang, 2013). This work demonstrates how online *and* offline activities are motivated by basic needs and how self-determination theory may underlie the decision to pursue constructive uses of new tools. However, while this work links emotional well-being and media choices with needs satisfaction, it does not look at how media itself supports basic needs or what broader sociocultural factors predict the decision to satisfy needs online.

While SDT researchers have not focused on the Internet's affordances for basic needs support, this framework has been reviewed with regards to other media. Specific features of video games influence needs satisfaction, and subsequent performance and enjoyment (Peng, Lin, Pfeiffer, & Winn, 2012; Przybylski, Rigby, & Ryan, 2010; Tamborini et al., 2011). These studies indicate that virtual environment affordances can influence psychology and therefore our motivational satisfaction. The three studies cited used experimental manipulations to showcase that virtual environments can have powerful impacts onto psychological needs satisfaction. And, by demonstrating the powerful affordances of virtual environments, they effectively extend self-determination theory and argue that scholars can use this framework to study technological choices and impacts. Therefore, these studies demonstrate the micro-impacts of virtual and physical spaces.

While basic needs theory looks at what it takes internally to support intrinsic motivation, other aspects of self-determination theory focus on motivational quality. In what follows, I outline these sub-theories.

2.2.2 The Importance of Motivational Quality

Not only does self-determination theory concern itself with the internal qualities that predict self-regulated learning and intrinsic motivation, it also focuses on the role that social environment, community, and external factors play in fostering motivational outcomes. Two sub theories – Cognitive Evaluation Theory (CET) and Organismic Integration Theory (OIT) – together explore how environments influence motivation.

Cognitive evaluation theory first emerged in lab experiments focused on how feedback and rewards influence intrinsic motivation. Building on basic needs, it looks at how certain needs influence the *quality* of motivation. The theory distinguishes between intrinsic motivation and extrinsic motivation. CET argues that competency can support intrinsic motivation, but only when the individual recognizes that they have control or autonomy (Ryan, 1982). As such, the

theory recognizes that an individual's environments must indicate their autonomy or the individual must tap into previously developed needs (likely influenced by peers, community, or prior experiences) (Ryan & Deci, 2000).

CET also recognizes how outside circumstances can thwart the development of intrinsic motivation. Meta-reviews established how tangible external rewards reduce intrinsic motivation (Deci, Koestner, & Ryan, 1999). At its most basic, rewards like prizes or money undermined the intrinsic interest students had in a subject or task (Deci, 1971). While feedback could support interest and motivation, when rewards were contingent on completion, interest decreased (Deci, 1972). The salience and meaning of the reward also influences motivation. When rewards contain a contingency, the reward exerts a *controlling* force on the individual and it is this control that undermines motivation (Ryan, Mims, & Koestner, 1983). However, when the reward is framed to offer information about competence rather than framed as an external control, intrinsic motivation suffers less (Ryan, 1982; Ryan et al., 1983). The studies summarized demonstrate that extrinsic and task-unrelated incentives can undermine the quality of motivation and subsequent performance. At the same time, when incentives are framed or designed to offer information that supports basic needs, motivation suffers less than it might in controlling settings. Together, results from CET demonstrate the importance of an individuals' feeling of power over their own circumstance or ability. When personal relationships, environments, or tasks impede this sense of personal control, motivation, interest, and performance suffers.

The results summarized from early cognitive evaluation theory experiments point towards a hierarchy of motivation and the environments' impact upon it. For example, task-contingent rewards have a stronger detrimental effect on intrinsic motivation than do performance-contingent reward. Recognizing the emerging hierarchy, Deci & Ryan formulated Organismic Integration Theory (OIT). They view extrinsic motivation as any action being performed for an outcome while intrinsically motivated actions are performed for enjoyment of the activity itself. However, external outcomes may differ based on the extent to which they are

internalized or *integrated* into an individual's belief system (Ryan & Deci, 2000). Ryan & Deci (2000) offer students' homework as an example of this divide. While some may do homework because their parents tell them to, others do it because it will help their long-term career goals. While, in both cases, the students are doing homework for instrumental or extrinsic goals, in the case where the student does homework for career-growth, they appear to have more strongly internalized the importance of the activity. Internalization is a process through which an individual assimilates external expectations or values into their own personal values or self-regulations (Deci & Ryan, 2000). While the process occurs naturally and subconsciously, it can be stalled or halted, resulting in less-than-self-determined motivations. Thus, Deci & Ryan (2000) formulated four styles of motivation that vary based on the extent to which individuals have internalized the activity and are self-determined.

Externally regulated behaviour results from either tangible rewards or threat of punishment. While a behaviour may persist when in the presence of the external goal, once it is removed, the behaviour typically dissipates. For example, an early study of OIT found that testing-oriented learning environments undermined student learning, performance, and continued interest (Grolnick & Ryan, 1987).

At other times, the external goal or contingencies may be maintained and recognized by the individual, but the individual does not believe or fully accept them. This concept is known as *introjected motivation*. The belief does not rest within the person or their locus of control and therefore may manifest itself as pressure. As an example, Vansteenkiste, Lens, & Deci (2006) explain that a student who does their homework before going outside to play because they'd feel guilty if they did not complete their homework displays introjected motivation – the desirable behaviour[doing homework] is exhibited but is not performed because of the belief in its importance (p. 21).

While introjected behaviours reflect beliefs that have not been accepted, *identified* beliefs are those that the individual has accepted and internalized as worth pursuing. Identified actions

have been recognized as valuable and therefore individuals regulate the behaviour themselves. For example, someone might exercise because they know it is good for them, not necessarily because they love the sport. In this case, the behaviour is still extrinsically motivated as it is being performed for instrumental reasons. However, it may be better sustained over time, as the individual recognizes its worth.

Finally, we may integrate a value or behaviour into our identity because we identify with its importance. Then it becomes *intrinsically* motivated. This is the most self-determined form of motivation.

These motivational styles do not need to be sequentially acquired. Rather, new activities or interests can start at any motivational level. While some behaviours may be assimilated according to this continuum, others may remain constant over the life-span. However, children's motivation tends to become more self-regulated and internalized over time (Chandler & Connell, 1987). This suggests that the theory is particularly salient to the population in question and that it is crucial to focus on how to support children and adolescents' internalization process.

CET and OIT advance four motivational styles that differ based on level of self-determination and broadly classifies the subsequent motivations as either *autonomous* or *controlled*. Autonomous motivation styles are categorized by an intrinsic desire or an internal integration of an activities value (Deci & Ryan, 2008). This includes intrinsic motivation and identified motivation. Meanwhile, an individual evidences a controlling motivational style when she has external behaviour regulation or introjected regulation. When controlled, an individual's need for autonomy is thwarted and she feels that external factors control or induce behaviour. In these situations, the individual feels an external pressure to perform, think, or feel (Deci & Ryan, 2008).

Applications of self-determination theory often focus on autonomous versus controlled motivational styles, rather than querying the presence of all five sub-styles. This dichotomy provides a simple framework through which to evaluate a situation's orientation and likely

impact on behaviour. Indeed, motivation within a domain can be both autonomous and controlled at the same time. For example, while an individual may be intrinsically motivated to get an advanced degree because she enjoys studying the material, she might simultaneously demonstrate identified or introjected motivation because she believes that getting the degree will help her career prospects. Researchers therefore often focus on the total amount of controlled or autonomous motivation and use this metric to reflect the general motivational orientation and predict outcomes from engagement.

While this thesis is not principally concerned with motivation levels, CET and OIT showcase the direct relationship between emotional well-being, behaviour choice, and the broader sociocultural environment. Additionally, variance in motivational levels may influence the take-up of technical opportunities. CET and OIT posit that the decision to engage in activity and the relative autonomy of motivation within that domain predict the well-being it provides and the quality of the outcomes. Therefore, we may expect that individuals who pursue positive online opportunities or technical education are intrinsically motivated by the activity. In what follows, I outline work on CET and OIT that showcases how motivational style and autonomy supportive environments foster positive outcomes.

2.2.2.a Relating CET and OIT to Adolescents and Virtual Environments

While both cognitive evaluation theory and organismic integration theory first emerged through laboratory experiments, they have since been used to describe domains including physical education, the workplace, parenting, and more.

CET and OIT explain how motivation influences the quality and nature of outcomes. Across studies, scholars demonstrate how motivational quality variably influences outcome, sustainability, and performance of a task. At its most general, intrinsic motivation both correlates with and predicts desired behaviour, while more extrinsically motivated behaviours lead to either underperformance, psychological unrest, or unsustainable behaviour.

Just as basic needs satisfaction predicts intrinsic motivation and positive outcomes, motivational quality has been linked directly with psychological well-being and task performance. In a review of CET and SDT research, Ryan & Deci (2000) note established links between intrinsic motivation and task persistence, self-esteem, general well-being. The early studies they summarize linked motivational quality with individual and psychological outcomes. Later work more robustly connects motivational quality with tangible outcomes, establishing a definitive link between motivation and how individuals engage and perform across life's domains. Using similar frameworks to the study summarized above, researchers across domains have linked self-regulated motivation with societally and personally-desired outcomes. Generally, the more self-regulated the motivation, the better the outcome. Outcomes may be measured as desirable psychological states or as concrete actions. With regards to psychological states, results have been observed in schools, in the workplace, and in relationships. Autonomous motivation has been linked with teachers' lowered emotional exhaustion and increased sense of personal satisfaction (Roth, Assor, Kanat-Maymon, & Kaplan, 2007) As regards concrete outcomes, autonomous motivation has been linked to healthy eating behaviour and low fat talk, students' intention to finish math homework, volunteers' work ethic, and even lowered blood pressure (Bidee et al., 2013; Guertin, Barbeau, Pelletier, & Martinelli, 2017; Hagger, Sultan, Hardcastle, & Chatzisarantis, 2015; Weinstein, Legate, Kumashiro, & Ryan, 2016). These studies point to the importance of focusing on motivation when encouraging desired behaviours, such as the pursuit of technological opportunities.

This observed trade-off between intrinsic and extrinsic motivation has been extensively reviewed in professional settings. Motivational quality strongly predicts work outcomes. Motivational orientation supports pro-social work and benefits both the helper and the recipient (Weinstein & Ryan, 2010). For example, in the professional domain, intrinsically motivated fire-fighters worked more overtime and had more pro-social motivations. Similarly, fundraisers who

were intrinsically motivated raised more money and made more calls than those with extrinsic motives (Grant, 2008). Grant's results are striking because they relate productivity in two unrelated domains with motivational quality. Although fire-fighters and volunteers are generally thought of as uniformly altruistic and pro-social, these results demonstrate that motivational quality is still significant and can sustain work in otherwise difficult circumstances. Applications of OIT within physical education, the workplace, parenting, and online learning all demonstrate how the level of integration of motivation variably influenced outcomes, sustainability, and performance (Assor, Vansteenkiste, & Kaplan, 2009; Gagné et al., 2015; Chen & Jang, 2010) These results illustrate the importance of focusing on motivation quality, OIT's applicability across domains, and the specific ways that individual differences lead to differential results.

While CET and OIT establish the importance of motivational quality in supporting personally desirable outcomes, by recognizing the impacts of controlled motivation, these theories present opportunities to focus on environmental and interpersonal affordances for motivational quality – whether by encouraging autonomy or controlling the individual. As such, many researchers apply these theories towards studying the relationship between environmental and social supports and subsequent motivation. Several features commonly found in professional and educational settings have been shown to reduce intrinsic motivations. Deadlines (Amabile, Dejong, & Lepper, 1976), competition (Przybylski et al., 2010), and testing (Deci et al., 1991) can reduce intrinsic motivation and enjoyment because they are perceived as controlling an individual's behaviour (Ryan & Deci, 2004). Meanwhile, we might assume that active learning situations can make educational settings more autonomy supportive and therefore foster autonomous motivational styles by allowing individuals choice and flexibility in what and how to study (Black & Deci, 2000).

The studies outlined above focus on environmental factors, but additional research looks at how individuals can also encourage autonomous motivation. When individuals' needs are

satisfied through a relationship, they will be more motivated within the relationship and relationships will flourish (Deci & Ryan, 2014). The experience of strong relationships with individuals in library settings, such as librarians and peers, increased intrinsic motivation for information-seeking behaviour (Crow, 2009). Relationships with both parents and teachers can steer individuals towards self-regulation. When teenagers perceive their parents as autonomy supportive, they develop self-determination in school, their social engagement, and their professional orientations. Meanwhile, when they perceive their teachers as autonomy supportive, they develop self-determination in school and professional domains, but not in social engagement (Soenens & Vansteenkiste, 2005). This study relates interpersonal affordances to motivation and then motivation towards broader outcomes. Indeed, Soenens & Vansteenkiste (2005) found that self-determination predicted adjustment and psychological functioning in the domains under review. This study showcases how self-determination intervenes between the adolescent's social environment and psychological outcomes to support adjustment and performance. Not only does this demonstrate that self-determination theory allows researchers to link different aspects of the psychosocial framework towards concrete desirable outcomes, but by focusing on the similar affordances of parent and teacher relationships, it links developmental and educational psychological traditions and shows how motivation underlies all relationships.

Building on these findings, other researchers use self-determination theory to link interpersonal situations towards pro-social and positive outcomes. Correlational evidence found that autonomy supportive teachers helped students internalize kindness and that those with identified regulation self-reported fewer bullying incidents than students with external regulation. The more strongly the students identified with the value of being considerate towards others, the stronger the relationship between teachers' autonomy support and student bullying (Roth, Kanat-Maymon, & Bibi, 2011). While concerned with offline results, this study shows how school climate influences motivation and the crucial role that motivation plays in supporting

pro-social behaviour. Parent support also positively predicts academic performance and negatively predicts externalizing problems and difficulties with emotional-regulation (Aunola & Nurmi, 2004; Grolnick, Deci, & Ryan, 1997). Similarly, teacher autonomy support also predicts academic performance, school adjustment, and student-teacher relationship (Assor, Kaplan, & Roth, 2002; Reeve, 2006; Ryan, Stiller, & Lynch, 1994; Skinner, Furrer, Marchand, & Kindermann, 2008). Both parents' and teachers' autonomy support leads to self-determination within an academic domain, but appear to support different measures of academic self-regulation. This shows the complementary roles that aspects of the social system may have in academic motivation.

Given the importance of motivation to school performance, a large body of literature focuses on how motivational quality may impact school behaviour. Researchers found that autonomous academic motivation mediates an observed relationship between academic self-concept – or a student's view of themselves as academically successful – and academic achievement, however, on its own, academic self-concept did not predict achievement (Guay, Ratelle, Roy, & Litalien, 2010). These results establish the crucial gateway role motivational quality can play in adolescent achievement and suggest that, if we hope to improve adolescent outcomes, researchers should focus on creating situations that support autonomous motivation.

Just as physical settings offer affordances that influence motivation, virtual settings can also directly impact motivational quality. Just as autonomy supportive positive feedback in physical environments leads towards autonomous motivation, in-game feedback during a brain-training game influenced basic needs for competency and autonomy, and ultimately towards autonomous motivation (Burgers, Eden, van Engelenburg, & Buningh, 2015). Similarly, games that make individuals feel competent increase intrinsic motivation, while competency-impeding games reduce feelings of autonomous forms of motivation for gameplay (Przybylski, et al., 2014). These studies showcase that virtual environments can be as impactful as physical environments in supporting motivation. Both demonstrate that the same controls that influence

off-line motivation can have the same effects when delivered virtually. This suggests that virtual affordances may be as strong as physical. Additionally, these results demonstrate how motivation for a task predict its outcomes and that digital behaviour can be predicted through motivational quality. When individuals see their ideal selves in the game they are playing, they are more intrinsically motivated (Przybylski, et. al, 2012) and, as such, we might expect that when technology allows individuals to perform their identity, they are more motivated to engage constructively. Together, these studies on digital motivation point to the need for more research in this area but demonstrate how virtual affordances influence motivation and that technological take-up may be explained by motivational forces.

2.2.3 Applying SDT towards Technological Outcomes

Ryan & Deci (2000) argue that intrinsic motivation is the "prototypic manifestation of the human tendency towards learning and creativity" (p. 69). While learning occurs inside and outside of the classroom, self-determination researchers acknowledge that motivation and optimal outcomes can be observed as "engagement" in a desirable activity (Reeve, 2012, p. 151). Motivation and engagement are linked because motivation is the internal force that drives the observable behaviour. Therefore, scholars have linked 'engagement' in a variety of settings towards more or less motivated situations. As noted above, this 'engagement' has been observed in a breadth of settings, including some mediated by technology. I intend to follow their model and apply self-determination theory towards the study of teenage girl technology use and study. In what follows, I present three discrete studies that demonstrate how motivational processes underlie technical opportunities. Therefore, I extend both self-determination theory's applications and literature on technical opportunities.

Much research on SDT applies a universalist perspective, arguing that its principles uniformly describe differences across individuals. The contrasting individual or relativistic perspective believes that individuals vary in their psychological characteristics and that

psychological interventions or studies must focus on an individual's factors rather than on universal psychological traits. While the relativistic paradigm may be fruitful within interpersonal settings, focusing on universalist theories allows the researcher to identify broadly applicable interventions and to move between individuals, their social setting, and their cultural values. Notably, universalist and individualist paradigms often support one another. For example, Schüler, Sheldon, & Fröhlich, (2010) found that while needs-satisfaction influences intrinsic motivation in all individuals, the relationship was stronger in those who had a high individual need for achievement. This suggests that a richer understanding of individuals may arise when we merge psychological perspectives but that the universalist perspective can still describe large variance in behaviour. Therefore, I am justified in applying SDT to the study of teenage technology-related behaviour. In what follows, I review how each study relates to the literature reviewed above.

In Study 1 (chapter 3), to explore the role of individual psychological, device, and interpersonal affordances in predicting the take-up of digital opportunities, I perform a series of quantitative analyses in two representative datasets that together demonstrate how psychological factors intersect with an individual's support system to predict positive online opportunities. Recognizing that the media effects' tradition largely ignores psychology-related predictors, this study includes a 2010 dataset often referenced in communications study of technology (Haddon & Livingstone, 2012) but adds in psychological predictors to broaden our understanding of the relationship between individual psychology, social setting, and observed outcomes. Then, drawing on a 2014 dataset (Przybylski, Mishkin, Shotbolt, & Linington, 2014), which includes SDT-related predictors, I demonstrate how a teenage girl's parental needs support and individual motivational quality predict positive outcomes from her technology use. This therefore extends the principles of basic needs theory, organismic interaction theory, and cognitive evaluation theory towards Internet use and demonstrates that positive outcomes are predicted by motivation, not just by demographic factors.

Study 2 (chapter 4) applies basic needs theory towards intrinsic motivation for learning computer science. It runs a field experiment during a commonly-piloted educational intervention to determine how outreach towards women influences their needs satisfaction and intrinsic motivation for learning. In doing so, it both validates needs satisfaction's relevance in computer science education and demonstrates how SDT applies to educational interventions. Additionally, study 2 explores the relationship between needs-satisfaction and intrinsic motivation to explore how the theory is relevant for minorities in computing.

Finally, study 3 (chapter 5) links studies 1 and 2 and demonstrates the importance of focusing on psychology across technical-domains. Building on basic psychological needs theory, study 3 demonstrates how the need for relatedness predicts both autonomous forms of motivation and socially-desirable outcomes. Study 3 contains three discrete experiments that each use the same SDT-based intervention to predict different positive outcomes from technology use. First, it pilots an intervention to manipulate parents' relatedness. Following this, online experiments explore how parental relatedness satisfaction a) influences their technology-related anxieties and b) predicts autonomy support of digital opportunities for their children. As such, it showcases the causal role that relatedness plays in predicting technology-related behaviours and supporting climates that foster young women's outcomes from technology use.

Each study focuses on a different technical outcome to review the ways in which young women interact with technology. The first study focuses on the uptake of online opportunity, the second looks at girls' computer science motivation, and the third focuses on both parental autonomy-support, anxiety, and subsequent mediation practices. However, all three are united by self-determination theory.

3 What Predicts British Adolescents Take-Up of Digital Opportunities: An investigation of Access, Social Support, and Motivation

3.1 Introduction content

A re-emergence of moral panics surrounding young people's technology use blinds us to the opportunities that new media offers. Over the past several years, new moral panics concerning teenagers and technology have emerged that focus on risks of technology addiction, sexual content, and emotional well-being (Anderson, Steen, & Stavropoulos, 2017; Livingstone et al., 2017; Twenge, 2017). Yet, amidst these fears, the children's rights perspective champions the opportunities available to youth through the Internet and argues that the risks-focused rhetoric blinds us to these benefits and prevents their take-up.

To encourage opportunities, the children's rights perspective argues that researchers must reframe this attention-grabbing narrative and instead focus research on identifying the factors that predict taking up the many opportunities offered in the online sphere. Even still, politicians and researchers often focus on structural factors, not emotional ones. While the Internet offers rewards and enriching possibilities to individuals from economically privileged or well-educated backgrounds, opportunities are not guaranteed (Livingstone & Helsper, 2010). The UK government's programme for digital skills works both to target the skills – and the confidence and motivation gap that may exist for non-users (UK Digital Strategy, 2017). Social support and social value need to be placed upon technology and technology literacy for individuals to develop the skills necessary to succeed in this domain (Eynon & Malmberg, 2012).

Social support and motivation as abstract concepts are therefore determined to be of paramount importance for later technical successes.

Eynon & Malmberg (2012)'s quantitative analysis contends that it cannot identify why social support is so critical for later the take-up of online information seeking. To do so, it argues, one needs qualitative research to elucidate the lived experience of those with and without social support. However, psychologists traditionally rely on quantitative measurement of subjective experiences to generalize and conceptualize of an individual's internal reality. Thus, drawing from the psychological tradition, this study extends the UK Digital Strategy and Eynon & Malmberg's arguments but uses quantitative measurements to explicate these experiences. To do so, it relies on two representative datasets of female British adolescents, one from 2010 and the other from 2014. Each includes convergent predictors of access, skills, and forms of parent support. However, the 2014 cohort builds on the measures from 2010 to include psychological predictors. By comparing analyses across datasets, this study can argue and demonstrate the unique explanatory power of motivation and support in sustaining teenagers' lived experiences.

3.2 Literature Review

By exploring two representative and previously analysed datasets, this study can confirm existing theories relating to technology and young women and offer more robust explanations of observed phenomenon. In this section, I begin by justifying this study's focus on opportunities for young women, and then review factors commonly linked with online opportunities, before arguing for the importance of including the psychosocial perspective.

3.2.1 Defining Opportunities

Parents, educators, and policy makers often speak of female empowerment through technology. Within media discourse around young women, "empowered" use is offered as a

blanket word to capture positive social, emotional, and transactional outcomes after an experience, particularly one where an individual has the capacity to take control in her own life on issues important to herself (Page & Czuba, 1999). However, it remains poorly operationalised with respect to social science. At present, there are no pre-validated tests surrounding its use and popular discourse offers it as a vague descriptor rather than as a measurable phenomenon (Kabeer, 2002).

Recognizing the overused and under-defined "empowerment" approach, academic researchers across disciplines have focused on validating and measuring discrete positive experiences. Researchers from the educational, sociological, and psychological traditions focus on qualitative explorations of empowered actions or how individuals use technology to empower oneself (Malhotra et al., 2009). Within this camp, others attempt to quantify empowerment by measuring presence of actions viewed as "positive" (e.g. Lenhart, Purcell, Smith, & Zickuhr, 2010; Mascheroni & Ólafsson, 2016). Meanwhile, psychology researchers focus on identifying psychological traits they posit as necessary to empowerment, these include self-efficacy (Shank & Cotten, 2014), motivation (Deci & Ryan, 2000), and self-esteem (Mishkin & Turner, 2015).

Much of this methodological divide stems from different perspectives on how opportunities emerge. While psychologists argue that if a young woman has self-efficacy and motivation, she will take constructive action on-line, communications and education researchers look for concrete actions because structural blocks may emerge with regard to the decision to engage. Focusing on concrete outcomes can help policy makers measure the success of their recommendations because it allows them to quantify observed phenomenon (Byron, 2008). In contrast, the existence of psychological outcomes, such as intrinsic motivation, can suggest that a young woman has a disposition towards resilience, even if no concrete results are observed (Vansteenkiste & Ryan, 2013). Exploring the outcomes associated with each research tradition can note points of convergence within these traditions and the factors that may lead to one or

the other. Therefore, this study focuses on both concrete and psychological outcomes and tries to identify the environmental and interpersonal factors that lead to both.

Towards this, a historical review of literature on what predicts children's technological outcomes notes a shift in focus – from focus on individual access, to a focus on family, to a focus on psychology. In what follows, I review each trend before arguing that they must be viewed holistically to better theorize the pursuit of online opportunities.

3.2.2 Individual Level Factors: Access and Skills

When ICTs and mass computing first entered mainstream use, researchers grew concerned about divides in access and about what access could offer. Despite disagreement over whether to define access in terms of device ownership, available opportunities to use ICTs, or functioning technological infrastructure, remedying these divides was viewed as paramount (van Dijk, 2006; van Dijk & Hacker, 2003). Access was equated with opportunity and so reducing potential divides and disparities was regarded as particularly crucial for ensuring the Internet's benefits spread. And, while access alone might not guarantee positive or sophisticated uses, it continues to be a necessary precursor that might interact with other elements of a child's sociocultural system to influence behaviour (Stald et al., 2014).

Recognizing access as a necessary precursor to use technology for both opportunities and harms, over the past 20 years, young people have become increasingly connected. Mobile phones, computers, and gaming devices have created a sense of nonstop connection, particularly for affluent families (Mascheroni & Ólafsson, 2016; Rosen, 2010). Thus, one might assume these concerns have dissipated. Yet, new inequalities in relative access and connection type can re-emerge as individuals from privileged backgrounds may have newer devices or more exposure to the latest technology (Robinson et al., 2015). It is therefore critical to explore the relationship between access and opportunities, especially over time.

Access is a necessary, if not sufficient, predictor of positive outcomes. Skills are not innate and without an ability to use what one has, positive outcomes cannot emerge. Therefore, skill level is another individual level factor that has been linked to online opportunities.

Historically, digital skills have been viewed both as a desirable outcome and as a precursor to exploring online opportunities. Using representative UK results from 2004, Livingstone & Helsper (2010) explore the connection between skills and access, and between skills and later outcomes. They found that increases in age and socioeconomic status predicted access and that age alone influenced skills. Yet, while access predicted opportunities and skills, online skills (divorced from access) predicted pursuing positive online outcomes. This underscores the importance of skills. This issue is acutely important for young women who underestimate their technology abilities relative to their male peers (Hargittai & Shafer, 2006). Significantly, this report links various aspects of demographics and ability, modelling one level of the psychosocial ecosystem.

Indeed, Internet ability and knowledge is currently valued as a "21st Century Skill" that may open up opportunities for employment or be necessary to succeed in the current era (Binkley et al., 2012). Implicit within this belief is the idea that skills may also predispose students towards positive outcomes. It is therefore critical that we investigate the continued relevance of this hypothesis.

Together, access and skills appear to be necessary conditions that support opportunities and it is therefore crucial to establish their continued importance across time and cohorts. This leads directly to Research Question 1:

> *RQ 1: What role do individual-level predictors of access and skill play in predicting positive outcomes from teenage girls' technology use?*

3.2.3 Environmental Factors: Parents and Social Supports

Both off- and on-line, social support is regarded as acutely necessary for young women's development and growth. Indeed, social connection with both friends and parents has been linked with offline academic, emotional, mental and physical health benefits (DuBois, Felner, Brand, Adan, & Evans, 1992; Goodenow, 1993; Helsen, Vollebergh, & Meeus, 2000; Repetti, Taylor, & Seeman, 2002). Recognizing the offline correlates to social support, media researchers have sought to determine how support relates to outcomes from media use.

Researchers studying the relationship between media outcomes and social contexts historically rely upon parental mediation theory. Mediation theory, which emerged in response to television viewing, identifies the specific strategies parents use to provide support and structure and then connects these strategies with outcomes. In what follows, I review parental mediation theory before outlining other approaches to quantifying social support.

Across media forms, mediation theorists recognize three broad mediation styles: *Active*, *Restrictive,* and *Co-Viewing* (Clark, 2011a; Collier et al., 2016; Valkenburg, Krcmar, Peeters, & Marseille, 1999). *Active* styles involve the negotiation, discussion, and explanation of what the child is consuming (Austin, 1993). This strategy can be effective at promoting positive and learning outcomes from media use because it socializes the child towards the parents' values and desired outcomes (Nathanson, 2001). It also may make children more critical of what they consume. In contrast, when parents restrict content entirely or through rules governing the when/where of consumption, they engage in *restrictive mediation*. While this may be effective at preventing access to questionable content when children are young, restrictive mediation's effectiveness deteriorates as children develop autonomy. Particularly when content is restricted, adolescents may develop favourable perceptions of it or engage in more risk-taking behaviour (Nathanson, 2002; Sasson & Mesch, 2014). This strategy likely backfires because adolescent women increasingly question their parents and explore independence by rebelling against their

rules (Steinberg, 2001). *Co-viewing* involves the shared consumption or use of media. When co-viewing media, parents socialise their children towards their values because the child often assumes tacit approval of the content because the parent is consuming it (Dorr, Kovaric, & Doubleday, 1989). Results on co-viewing's efficacy are mixed. While co-viewing violent content may lead towards positive perceptions of violence, it can also socialize children towards educational content or critical thinking (Nathanson, 1999; St. Peters, 1989). While these three techniques emerged from television research, it is broadly assumed that across off- and on-line media, active strategies predict positive outcomes, restriction leads to negative outcomes, and co-viewing produces mixed results.

These strategies have been adapted and replicated as parents respond to new ICTs. Active mediation continues to predispose individuals towards technological benefits. Restrictive mediation strategies limit the risks encountered, but, as an unintended consequence, also limit the opportunities to which young people are exposed (Livingstone & Haddon, 2009). Additionally, new ICTs also present opportunities for new mediation styles derived from, but enhancing, restrictive strategies. These include technical *parental controls* or in-person media *monitoring* (Duerager & Livingstone, 2012; Nikken & Jansz, 2014). In the digital age, co-viewing has also been adapted to include *co-use*, because new tools are increasingly interactive (Livingstone & Helsper, 2008). Again, similar to offline patterns, co-viewing and co-use can be effective at socialising children or show no effect if the parent is too physically removed from the child. Notably, while trends emerge regarding mediation and outcomes, new research suggests these largely dissipate when children reach adolescence (Khurana, Bleakley, Jordan, & Romer, 2015; Nathanson, 2002).

As individuals reach adolescence, mediation strategies' efficacy decreases as the importance of peer relationships increases and individuals are influenced by a breadth of sources. For example, in their study on the efficacy of restrictive internet mediation, Sasson & Mesch (2014) identified that restrictive mediation of technology increased the likelihood of pursuing

online risks, particularly when individuals' believed their peers approved of this behaviour. This work parallels offline findings that demonstrate the increasing importance of peer approval as individuals enter adolescence (Steinberg, 2001). While much research has explored Internet mediation and its impacts, these analyses have largely ignored peer or academic influences, which might be more impactful than parents.

The two most common realms in which students engage outside the home are their peer and academic spheres. In adolescence, peers' approval gains increased importance and young women are more likely to be influenced by values, norms, and information heard through these networks (Nelson & DeBacker, 2008). While peer networks can lead to risk-taking, particularly when that is the norm within the group (Shin & Lwin, 2017), peers also have a unique ability to promote well-being and prevent the spread of risky behaviours (Laible, Carlo, & Raffaelli, 2000; Maxwell, 2002). While peers informally guide their networks, teachers formally hold this role. As members of educational institutions, teachers are increasingly called upon to teach technology literacy and motivate or guide students towards digital opportunities. Indeed, within the broader EU Kids Online database, Kalmus, von Feilitzen, & Siibak (2012) identified that broad teacher involvement predicted the general take-up of online opportunities. Unlike peer socialization, teachers' active mediation may limit incidence of risk and harm (Shin & Lwin, 2017). In addition to teaching students, teachers may also act as informal role models (Wentzel, 1998, 1999). Given the formal and informal influence teachers can have, it is necessary to explore their impacts.

Emerging research therefore suggests that several forms of mediation interact in a teenager's life to socialize them towards or away from online opportunities. Yet, at present, no one has analysed either how these interact or the comparative efficacy of their strategies. Therefore, Research Question 2A looks specifically at these strategies and asks:

> *RQ 2A: Given the multiple sources of mediation facing adolescents, which are effective at encouraging the take-up of online opportunities?*

Despite the communications-based significance of Mediation Theory, psychologists argue that it is the feeling of closeness that emerges through mediation that may predispose one towards outcomes. Indeed, Mishkin (2014) demonstrated that mediation strategies are only effective when the individual feels love or warmth from the parent.

Self-Determination Theory (SDT) argues that when parents provide warmth, interest, and autonomy towards their children, their children develop intrinsic motivation and the ability to realize goals in line with their desires. These parenting practices lead towards intrinsic motivation, which is associated with school motivation and achievement, emotional regulation, and social skills (Davidov & Grusec, 2006; Grolnick & Farkas, 2002; Grolnick, Ryan, & Deci, 1991; Soenens & Vansteenkiste, 2005). Notably, these findings parallel observed online opportunities. Livingstone & Haddon (2009) and Ito et al. (2009) use qualitative and quantitative methods to demonstrate that teenagers use new technology for socialising, learning, and self-enrichment. Parents who provide warmth evidence children with lower risks of both getting cyberbullied or being one themselves (Wang, Ianotti, & Nansel, 2009). While parenting style is associated with beneficial offline outcomes, less is understood about how parenting style predicts online outcomes. Additionally, SDT argues that all relationships have the potential to offer the important feelings of support and relatedness that lead to intrinsic motivation. Further research is needed to identify the impacts of social relationships onto motivation and opportunities, as well as whether the same styles that predict offline rewards replicate themselves online. Therefore, Research Question 2B queries the emotional support provided by parents, teachers, and peers.

> *RQ 2B: Given the importance of social support to offline opportunities, what role does social support and parental support play online?*

Teenagers develop feelings of belonging and support from a variety of sources. These can interact with or contradict parental rule setting and parenting styles. Together, these jointly

influence a students' feelings of emotional connection and these subjective experiences of relatedness predispose an individual towards wellbeing and later towards concrete outcomes (Deci & Ryan, 2000). However, social support is not the only factor that contributes to psychological well-being. In the following section, I review literature on what causes psychological well-being and its outcomes.

3.2.4 Psychological Factors: Self-Efficacy and Motivation

While research on individual and environmental predictors identifies attributes external to the self, increasing research recognizes the importance of a teenager's internal drive towards pursuing online opportunities. In contrast to the sociological and communications-based approaches, psychologists argue that the *why* of media use is critical and predictive of success. Psychology researchers have traditionally studied how psychological factors predict the take-up of offline opportunities and this has now been extended to online opportunities.

Psychological research establishes a link between offline behaviour and online uses of technology. Contrary to early theorists who viewed distinct differences between the offline and online worlds in which teenagers engage and therefore exoticised technology, more recent scholarship recognizes that teenagers' online activities can extend their offline lives and personalities. A longitudinal study identified that similar friendship patterns and feelings of overall well-being in early and late adolescence predicted similar social media habits at both points in time (Mikami, Szwedo, Allen, Evans, & Hare, 2010). This study establishes that an individual's overall psychological disposition predicts similar offline and online behaviours and that an individual's outcomes persist over time. Even adolescents engaged in online aggression or cyberbullying note offline parallels and experience (Werner, Bumpus, & Rock, 2010). Together, this suggests that approaches to measuring offline personality are valid and applicable online.

Self-determination theory links environmental factors with psychological health. It recognizes how sociological predictors such as access, skills, or support can lead to psychological sensations of competency, relatedness, and autonomy. Moreover, according to SDT, when an environment makes young women feel competent, related to others, and autonomous, they are more likely to be intrinsically motivated and to take up the opportunities available to them. Therefore, SDT demonstrates how the lived experience of feeling connected or feeling competent predisposes young people towards positive outcomes.

SDT blends the sociological perspective with the psychological by showcasing how environments predict psychology, which in turn influences outcomes. It argues that intrinsically motivated behaviours predispose an individual towards positive outcomes within that domain. Examples from education, the workplace, and social relationships demonstrate a connection between intrinsic motivation and socially-desirable outcomes (Black & Deci, 2000; La Guardia, Ryan, Couchman, & Deci, 2000; Vansteenkiste et al., 2007). While the connection between motivational quality and outcomes has been drawn in other digital domains (e.g. Burgers, Eden, van Engelenburg, & Buningh, 2015; Przybylski, Deci, Rigby, & Ryan, 2014), this connection has not been drawn for Internet use or exclusively within adolescent females. Therefore, drawing on and extending self-determination theory, this thesis hypothesizes that when young women use the Internet because it is in line with their goals and desires, and not in line with external expectations or controls, they will be more likely to pursue positive online opportunities. This hypothesis is supported by digital divide research which finds that motivation to use the Internet often precedes acquiring access and skills (van Dijk, 2006). While this literature often defines motivation in terms of specific Internet uses (van Deursen & van Dijk, 2014; van Dijk & Hacker, 2003), by acknowledging the importance of an internal drive to use the Internet, it points to the need to explore these constructs psychologically.

While self-determination theory argues that internal states predispose one towards opportunities, it recognizes the ways in which sociological settings encourage autonomous

motivation. When a young woman senses an external locus of control, she will develop extrinsic forms of motivation. With regards to parenting, when parents restrict children's choices and don't encourage autonomous decision making, children show decreased well-being and fewer positive outcomes (Joussemet, Landry, & Koestner, 2008; Van Petegem, Soenens, Vansteenkiste, & Beyers, 2015). Yet, when autonomy is encouraged, young adults develop intrinsic motivation and self-confidence because they see their beliefs and interests encouraged. They often then feel closer to their parents and internalize the parents' values (Barni, Ranieri, Scabini, & Rosnati, 2011). These and other studies demonstrate how environmental conditions (here viewed as parenting strategies) influence relationships and subsequent motivational states.

Self-efficacy, a related but distinct concept, outlines how an individual's self-concept interacts with her social climate to motivate opportunities. Self-efficacy describes an individual's belief in her ability to succeed in a specified environment or task (Bandura, 1977). A belief in one's self-efficacy can improve motivation within academic and personal settings (Bandura, 1993; Zimmerman, Bandura, & Martinez-Pons, 1992) and the construct has been likened to SDT's perceived competence (Bandura & Schunk, 1981). Together, this suggests that confidence in one's ability leads to motivation to perform. While an internal belief system, self-efficacy can be supported by peers and relationships. From infancy, observing similar-aged same-sex individuals performing a task influences the individual's own self-efficacy in that task (Schunk & Hanson, 1985). As young women age and as the influence of peers increases, so too does peers' influence onto self-efficacy; young women who reported close peer relationships reported greater self-efficacy and academic motivation. In line with this, SDT points to the importance of relatedness for motivation. Taken together, this showcases how self-efficacy is a psychological construct influenced by social settings.

Self-determination theory provides a link between the effects of social rule-setting, the feeling of social support, and observed outcomes. Therefore, it was selected as a framework

from which to view the relationship between social support and online opportunities and this leads directly to RQ3.

RQ 3A: What predicts intrinsic motivation for Internet use?

RQ 3B: Does intrinsic motivation for Internet use predict online opportunities?

In what follows, I outline analyses across two cohorts that relate individual, environmental, and psychological predictors to the take-up of online opportunities. I begin by exploring these analyses in a 2010 cohort, a previously analysed source (e.g. Haddon & Livingstone, 2012), before replicating and explicating observed relationships through a 2014 dataset, which has not yet been subject to peer-reviewed research.

3.3 Purpose of studies

3.3.1 Research questions

In summary, based on the importance of access, skills, social support, and motivation, this study asks the following questions of two datasets:

RQ 1: What role do individual-level predictors of access and skill play in predicting positive outcomes from teenage girls' technology use?

RQ 2A: Given the multiple sources of mediation facing adolescents, which are effective at encouraging the take-up of online opportunities?
RQ 2B: Given the importance of social support to offline opportunities, what role does social support and parental support play online?

RQ 3A: What predicts intrinsic motivation for Internet use?
RQ 3B: Does intrinsic motivation for Internet use predict online opportunities?

3.3.2 Population focus

Throughout historic, academic, and media rhetoric, young adolescent women have been objects situated within the broader socialization of childhood. "Childhood," Jackson & Scott (1999) argue, is framed as a perilous sociological construction consistently at risk of being

toppled. It may be at risk from the outside by corrupting forces like the computer or mass media (Cassell & Cramer, 2007; Marwick, 2008; Taylor, 2010). On the other hand, it is at risk of being toppled from the inside out as children themselves corrupt one another and rob each other of their innocence (Barron & Lacombe, 2005; Ringrose, 2006). This narrative casts adolescent women as inherently aggressive and potentially pathological. These assumptions and projections are particularly troublesome because of the judgment they cast onto young women. Additionally, by focusing on what corrupts and on socially constructing an inherent morality to childhood, researchers run the risk of ignoring the developmental continuum that children operate under.

Recent studies of young women ignore the connection between adolescents' psychosocial development and later outcomes (Ward & Benjamin, 2004). By pathologising childhood and divorcing it from later outcomes, researchers are prevented from exploring the developmental continuum and safeguarding children. Yet, given the relationship between teenage girls, psychosocial adjustment, and their potential to either corrupt or be corrupted by technology, it is critical to explore the relationships between young women, technology use, and their psychosocial environment. By exploring these factors, this work can move away from assumptions and towards quantifying patterns of teenage use. Towards this goal, this paper moves beyond notions of risk and harm and towards quantifying online opportunities.

Based on this, this chapter focuses exclusively on teenage females' self-reported data to explore notions of opportunity and support over the lifespan and across time. Within two representative cohorts – one from 2010 and one from 2014 – this study aims to establish persistent patterns within adolescent females and to point to the psychological mechanisms that influence this demographic.

3.3.3 Survey methodology

Using secondary data from two cross-sectional population-level surveys – the 2010 EU Kids Online survey and the 2014 Building Online Resilience survey – the present chapter runs

analyses across both datasets to note trends and identify the persistent significance of access, support, and psychology over time. Both datasets were collected by contacting young women directly and surveying them on their experiences. In doing so, they measured teenagers' lived experiences and avoided projecting adults' insecurities onto the results.

3.4 Study 1: 2010 Cohort Study

3.4.1 Why this Data Set?

Originally collected in 2010, the EU Kids Online project used structured interviews and paper surveys with over 25,000 young people ages 9-16 and their parents from 25 countries across the EU to quantify broad patterns of access, risk, harm, and opportunities of technology use. To improve construct validity (Clark & Watson, 1995), before data collection, the researchers engaged in a two-year process of question-generation based on commonly-held beliefs and peer-reviewed links between access, skills, parenting, and online opportunities. The researchers then pre-validated all measures within the survey before collecting data from participants in 2010 (Livingstone, Haddon, Görzig, & Ólafsson, 2011).

Since its original collection, the project has produced several reports summarizing individual country patterns and broader European activities. However, no work has focused exclusively on young adolescent females or on the specific relationships between individual factors, environmental factors, and psychology. This 2010 cohort and subsequent analysis establish patterns of adolescent engagement in a pre-validated dataset and therefore provide a jumping off point for later analysis in the 2014 cohort. This improves the external validity of both analyses.

This dataset includes measures related to individual level factors and social support factors, not psychological factors. Therefore, it explored research questions 1 and 2 and tested hypotheses demonstrating their importance.

RQ 1: What role do individual-level predictors of access and skill play in predicting positive outcomes from teenage girls' technology use?

RQ 2A: Given the multiple sources of mediation facing adolescents, which are effective at encouraging the take-up of online opportunities?

RQ 2B: Given the importance of social support to offline opportunities, what role does social support and parental support play online?

3.4.2 Hypotheses

Three hypotheses were developed based on these research questions' focus on individual factors, parents' Internet mediation, and general social support. Consistent with Eynon & Malmberg (2012) and Livingstone & Helsper (2008), Hypothesis 1 posits that access to technology and an ability to use it are necessary predictors of online opportunities. Contrary to media rhetoric, teenagers are not "digital natives" and must learn (or be taught) how to use and engage with technology (Bennett & Maton, 2010). Yet, while teenagers may need to develop skills in order to pursue online opportunities, having skills and access does not mean that individuals will use them for online opportunities. Therefore, these analyses begin by establishing the critical link between access, skills, and opportunities. Hypothesis 1 suggests that: *Access* and *Skills* predict the take-up of online opportunities.

Yet, recognizing contributions from Eynon & Malmberg (2012) on networks of support, it is likely that teens feeling social support will be more likely to engage in online opportunities than those without support. Therefore, Hypothesis 2 states: *Social Support* predicts the take-up of online opportunities.

In adolescence, social support increasingly influences young women's decisions and parents lose influence (Steinberg, 2001). Therefore, as with television (Nathanson, 2002), parental Internet mediation is likely to decline in influence and so Hypothesis 3 contends that: *Parental Mediation* does not increase the take-up of online opportunities.

3.4.3 Methodology

3.4.3.a Participants and Sampling Procedure

The 2010 EU Kids Online researchers sampled based on Eurostat regions and stratified data based on the number of children living in each locality. They collected a random selection within regions using the random walk method to perform offline structured interviews and distribute paper surveys (O'Neill, Livingstone, & McLaughlin, 2011). This method produces statistical uniformity when performed in regionally equivalent units (Wei, Erinrich, & Selman, 2004). Thus, this dataset produces results of comparable generalizability to other sampling methods. Researchers conducted structured interviews with participants on basic measures including skills and demographics. They then asked participants to complete a paper survey about sensitive information to improve these questions' reliability. Results from the interviews and surveys were codified into the final dataset.

The original UK dataset contained 1032 British individuals, ages 9-16. When filtered for female British teenagers, the resulting representative sample contains 233 British females, ages 13-16 (M = 14.37; SD = 1.13). Table 3.1 summarizes the sample data.

Table 3.1

Unweighted Sample Data for the 2010 Cohort

Age	Frequency	Unweighted Percent
13	72	30.9
14	51	21.9
15	62	26.6
16	48	20.6
Total	233	100

Region	Frequency	Unweighted Percent
East Midlands	27	11.6
East of England	7	3
London	50	21.5
North East	13	5.6
North West	29	12.4
Northern Ireland	7	3
Scotland	27	11.6
South East	21	9
South West	13	5.6
Wales	9	3.9
West Midlands	10	4.3
Yorkshire and the Humberlands	20	8.6
Total	233	100

3.4.3.b Measures

Individual Predictors

Technology Access. Participants in the 2010 cohort were asked to select the number of places they used the Internet from a list of 8 options: Your bedroom (or other private room) at home; Living room (or other public room) at home; At school or college; In an internet cafe; In a public library or other public place; At a friend's home; At a relative's home; When 'out and about'. A summed score of "Number of places accessed" was created to measure the amount of access the participant had. Participants were also asked "How frequently do you use the Internet?" and this was coded on a 4-point scale where 1 = every day and 4 = less than once a month. This produced two distinct measures of access: the *Number of Places* they have access and their *Frequency of Use*.

Adolescent Skills. A checklist measured adolescents' self-reported competencies at using the Internet. Participants were given a list of 8 activities they may or may not know how to do on the Internet and asked if they could do that item. The list of *Internet Competencies* included items such as "Compare different websites to decide if information is true," "Change filter preferences," and "Block messages from someone you don't want to hear from." A composite *Internet Competencies* score was calculated for each participant by summing all of their abilities (α = .840).

Environmental Predictors

Parental Mediation. For the 2010 dataset, students were asked to make a binary judgment on whether their parents engaged in certain mediation strategies. Two items such as "Talk to you about what you do on the internet" were summed to create an *Active Mediation* score (α = .491). Two items such as "Sit with you while you use the internet" were summed to create a *Coviewing* score (α = .648). While the 2010 dataset originally defined Active Mediation and Coviewing under one "Active construct," this study separated the concepts to align with the 2014 dataset

and Nikken & Jansz (2014). Two items such as "Parental controls or other means of blocking or filtering some types of website" were summed to measure awareness of *Parental Controls* (α = .815). To assess restriction, students were given a list of five online activities and asked if their parents "allow them to do all of the time, only with permission/supervision, or never allow." A *Restrictive Mediation* score was created by summing all activities they were never allowed to do and a *Light Restriction* score was created by summing all the activities they were allowed to do with permission/supervision. Finally, students were asked whether their parents checked any of four activities after use (e.g., "The messages in your email or instant messaging account"). Responses were summed to create an overall *Monitoring* score (α=.861).

Social Support. In the 2010 dataset, two constructs were created to explore social support: *Presence of Support* and *Sources of Support*. Presence of support was based on answering yes to any social support system in response to the question: "When I am bothered about something, I talk to… a) My mother or father, b) My brother or sister, c) A friend, d) A teacher." Separate variables were coded for each *Source of Support* listed to track whether the child turned to that individual.

Table 3.2 displays descriptive statistics for all predictors.

Table 3.2

Descriptive Statistics for Predictor Variables in 2010 Cohort

Construct	N	Min	Max	Mean	SD
age	233	13	16	14.369	1.126
sex	233	2	2	2.000	0.000
Individual Predictors					
Number of Places Accessed	233	1	8	4.090	1.541
Frequency of Use	233	1	4	3.854	0.410
Internet Competencies	233	0	8	5.262	2.466
Environmental Predictors					
Parental Mediation					
Active Mediation	230	0	2	1.200	0.756
Restrictive Mediation	213	0	5	0.939	1.108
Monitoring	196	0	4	1.219	1.431
Parental Controls	204	0	2	0.711	0.842
Light Restriction	213	0	5	0.901	1.246
CoViewing	231	0	2	0.879	0.846
Social Support					
Presence of Support	233	0	1	0.944	0.230
Parent Support	233	0	1	0.635	0.482
Sibling Support	233	0	1	0.270	0.445
Friend Support	233	0	1	0.717	0.452
Teacher Support	233	0	1	0.146	0.354
No Support	233	0	1	0.043	0.203

Outcomes:

Online Opportunities. The 2010 dataset includes items relating to 3 categories of online opportunities: *Socialising*, *Consumption*, and *Creativity*. 6 items assessed socialising. Statements included "visited a social networking profile; used instant messaging" (α = .626). Consumption was assessed via an additional 4 items which included activities such as "Used the Internet for school work; watched video clips" (α = .350). Girls' creativity was assessed with 6 items which included statements such as "Written a blog or online diary; spent time in a virtual world" (α = .687). Across opportunities, students were asked to make a binary selection on whether they engaged in this activity. An additional *Activity Range* was calculated for all students which represented the total number of activities pursued (inclusive of all subtypes) (α = .806). Finally, the dataset explored offline self-efficacy with four items such as "It is easy for me to stick to my aims and accomplish my goals." Results were summed to create a composite score (α = .566). While individual alphas for some of these constructs are low, they correspond to the categories outlined in documentation and are lower than the dataset's original results because of this study's smaller sample size.

Table 3.3 displays descriptive statistics for all outcome variables.

Table 3.3

Descriptive Statistics for Outcome Variables in the 2010 Cohort

Construct	N	Min	Max	Mean	SD
Online Opportunities					
Consumption	233	1	4	2.760	0.939
Socialising	233	0	6	3.369	1.421
Creativity	232	0	6	2.263	1.676
Activity Range	233	1	16	8.382	3.299
Self-Efficacy	232	4	12	8.780	1.745

3.4.3.c Analytical Strategy

Hypothesis 1 was concerned with the importance of individual-level predictors of access and skills for pursuing digital opportunities. To test this, a linear regression model explored the

direct effect of device access and frequency onto each outcome. An additional linear regression model measured the direct effect of Internet competencies onto each outcome.

In line with the approach used to test Hypothesis 1, I evaluated Hypothesis 2 using regression analyses. I aimed to test the idea that Social Support predicts opportunities and explored the role that having an offline source of support may have on pursuing positive opportunities online. Modelling these relations in this way served as a proxy for the feeling of emotional closeness. Analyses both explored whether a) the existence of support impacted online opportunities and then b) expanded to a multiple regression model that that regressed each opportunity onto all forms of support to identify whether different relationship types were more effective than others at supporting the take-up of opportunities.

Finally, to evaluate Hypothesis 3 about the impact of rule-setting strategies on the take-up of online opportunities, a series of linear regression models examined mediation subtypes' influence onto each constructive outcome. Consistent with Nikken & Jansz (2011), analyses considered all mediation subtypes as predictors.

3.4.4 Results

3.4.4.a Preliminary Results

Due to the number of variables included in the 2010 cohort, a series of bivariate correlations were calculated between predictor variables (Table 3.4), outcome variables (Table 3.5), and predictor onto outcome variables (Table 3.6). Despite several significant correlations, no patterns were observed within the data and all correlations were low.

Table 3.4

Pearson Correlations for Predictors in the 2010 Cohort

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Number Places Used	--													
2. Frequency Accessed	.110	--												
3. Internet Competencies	.205**	.264**	--											
4. Active Mediation	-.109	.011	.000	--										
5. Restrictive Mediation	-.262**	-.334**	-.296**	.112	--									
6. Monitoring	-.187**	-.126	-.018	.174*	-.054	--								
7. Parental Controls	-.118	-.215**	-.020	.292**	.194**	.369**	--							
8. Light Restriction	-.199**	-.020	-.090	.198**	-.141*	.358**	.139	--						
9. Co-Viewing	-.104	-.039	-.112	.297**	.092	.365**	.161*	.243**	--					
10. Support	-.047	.096	-.096	.04	-.013	-.025	.088	-.003	.009	--				
11. Parent Support	-.153*	-.009	-.093	.309**	.082	.097	.149*	.176**	.233**	.321**	--			
12. Sibling Support	.002	.005	-.006	-.047	.014	.023	.014	-.046	-.039	.148*	.220**	--		
13. Friend Support	.198**	.102	.055	-.023	-.129	.032	-.006	-.085	.011	.387**	-.061	.104	--	
14. Teacher Support	-.032	.058	.060	-.029	-.070	.168*	-.033	.138*	.060	.100	.136*	.104	.152*	--

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 3.5

Correlation Table for Outcome Variables in the 2010 Cohort

	1	2	3	4	5
1. Consumption	--				
2. Socialising	.455**	--			
3. Creativity	.430**	.549**	--		
4. Activity Range	.694**	.841**	.866**	--	
5. Self-Efficacy	.047	.009	.126	.084	--

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 3.6

Correlation Tables Outcomes on Predictors in the 2010 Cohort

	Consumption	Socialising	Creativity	Activity Range	Self-Efficacy
Number Places Used	.203**	.115	.264**	.239**	.148*
Frequency Accessed	.278**	.278**	.226**	.312**	.033
Internet Competencies	.388**	.351**	.406**	.469**	.117
Active Mediation	.033	.061	.088	.081	.021
Restrictive Mediation	-.387**	-.481**	-.314**	-.471**	-.008
Monitoring	-.075	.128	.013	.035	-.050
Parental Controls	-.042	.001	.055	.011	-.097
Light Restriction	-.051	.031	-.097	-.048	-.092
Co-Viewing	-.109	-.093	-.104	-.120	.052
Support	-.142*	-.095	-.096	-.131*	.116
Parent Support	-.071	-.048	-.171**	-.123	.023
Sibling Support	.032	-.097	-.095	-.085	.227**
Friend Support	-.039	-.071	-.017	-.046	.219**
Teacher Support	.015	.150*	.066	.103	.017
No Support	.100	.034	.081	.085	-.083

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

3.4.4.b Hypothesis 1: Access and Skills predict the take-up of online opportunities

Technology Access. Results from the models regressing each opportunity onto the frequency of access and the number of devices accessed indicated that access predicted the opportunities pursued online (see full model results in Table 3.7). Device access predicts pursuing a range of activities ($\beta = .377$; $p < .001$), as well as the 2010 dataset's subsets: consumption ($\beta = .357$; $p < .001$), socialising ($\beta = .214$; $p = .001$), and creativity ($\beta = .364$; $p < .001$). Similarly, frequency of Internet use predicts the activity range ($\beta = .245$; $p < .001$), consumption ($\beta = .213$; $p < .001$), socialising ($\beta = .238$; $p = .000$), and creativity ($\beta = .364$; $p = .008$). The 2010 dataset provides initial support for the relationship between needing access to devices to use them for positive outcomes.

Skills. The 2010 dataset demonstrated a significant relationship between a young woman's Internet skills and her pursuit of positive online opportunities. Results from regression models testing skills influence on opportunities found that internet competencies predicted the activity range ($\beta = .459$; $p < .001$), as well as pursuing consumption ($\beta = .372$; $p < .001$), socialising ($\beta = .339$; $p < .001$), and creative ($\beta = .406$; $p < .001$) opportunities online. Table 3.7 outlines results from both tests.

Table 3.7

Hypothesis 1 Model Results for Regression Analyses with Access Predictors and Skill Predictors

Outcome	Access Model				Skills Model			
	R^2	$\overline{R}^2$	F	p	R^2	$\overline{R}^2$	F	p
Consumption	.219	.209	21.45	< .001	.161	.154	22.14	< .001
Socialising	.135	.123	11.88	< .001	.129	.122	17.07	< .001
Creativity	.178	.167	16.42	< .001	.165	.158	22.66	< .001
Activity Range	.245	.236	24.83	< .001	.224	.218	33.25	< .001

Note. R^2 denotes the share of variability in the outcome as accounted for by the model. $\overline{R}^2$ notes the Adjusted R^2. F represents the omnibus test statistic and the p value reflects the overall model significance.

3.4.4.c Hypothesis 2: Social Support predicts the take-up of online opportunities

The Importance of Support. A series of regression models explored how sensing offline social support predicted each opportunity. Models predicting the activity range (R^2 = .037; Adjusted R^2 = .029; F = 4.459; p = .013) and consumption (R^2 = .049; Adjusted R^2 = .040; F = 5.876; p = .003) were both statistically significant. Identifying any source of social support negatively predicted pursuing a range of online activities (β = -.137; p = .035), it also negatively predicts basic consumption activities (β = -.150; p = .021). There were no statistically significant relationships observed between social support and either creativity or socialising (all ps > .05).

Forms of Support. A series of models regressed each online opportunity onto all forms of social support: parent, teacher, sibling, friend. There were no statistically significant patterns observed between specific offline supports and online opportunities, but there was a small relationship between similar-aged offline supports and offline self-efficacy. Both sibling support (β = .212; p = .001) and friend support (β = .119; p = .003) positively predicted self-efficacy (R^2 = .092; Adjusted R^2 = .072; F = 4.599 p = .001). Models predicting the activity range (R^2 = .058; Adjusted R^2 = .037; F = 2.772; p = .019). and socialising (R^2 = .064; Adjusted R^2 = .043; F = 3.105; p = .010) were both statistically significant. In both cases, teacher support was the only significant predictor ($\beta_{socialising}$ = .180; $p_{socialising}$ = .007; $\beta_{ActivityRange}$ = .137; $p_{ActivityRange}$ = .040). No relationship was observed between offline support and consumption or creative Internet use (ps > .05).

3.4.4.d Hypothesis 3: Mediation reduces the take-up of online opportunities

To test whether parental mediation predicted teenagers' pursuit of digital opportunities, regression models measured the joint impact of parent mediation styles onto each online opportunity. An insignificant positive relationship was observed between active mediation and the activity range, and active mediation was not predictive of any specific subtype. In contrast, restrictive mediation negatively predicted the take-up of all opportunities surveyed and the

activity range. No relationship was observed between any other form of mediation and online opportunities (ps < .05). Model results and information on these two predictors are summarized in Table 3.8.

Table 3.8

Regression Results for Mediation Models and Two Key Predictors

Outcome	Model Significance				Restrictive Mediation				Active Mediation			
	R^2	$\overline{R}^2$	F	*p*	*b*	*β*	SE	*p*	*b*	*β*	SE	*p*
Consumption	.118	.079	3.083	.004	-.308	-.324	.075	< .001	.144	.114	.104	.169
Socialising	.202	.167	5.85	< .001	-.528	-.381	.103	< .001	.227	.124	.144	.118
Creativity	.115	.076	2.979	.006	-.527	-.313	.133	< .001	.281	.126	.185	.131
Activity Range	.188	.153	5.355	< .001	-1.364	-.415	.248	< .001	.657	.151	.346	.059

Note. Table displays the overall model significance when each outcome (DV) was regressed onto all mediation styles. It includes the individual significance and partial predictors for two relevant predictors: restrictive and active mediation.

3.4.5 Discussion

Consistent with Hypothesis 1 and Livingstone & Helsper (2010), results indicate that access and skills positively impact the take-up of online opportunities. This lies in contrast to psychological research, which often focuses exclusively on interpersonal and internal factors. By establishing access and skills as paramount, these results point to the importance of a continued policy focus on digital access and inequalities. Since individuals need technology literacy to take advantage of online opportunities, future research should look at the factors that lead towards the technology literacy that promotes opportunities while preventing risks. Towards this, the next analyses explored how social climate supports outcomes.

In response to parental mediation research, Hypothesis 3 looked at how rule-setting around technology influenced the take-up of online opportunities. As young women mature, despite evidence that parental mediation can safeguard against risks and encourage opportunities (Lee & Chae, 2007; Mesch, 2009), parental mediation's effectiveness appears to wane. No relationships were observed between digital mediation styles and the take-up of online

opportunities, but restrictive strategies decreased incidence of online opportunities. While restricting the Internet may reduce risks in younger individuals (Kalmus et al., 2012; Lee & Chae, 2012), it appears to also reduce rewards in older adolescents. This suggests that opportunities require skills and freedom. Active mediation styles mildly predict the range of online opportunities. No relationship was observed between active mediation and socialising, creative, or consumptive uses of the Internet. This suggests that active mediation styles may encourage students to take up the opportunities that are meaningful to them but in ways unique to individuals. By demonstrating that students are pursuing unique but significant activity ranges, this study showcases the discrete and identity-supportive ways that young adolescents may use the Internet when their support systems guide them to do so.

In support of this, and consistent with Hypothesis 2, discrete forms of social support predicted the take-up of online opportunities. Identifying a similar-aged peer as a source of support (e.g. sibling or friend) predicted feelings of self-efficacy. Because you can't be what you can't see, supportive peers led to an internal belief in one's own ability. Self-efficacy, or the belief in one's own ability, is an important psychological protector that can help individuals build their resilience. While no relationships were observed between peer supports and online outcomes, these results suggest that, unlike rule-setting strategies, relationship quality can produce psychological effects. Additionally, the constructs measuring self-efficacy and social support focused on offline behaviour (see Appendix A). As individuals felt connected offline, it is possible they did not feel the need to pursue online opportunities. This is supported by results which showed how peer supports reduced the take-up of opportunities and of generic Internet consumption. Self-determination theory suggests that when individuals feel supported and related to others, they are more likely to take advantage of opportunities available to them – whether off- or on-line. This psychological principle supports Eynon & Malmberg (2012) finding that skills spread through networks of support. There exists a need for more research

establishing the connection between these effects and later resilience and technology use. Yet, these results crucially establish the protective and supportive ability of peers and friends.

Additionally, opportunities may develop from outside of the friend group. Teachers supported the take-up of the Internet for social purposes. While parental support reduced the incidence of opportunities, it is possible that because individuals felt close to their families, they did not need to turn elsewhere for support. Future research should further explore the connection between student-teacher relationships and online activities.

While the combined results paint an illustrative picture about individual and environmental factors, they largely ignore why those who do engage choose to do so. Towards this goal, it is necessary to include the 2014 cohort.

3.4.6 Conclusion for Study 1

Secondary data analysis within the 2010 cohort suggests that individual predictors, including access and skills, positively predict the take-up of online opportunities. While this debunks digital native myths and demonstrates the importance of improving access, neither access nor skills are enough to encourage individuals to take-up opportunities. That said, these analyses do not establish what communities can do to encourage those with skills and access to pursue positive uses of digital technology. This requires a more robust dataset that includes constructs that explore the psychological processes at play in the decision to engage with technology. For this, I now turn to the 2014 cohort.

3.5 Study 2: 2014 Cohort Study

3.5.1 Why this Data Set?

In 2014, a Building Online Resilience team, made up of researchers from the Oxford Internet Institute and Parent Zone, a social enterprise with expertise in digital family life, surveyed a representative sample of 2,000 UK teenagers about their online experiences, parenting experiences, and motivation for technology use. For the project, the Oxford researchers designed the survey and performed the research, while Parent Zone contributed their expertise and to the final project write-up (Przybylski, Mishkin, Shotbolt, & Linington, 2014). Working with the 2014 team during data collection, I added measures focused on parenting practices and online opportunities. Unlike the 2010 cohort, the 2014 dataset included measures on parents' psychological impact and the psychology behind young people's digital engagement. Yet, despite a white paper focused on resilience building strategies (Przybylski, et al., 2014), no work has established the interaction between social setting, motivation, and online opportunities. Similar to the 2010 cohort, in what follows, I outline a series of tests that together establish the crucial role that social support and psychological processes play in predisposing young adolescent women towards the take-up of online opportunities.

Like the 2010 cohort, the 2014 cohort dataset assessed concepts related to individual-level predictors of access and skill. It was supplemented with measures of parental mediation and mediation from non-parent sources. Therefore, my analysis of the 2014 cohort data begins by mirroring the 2010 dataset analyses and explores the same initial research questions:

> *RQ 1: What role do individual-level predictors of access and skill play in predicting positive outcomes from teenage girls' technology use?*
>
> *RQ 2A: Given the multiple sources of mediation facing adolescents, which are effective at encouraging the take-up of online opportunities?*

The 2014 cohort then builds on the 2010 cohort in two significant ways. Firstly, while the 2010 cohort established a moderate relationship between parenting and online opportunities, the 2014 cohort builds on this by exploring how parenting styles, such as autonomy-support, influence online opportunities. Secondly, the 2010 cohort establishes *what* young women do online but is unable to explain why. In contrast, the 2014 cohort includes variables about the motivation behind why young women use technology. It therefore explores why individuals choose to engage online and examines the importance of an individual's underlying motivation for Internet use. As such, it is used to more thoroughly explore the remaining three research questions.

> *RQ 2B: Given the importance of social support to offline opportunities, what role does social support and parental support play online?*
>
> *RQ 3A: What predicts intrinsic motivation for Internet use?*
>
> *RQ 3B: Does intrinsic motivation for Internet use predict online opportunities?*

3.5.2 Hypotheses

This study begins by replicating the three hypotheses from the 2010 cohort.

Hypothesis 1: Access and Skills predict the take-up of online opportunities

Hypothesis 2: Social Support predicts the take-up of online opportunities.

Hypothesis 3: Parental Mediation does not increase the take-up of online opportunities.

Following this, based on SDT's positing that close relationships predict intrinsic motivation and that this then leads individuals towards the take-up of offline opportunities, this thesis tests Hypotheses 4-6:

Hypothesis 4: Parent Mediation styles impact intrinsic motivation for Internet use.

Hypothesis 5: Parenting relationships predict intrinsic motivation for Internet use.

Hypothesis 6: Autonomous motivation predicts the take-up of online opportunities.

3.5.3 Methodology

3.5.3.a Participants and Sampling Procedure

The survey was administered in 2014 through ICM Research's online panel. Because the online methodology prevented constructing a fully random sample for the 2014 cohort, using a panel-based sample and the ease of contacting participants allowed researchers to construct a representative sample (Bryman, 2016). The dataset offset sampling biases and ensured a representative sample using a series of statistical weights. The target population's demographics were based on 2011 UK Census data on 14-17 year olds by both gender and region (Official Labour Market Statistics, 2011), the most recent profile of the UK population at the time of collection. Together, the weighting and sampling approach offset some generalizability biases when using online panels and promoted external validity (Chang & Krosnick, 2009).

The original dataset contained 2002 adolescents ages 14-17 (M=15.63; SD=1.095). When filtered for young women, the subsequent cohort contains 1076 British females ages 14-17 (M = 15.76; SD = 1.075). The larger sample size relative to the 2010 cohort improves reliability of results. Individuals were sampled from across social grades and from Scotland, Wales, and England. Table 3.9 presents frequencies for age, geographic, and economic demographics.

Table 3.9

Unweighted Sample Data for the 2014 Cohort

Age	Frequency	Unweighted Percent
14	184	17.1
15	231	21.5
16	323	30
17	338	31.4
Total	1076	100

Social Grade	Frequency	Unweighted Percent
A	106	9.9
B	198	18.4
C	236	21.9
C2	145	13.5
D	82	7.6
E	92	8.6
Prefer Not to Say	217	20.2
Total	1076	100

Location	Frequency	Unweighted Percent
East Midlands	80	7.4
East of England	80	7.4
London	148	13.8
North East	45	4.2
North West	137	12.7
Scotland	70	6.5
South East	176	16.4
South West	108	10
Wales	39	3.6
West Midlands	107	9.9
Yorkshire and the Humberlands	86	8
Total	1076	100

3.5.3.b Measures:

Individual-Level Predictors:

Technology Access. For the 2014 cohort, as there was no data on frequency, the only access predictors explored were the devices available to the individual. For a range of devices, participants were asked whether they had their own, shared it with their siblings, or shared it with their parents. For each device where the student had at least one point of access, they were considered to have access to that device. A composite score for *Number of Devices Available* was created for each participant which summed up all devices available to her.

Adolescent Skills. In the 2014 cohort, students were asked to rate their skills from "0=I don't know what this is" to "4 = Very skilled" on a list of 9 technical tasks including items such as "finding needed information online" and "masking your IP address." A composite *Kid Skills* predictors was created by summing up their skills (α = .793).

Parent Skills. Along the same scale, participants were also asked to rate their parents' skills on an abridged 6-item list of the same items that included: Finding needed information online; Playing video games; Using social media; Checking a computer's web browser history; Uploading documents to an email; Changing computer and web passwords. A corresponding *Parent Skills* variable was created by summing the relevant items for each measure (α = .847).

Environmental Predictors:

Parental Mediation. Consistent with and building on the 2010 cohort, 7 styles of mediation were used. Categories and items were previously validated by Livingstone & Helsper (2008) and Nikken & Jansz (2014) and a deeper explanation of the scale is offered in Mishkin (2014). Unlike the 2010 cohort which used forced-choice questions, in the 2014 cohort, students were asked to rank on a 1-5 Likert scale where 1 = "Not at all true" and 5 = "Completely true" the extent to which their parents pursue a range of mediation strategies. Four items such as "... encourage me to talk about my online activities" were averaged to create an *Active Mediation* score (α =.887).

For *Restrictive Mediation,* two items were averaged to look at the extent to which parents do not allow certain technologies (α = .822). A related *Light Restriction* score was created to explore the extent to which parents set rules around use. Six items were averaged including "do not let me visit some kinds of websites (e.g. adult sites); set rules about when I can use online technology" (α = .860). *Coviewing* was assessed by averaging three items such as "... encourage me to use online technologies with them" (α = .822). A *Monitoring* construct was averaged from two items that explore direct checking of an individual's technology use that included items like "...regularly check my browsing history/emails/texts" (α = .809). Finally, an additional *Parent Lessons* construct used two items to explore the extent to which parents explicitly taught students about online safety, such as "...taught me about online privacy and safety" (α = .849).

Social Support. Recognizing that as they reach adolescence, young women increasingly look for advice outside of the house, items in the 2014 cohort measured two alternate sources of information about Internet safety: teachers and friends. To measure teacher information sources, individuals were asked "My teachers have taught me how to interact with others online. My teachers have taught me about online privacy and safety." Results were summed to create a *Teacher Mediation* score. To measure *Friend Mediation*, individuals were asked "I learned how to interact with others online from my friends." All items were measured on 5-point Likert scales.

Psychological Predictors

Parent Relationship. The 2014 cohort only explores parents' support, ignoring the potential influence of friends and teachers. Parental warmth, involvement, and autonomy were assessed using the Perception of Parents' Scale, designed to explore how adolescent-parent relationships support motivation and self-regulation (Robbins, 1994). Each factor was assessed on a 5-point Likert scale from 1= "not at all true" to 5= "completely true". The *Warmth* scale included six items such as "my parents accept me and like me as I am" and "my parents make me feel special" (α = .882). *Autonomy* was calculated as the average of a 9-item scale that was made of

items such as "My parents, whenever possible, allow me to choose what to do" and "My parents listen to my opinion or perspective when I've got a problem" (α = .863). *Involvement* measured factors including "My parents spend a lot of time with me," and "My parents put time and energy into helping me." Six items were averaged to create a composite score (α = .839). Items were averaged to create a score for overall warmth, autonomy, and involvement.

Table 3.10 outlines the descriptive statistics for all of the predictor variables.

Table 3.10

Descriptive Statistics for Predictor Variables in the 2014 Cohort

Construct	N	Min	Max	Mean	SD
Individual Predictors					
Device Access	1076	0	6	3.97	1.11
Kid Skills	1076	0	36	25.65	5.47
Parent Skills	1076	0	24	16.81	4.92
Environmental Predictors					
Active Mediation	1076	4	20	9.51	4.53
Restrictive Mediation	1076	2	10	2.50	1.38
Coviewing	1076	3	15	6.15	3.19
Monitoring	1076	2	10	3.41	2.20
Parental Controls	870	2	4	2.63	0.91
Light Restriction	1076	6	30	12.59	6.09
Safety Discussions	1076	2	10	6.12	2.49
Teacher Lessons	1076	4	20	11.60	4.48
Friend Lessons	1076	1	5	2.91	1.20
Psychological Predictors					
Warmth	1076	1	5	3.98	0.92
Involvement	1076	1	5	3.89	0.85
Autonomy	1076	1	5	3.66	0.79

Outcomes

Online Opportunities. Online opportunities were measured with a 20-item inventory inspired by the 2010 cohort, but inclusive of other forms of online opportunity noted in Ito et al. (2009). The 2014 dataset catalogues five forms of online opportunity: *Socialising*, *Creativity*, *Self-Expression*, *Civics*, and *Learning*. Consistent with the 2010 dataset, students were asked to make a binary choice of whether they had done the activity in the past six months. Recognizing that individuals, and particularly young people, poorly estimate the frequency of engaging in an activity (Junco, 2013), asking individuals if they recall doing an activity can offset some of the

validity concerns of estimating frequency by identifying those who identify as engaging in a task from those who do not. A deeper explanation of these items and the sources that inspired their inclusion is offered in Mishkin (2014). The *Socialising* scale was made of four items such as "Improved an existing friendship" (α = .621). *Learning* was made of four items including "Searched for information about something that personally interests me" (α = .604). *Creativity* was defined by four items such as "Wrote a blog entry about something I care about" (α = .544). *Self-Expression* was a psychological concept and, as such, included items such as "Expressed my true self" (α = .708). The 4-item *Civics* sub-scale referred to forms of online civic engagement such as "Signed an online petition" (α = .621). An additional *Activity Range* was calculated for each individual which included the total number of activities engaged in (inclusive of all subtypes) (α = .838). Appendix A includes all subscales.

Coding. In response to rhetoric around young women and computer science skills, students were also asked to rate their *Coding* ability from 0-5 (0= "I don't know what this is," 5= "Very skilled."). This aligns with Hargittai (2005)'s finding on the validity of directly surveying technology skills, where there is always the possibility of misunderstanding technical terminology. Moreover, "coding" and the practices it is associated with have been linked to young people's perceptions of the field (Cheryan, Plaut, Handron, & Hudson, 2013), and it was therefore considered an appropriate way of surveying their experiences with the skill. While coding ability was initially surveyed as part of their skills, this study frames it as an outcome, given the importance of young women's technology ability.

Intrinsic Motivation for Internet Use. Consistent with Deci & Ryan's motivational styles (2000), 15 items assessed levels of Intrinsic, Identified, Introjected, Extrinsic, and Amotivated motivations for Internet use. Each item was assessed on a 4-point Likert scale from "1=very true" to "4=not at all true." Each motivational construct was assessed with three items and results were summed to create a composite score for each motivational subtype: intrinsic,

identified, introjected, external, and amotivation. The items used were adapted from Ryan & Connell (1989) and a deeper explanation of their construction is offered in Przybylski et al., (2014). Additionally, consistent with Black & Deci (2000), a composite score called the Relative Autonomy Index (RAI) was created that summarized individuals' resonance with each motivational subtype. Recognizing that individuals may experience multiples forms of mediation at the same time, the RAI measure was employed to measure the combined feelings of teenagers. The RAI is a singular measure that reflects the extent to which individuals are autonomously motivated to use the Internet, thereby allowing the researcher to effectively compare individuals' motivational functioning (Black & Deci, 2000). Appendix A outlines these items.

Table 3.11 outline the descriptive statistics and tables 3.12-3.14 display the correlations between all predictor and outcome variables.

Table 3.11

Descriptive statistics for Outcome Variables in the 2014 Cohort

Construct	N	Min	Max	Mean	SD
Concrete Outcomes					
Activity Range	1076	0	20	7.15	4.41
Civics	1076	0	4	1.05	1.09
Creativity	1076	0	4	.78	1.03
Self-Expression	1076	0	4	1.39	1.37
Learning	1076	0	4	2.06	1.23
Socialising	1076	0	4	1.87	1.32
Coding	1076	0	4	1.48	1.18
Psychological Outcomes					
InternetRAI	1076	-5	9	3.46	2.37
Intrinsic Motivation	1076	1	4	3.36	.64
Identified Motivation	1076	1	4	2.72	.82
Introjected Motivation	1076	1	4	2.65	.83
External Motivation	1076	1	4	1.67	.74
Amotivation	1076	1	4	1.66	.73

3.5.3.c Analytical Strategy

Consistent with analyses in the 2010 cohort, a series of regression models tested Hypothesis 1 on the relationship between online opportunities and the individual predictors of access and skills. Analyses regressed each positive opportunity and motivation onto the number of devices each student had access to. Additionally, a series of regression models explored the

impact of both parent and child skills onto each opportunity. Recognizing that parent skills and child skills exist in tandem, this analytical strategy controlled for the dual impacts that both domains have upon resultant outcomes. All hypothesis tests controlled for age.

The 2nd Hypothesis tested whether discrete forms of social support predicted the take-up of digital opportunities. Recognising that, as young women age, they increasingly look to sources outside of the home for advice, linear regression models explored the competing influences of parent, teacher, and friend technology advice onto each surveyed online opportunity and onto overall Internet self-regulation. While this dataset did not include variables examining relationship strength, this approach implies that strength exists if they are trusting the individual's advice.

For Hypotheses 3-4, focused on the role of mediation strategies onto opportunities and motivation, a series of linear regression models regressed each surveyed opportunity and Internet motivation onto all mediation subtypes. As in the 2010 cohort, all mediation styles were included in each model because parents often use a range of mediation strategies (Nikken & Jansz, 2014).

Hypothesis 5 concerned the relationship between parent-daughter relationships and daughters' take-up of online opportunities. Recognizing the high correlations between parental involvement, autonomy, and warmth, the three parenting styles surveyed, stepwise regression tested the influence of parenting onto resilient use. For the initial model, involvement, autonomy, warmth, and age were independent variables, with Internet self-regulation as the dependent variable. Based on this model suggestion, a series of linear regressions explored the resulting significant variables influence onto each motivational subtype to demonstrate the relative importance of parent relationships for developing motivational functioning.

Finally, to test Hypothesis 6, the relationship between resilient Internet use and online opportunities, a series of regression analyses explored whether the relative autonomy of an individual's motivation led them towards online opportunities. To further demonstrate the

individual power of each motivational style, additional regression analyses related each motivational type to the take-up of online opportunities.

3.5.4 Results

3.5.4.a Preliminary Results

As in the 2010 cohort, analyses began by calculating bivariate correlations between all variables. Table 3.12 outlines correlations between predictor variables, table 3.13 outlines correlations between outcome variables, and table 3.14 outlines the correlations between the predictor and outcome variables.

Table 3.12

Pearson Correlations for Predictor Variables in the 2014 Cohort

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Device Access	--														
2. Kid Skills	.105**	--													
3. Parent Skills	-.031	.056	--												
4. Active Mediation	-.010	-.064*	.271**	--											
5. Restrictive Mediation	.060*	-.065*	-.059	.235**	--										
6. Coviewing	-.062*	-.078*	.205**	.693**	.361**	--									
7. Monitoring	-.025	-.083**	.210**	.606**	.419**	.645**	--								
8. Parental Controls	.000	-.099**	.216**	.413**	.165**	.416**	.450**	--							
9. Light Restriction	-.014	-.119**	.185**	.607**	.385**	.649**	.649**	.543**	--						
10. Safety Discussions	-.005	-.010	.296**	.387**	.028	.293**	.288**	.250**	.292**	--					
11. Teacher Lessons	.051	.032	.043	.175**	.061*	.131**	.126**	.150**	.161**	.420**	--				
12. Friend Lessons	.031	.05	-.081**	.006	.029	-.004	.013	-.037	-.005	.020	.156**	--			
13. Warmth	-.051	.009	.272**	.259**	-.227**	.161**	.062*	.130**	.148**	.342**	.117**	-.073*	--		
14. Involvement	-.037	.016	.259**	.284**	-.210**	.178**	.083**	.147**	.163**	.331**	.078*	-.111**	.839**	--	
15. Autonomy	-.040	.037	.260**	.259**	-.165**	.157**	.066*	.101**	.096**	.335**	.138**	-.076*	.849**	.796**	--

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Table 3.13

Pearson Correlations for Outcome Variables in the 2014 Cohort

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Activity Range	--												
2. Civics	.699**	--											
3. Creativity	.669**	.378**	--										
4. Self-Expression	.810**	.466**	.467**	--									
5. Learning	.714**	.426**	.330**	.437**	--								
6. Socialising	.728**	.329**	.345**	.504**	.386**	--							
7. Coding	.127**	.137**	.156**	.080**	.103**	.011	--						
8. InternetRAI	.271**	.198**	.130**	.227**	.285**	.137**	-.045	--					
9. Intrinsic Motivation	.269**	.150**	.168**	.228**	.254**	.168**	.013	.651**	--				
10. Identified Motivation	.257**	.119**	.198**	.266**	.157**	.183**	.134**	.277**	.499**	--			
11. Introjected Motivation	.046	-.022	.050	.056	.008	.067*	.032	-.300**	.260**	.515**	--		
12. External Motivation	-.085**	-.109**	.019	-.050	-.153**	-.011	.139**	-.714**	-.046	.253**	.429**	--	
13. Amotivation	-.065*	.004	.016	-.039	-.110**	-.090**	.162**	-.466**	-.255**	-.058	.068*	.453**	--

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

Table 3.14

Pearson Correlations for Predictors and Outcome Variables in the 2014 Cohort

	Activity Range	Civics	Creativity	Self-Expression	Learning	Socialising	Coding	Internet RAI	Intrinsic Motivation	Identified Motivation	Introjected Motivation	External Motivation	Amotivation
Device Access	.130**	.075*	.128**	.077*	.128**	.071*	.122**	.002	.018	.019	.026	.009	.061*
Kid Skills	.296**	.258**	.211**	.232**	.230**	.153**	.579**	.135**	.162**	.162**	.029	-.002	.003
Parent Skills	-.062*	-.072*	-.054	-.058	-.008	-.038	-.018	.030	.113**	.058	.117**	.015	-.082**
Active Mediation	-.087**	-.077*	-.028	-.090**	-.090**	-.029	.019	-.056	.028	.059	.083**	.100**	.000
Restrictive Mediation	-.193**	-.109**	-.055	-.132**	-.181**	-.205**	.135**	-.315**	-.185**	.025	.072*	.316**	.320**
Coviewing	-.143**	-.106**	-.059	-.123**	-.158**	-.068*	.034	-.121**	-.006	.103**	.135**	.170**	.097**
Monitoring	-.171**	-.117**	-.056	-.144**	-.175**	-.118**	.067*	-.170**	-.060*	.048	.071*	.207**	.152**
Parental Controls	-.117**	-.100**	-.089**	-.116**	-.071*	-.051	.020	-.098**	-.034	.046	.090**	.104**	.065
Light Restriction	-.188**	-.135**	-.106**	-.189**	-.138**	-.107**	.025	-.107**	-.023	-.012	.065*	.108**	.088**
Safety Discussions	-.074*	-.121**	-.045	-.063*	-.069*	.018	-.020	.001	.018	.018	.004	.021	-.030
Teacher Safety Talk	.033	-.014	.027	-.030	.060*	.078*	.033	-.018	.024	-.013	.000	.042	.034
Friend Safety Talk	.118**	.043	.083**	.134**	.047	.110**	.015	-.025	.082**	.115**	.081**	.128**	.076*
Warmth	-.058	-.035	-.067*	-.101**	-.019	.011	-.104**	.157**	.075*	-.114**	-.071*	-.209**	-.221**
Involvement	-.053	-.031	-.085**	-.102**	-.002	.023	-.068*	.169**	.087**	-.091**	-.060*	-.211**	-.215**
Autonomy	-.048	-.023	-.056	-.089**	-.009	.005	-.065*	.146**	.024	-.118**	-.114**	-.213**	-.162**

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

3.5.4.b Hypothesis 1: Access and Skills predict the take-up of online opportunities

Access. To test whether access lead to the take-up of online opportunities, regression models explored whether access predicted each positive opportunity. Results indicated that the more devices the adolescent had access to, the more likely she was to take-up all online opportunities ($R^2 = .037$; Adjusted $R^2 = .035$; $F = 20.618$; $p < .001$), as well as to use the Internet for self-expression ($R^2 = .019$; Adjusted $R^2 = .018$; $F = 10.668$; $p < .001$), creative outlets ($R^2 = .021$; Adjusted $R^2 = .019$; $F = 11.486$; $p < .001$), learning ($R^2 = .033$; Adjusted $R^2 = .031$; $F = 18.340$; $p < .001$), and civic engagement ($R^2 = .043$; Adjusted $R^2 = .041$; $F = 23.668$; $p < .001$). Device access also mildly predicted coding ability ($R^2 = .016$; Adjusted $R^2 = .014$; $F = 8.585$; $p < .001$). However, access did not predict opportunities for socialising or autonomous motivation for use.

Skills. As with access tests, a series of regression models regressed each online opportunity onto both parent and child technology skills. While children's digital skills were highly predictive of pursuing constructive opportunities online, parent skills were negatively predictive of such outcomes. A child's self-reported skills positively predicted using the Internet for both the entire range of activities ($R^2 = .101$; Adjusted $R^2 = .098$; $F = 40.005$; $p < .001$) as well as for each subtype: creativity ($R^2 = .049$; Adjusted $R^2 = .047$; $F = 18.483$; $p < .001$), self-expression ($R^2 = .064$; Adjusted $R^2 = .061$; $F = 24.341$; $p < .001$), socialising ($R^2 = .026$; Adjusted $R^2 = .023$; $F = 9.488$; $p < .001$), learning ($R^2 = .061$; Adjusted $R^2 = .059$; $F = 23.374$; $p < .001$), and civics ($R^2 = .094$; Adjusted $R^2 = .091$; $F = 36.945$; $p < .001$). Young women's skills also predicted their coding ability ($R^2 = .344$; Adjusted $R^2 = .342$; $F = 187.284$; $p < .001$). While child skills' positively predicted the range of activities pursued, parent skills negatively predicted the same outcome. This effect was observed for creativity, civics, self-expression and coding. However, while a child's skills positively predicted Learning and Socialising, no significant result was observed between these outcomes and parent skills. Finally, while child skills predicted intrinsic motivation for Internet use ($R^2 = .029$; Adjusted

R^2 = .027; F = 10.857; p < .001), no relationship was observed between parent skills and motivation. Individual predictor results are summarized in Table 3.15.

Table 3.15

Predictor Results from Hypothesis 1

Outcome	Device Access				Child Skills				Parent Skills			
	b	*β*	SE	*p*	*b*	*β*	SE	*p*	*b*	*β*	SE	*p*
Creativity	.119	.129	.029	< .001	.040	.210	.006	< .001	-.013	-.062	.006	.042
Self-Expression	.096	.078	.037	.010	.056	.224	.008	< .001	-.017	-.060	.008	.047
Socialising	.085	.071	.036	.020	.038	.158	.007	< .001	-.013	-.049	.008	.112
Learning	.143	.129	.033	< .001	.048	.215	.007	< .001	-.001	-.005	.008	.861
Civics	.075	.076	.029	.011	.048	.239	.006	< .001	-.014	-.063	.007	.034
Activity Range	.518	.131	.119	< .001	.128	.595	.005	< .001	-.015	-.063	.006	.012
Coding	.130	.122	.032	< .001	.230	.286	.024	< .001	-.058	-.065	.026	.028
Internet RAI	.006	.003	.064	.929	.050	.115	.013	< .001	.020	.041	.015	.184

Note. Overall model significance is indicated in text.

3.5.4.c Hypothesis 2: Social Support predicts the take-up of online opportunities

A series of regression models tested whether different forms of technology support predicted pursuing online opportunities. These models suggested that significant variability was accounted for in the general activity range (R^2 =.039; Adjusted R^2 = .035; F = 10.791; p < .001) and for each of the constructs within it: learning (R^2 =.030; Adjusted R^2 = .026; F = 8.298; p < .001), civics (R^2 = .049; Adjusted R^2 = .046; F = 13.939; p < .001), socialising (R^2 = .016; Adjusted R^2 = .013; F = 4.439; p =.001), self-expression (R^2 = .033; Adjusted R^2 = .029; F = 9.120; p < .001), creativity (R^2 = .014; Adjusted R^2 = .014; F = 3.727; p = .005). No effect was observed for coding ability (ps>.05). When compared to non-parental sources, parent safety discussions, negatively predicted learning (β = -.101; p = .003), civics (β = -.121; p < .001), and the overall activity range (β = -.089; p = .035). Teacher discussions positively predicted the take-up of the internet for learning opportunities (β = .107; p =.002). Finally, friend discussions positively predicted using the Internet

for socialising (β = .098; *p* = .001), self-expression (β = .132; *p* = .000), creativity (β = .073; *p* = .018), and the general activity range (β = .101; *p* =.001).

3.5.4.d Hypothesis 3: Parental Mediation does not predict online opportunities

Consistent with hypotheses, results from regression models focused on mediation identified that restrictive mediation negatively predicted the take-up of all opportunities except for creative opportunities, for which no relationship was observed (see predictor summaries in Table 3.16). Similarly, lightly restrictive strategies negatively predicted self-expression (β = -.146; *p* =.007), and parent safety discussions negatively predicted online civic engagement (β = -.106; *p* =.004). No other relationships were observed between mediation strategies and opportunities. Significance for all models is summarised in Table 3.16.

Table 3.16

Model Results and the Impact of Restrictive Mediation

Outcome	Model Significance				Restrictive Mediation			
	R^2	$\overline{R}^2$	*F*	*p*	*b*	*β*	*SE*	*p*
Learning	.049	.040	5.094	.000	-.119	-.135	.034	.001
Socialising	.049	.040	5.551	.000	-.167	-.175	.037	.000
Self-Expression	.049	.040	5.503	.000	-.094	-.096	.038	.013
Creativity	.015	.005	1.592	.123	-.012	-.016	.029	.692
Civics	.054	.045	6.134	.000	-.081	-.104	.030	.007
Activity Range	.061	.053	7.037	.000	-.472	-.149	.121	.000
Coding	.026	.017	2.885	.004	.141	.135	.033	.001

Note. Table displays the results for seven models, one for each outcome as regressed onto model predictors. The full models included all mediation types as predictors. For visual clarity, this table shows statistics for restrictive mediation as it was the most consistently statistically significant predictive factor. Other one-off relationships are summarized in-text.

3.5.4.e Hypothesis 4: Mediation styles impact intrinsic motivation for Internet use

A series of linear regression models regressed types of motivation onto mediation styles and found that just as parent restrictive mediation reduces the take-up of online opportunities, it reduces developing Internet self-regulation. Models included all mediation types as predictors and separate

tests were conducted for each motivational style: intrinsic (R^2 = .059; Adjusted R^2 = .050; F = 6.776, p < .001), identified (R^2 = .033; Adjusted R^2 = .024; F = 3.643, p < .001), introjected (R^2 = .031; Adjusted R^2 = .022; F = 3.480, p = .001), external (R^2 = .160; Adjusted R^2 = .153; F = 20.567, p < .001), amotivation (R^2 = .137; Adjusted R^2 = .129; F = 17.060, p < .001), and overall Internet self-regulation (R^2 = .155; Adjusted R^2 = .148; F = 19.807, p < .001).

In line with hypotheses, restrictive mediation negatively predicted the development of intrinsic motivation (β = -.247; p < .001), and positively predicted external motivation forms, including external (β = .334; p < .001) and amotivation (β = .325; p < .001). Similarly, it negatively predicted developing overall Internet self-regulation (β = -.356; p < .001).

Additional inconsistent relationships were observed, but all were consistent with expectations that restrictive forms of mediation would decrease autonomous motivation while more positive forms would support such motivation. Active mediation negatively predicts amotivation (β = -.138; p =.006). Coviewing predicts identified motivation (β = .193 p < .001) and introjected motivation (β = .162; p =.002). Monitoring very mildly predicted the development of external motivation (β = .174; p < .001) and amotivation (β = .100; p =.045), and negatively predicted developing Internet self-regulation (β = -.127; p =.010). Lightly restrictive strategies negatively predicted the development of identified (β = -.206; p < .001), introjected (β = -.138; p =.011), and external motivation (β = -.210; p < .001), while positively predicted the development of Internet self-regulation (β = .127; p =.012). No other significant relationships between a parent's mediation strategies and a daughter's subsequent motivation were observed (ps > .05).

3.5.4.f Hypothesis 5: Parenting relationships predicts motivation for technology use

Stepwise multiple regression evaluated the comparative predictive ability of involvement, warmth, and autonomy onto motivation for technology use. In exploring these three predictors'

influence onto Internet RAI, the resulting first model included just parental involvement (R^2 = .029; Adjusted R^2 = .028; F = 31.517; p < .001), while the second model included involvement and age (R^2 = .047; Adjusted R^2 = .046; F = 26.693; p < .001). Based on this, linear regression analyses focused on parental involvement and identified statistically significant relationships between parental involvement and each motivational subtype. As summarized in Table 3.17, parental involvement positively predicts the development of intrinsic motivation while negatively predicts the development of identified, introjected, external, and amotivation.

Table 3.17

Model Results and the Impact of Involvement

Motivation (DV)	Model Significance				Involvement (IV)			
	R^2	$\overline{R}^2$	F	*p*	*b*	β	SE	*p*
Internet RAI	.047	.046	26.693	< .001	.508	.830	.083	< .001
Intrinsic	.010	.008	5.431	.005	.069	.092	.023	.003
Identified	.008	.007	4.529	.003	-.088	-.092	.029	.003
Introjected	.008	.007	4.546	.110	-.065	-.068	.030	.027
External	.065	.063	37.442	< .001	-.196	-.226	.026	< .001
Amotivation	.047	.045	26.353	< .001	-.185	-.217	.025	< .001

3.5.4.g Hypothesis 6: Autonomous motivation predicts the take-up of online opportunities

As with hypotheses 1-5, regression models were used to test hypothesis 6. Internet self-regulation, measured by the RAI, positively predicts the take-up of online opportunities (See Table 3.18). Self-regulated Internet use predicts civics, creativity, self-expression, socialising, learning, and the broad activity range.

This effect largely stems from autonomous forms of motivation. Intrinsic motivation predicts the overall activity range, as well as creative, self-expressive, social, and learning Internet uses. Similarly, identified motivation predicts all surveyed online opportunities. In contrast, external

motivation negatively predicts using the Internet for civics, self-expression, learning, and the general activity range. Amotivation predicts using the internet for civic engagement. Table 3.19 summarizes the results for the overall model and the autonomous forms of motivation while table 3.20 displays results for external motivation.

Finally, while no relationship was observed between coding ability and internet self-regulation, coding ability is positively predicted by identified motivation for internet use and negatively predicted by introjected motivation.

Table 3.18

The Influence of Relative Autonomy for Internet Use onto Opportunities

Outcome	Model Significance				Internet RAI		
	R^2	$\overline{R}^2$	F	p	β	SE	p
Learning	.090	.088	53.102	< .001	.273	.015	< .001
Socialising	.019	.017	10.314	< .001	.370	.017	< .001
Self-Expression	.060	.058	34.038	< .001	.217	.017	< .001
Creativity	.020	.018	10.677	< .001	.124	.013	< .001
Civics	.068	.066	39.142	< .001	.178	.014	< .001
Activity Range	.086	.084	50.185	< .001	.258	.055	< .001
Coding	.003	.001	1.675	.188	-.049	.015	.274

Table 3.19

The Influence of Autonomous Motivational Styles onto Opportunities and the Overall Model Significance

Outcome	Model Significance				Intrinsic			Identified		
	R^2	$\overline{R}^2$	F	p	β	SE	p	β	SE	p
Learning	.103	.098	20.408	< .001	.199	.067	< .001	.114	.057	.003
Socialising	.046	.040	8.493	< .001	.083	.075	.022	.154	.064	< .001
Self-Expression	.109	.104	21.813	< .001	.116	.075	.001	.273	.064	< .001
Creativity	.056	.051	10.669	< .001	.105	.058	.004	.189	.049	< .001
Civics	.082	.077	15.697	< .001	.113	.06	.001	.134	.052	.001
Activity Range	.127	.122	26.005	< .001	.169	.237	< .001	.241	.202	< .001
Coding	.055	.050	10.399	< .001	-.013	.066	.708	.181	.056	< .001

Table 3.20

The Influence of Controlled Motivational Styles onto Opportunities

Outcome	Introjected			External			Amotivated		
	β	SE	*p*	*β*	SE	*p*	*β*	SE	*p*
Learning	-.031	.054	.399	-.157	.061	< .001	.021	.058	.534
Socialising	-.024	.060	.519	-.010	.068	.795	-.053	.064	.127
Self-Expression	-.071	.060	.051	-.097	.068	.009	.056	.064	.095
Creativity	-.068	.047	.07	-.019	.053	.614	.068	.049	.051
Civics	-.056	.049	.131	-.144	.055	< .001	.111	.052	.001
Activity Range	-.068	.192	.06	-.117	.217	.001	.051	.203	.130
Coding	-.096	.053	.01	.073	.060	.055	.143	.057	< .001

3.5.5 Discussion

Consistent with analyses in the 2010 cohort, technology access predicted take-up of all concrete online opportunities. However, access to technology did not predict the development of online resilience and self-determined use. This suggests that what an individual has access to does not predict her psychological resilience; this stems from environmental cues. If researchers want to develop self-determined access they must look to the social systems around teenage women.

Also supporting results from 2010 analyses, young women's skills are highly predictive of all positive online opportunities. Supporting recent scholarship debunking the digital natives myth (Hargittai, 2010; Smith, Skrbis, & Western, 2013), these results suggest that differences in skills persist and that these differences lead directly to opportunities. This cross-study finding points to the necessity of Internet skills and of continuing to invest in digital training. To take advantage of the many opportunities that new media provides for development, individuals need to learn how to navigate the broader digital environment. While parents' abilities negatively predict their daughters' take-up of online opportunities, both Nikken & Jansz (2014) and Livingstone & Helsper (2008) indicate that parents' abilities positively predict their decision to engage in Internet mediation of all

forms. This showcases how parents' abilities create climates that foster Internet discussion and use. When parents feel competent, they are more likely to take action regarding to their children's use. However, it is important to identify the impact of these actions on children's outcomes. Therefore, subsequent analyses directly queried the impact of parental mediation strategies onto the take-up of online opportunities.

Access and skills allow individuals to find activities and explore them, but it cannot give one the emotional capabilities to take advantage of them. Analyses within the 2010 cohort suggested that this emerges through social and psychological support. Therefore, Hypotheses 2-5 focused directly on the relationships between social support and outcomes.

Results from Hypothesis 2 found that guidance on how to use technology that comes from outside the home may predispose young women towards online opportunities. When individuals learn about technology from their friends, they are likely to use technology to express themselves online and to socialize. Consistent with expectations of supportive teachers, when individuals learn about technology from their teachers, they are likely to use technology to learn new things. Notably, while discussions with peers and teachers may promote opportunities, discussions with parents reduced incidence of opportunities, showcasing the decreased impact that parents have over the life span. Consistent and in response to this finding, Hypothesis 3 tested the relationship between parent rule setting and opportunities.

Few relationships were observed between mediation types and the take-up of online opportunities, in contrast to offline mediation theory (e.g. Clark, 2011a; Nathanson, 2001), but similar to 2010 results. Restrictive forms of mediation negatively predict the take-up of opportunities. This appears consistent with Livingstone & Helsper (2010), who demonstrate how restricting and filtering the Internet may prevent risks, but also prevent opportunities. While this thesis is not focused on online risk, these results partially support this finding by showcasing how

opportunities are reduced when parents prevent their daughters from accessing the Internet. Mishkin (2014) argues that mediation's impact is moderated by feelings of parental warmth, suggesting that mediation forms are only impactful when the student reports feeling unconditional love from her parent.

There are several reasons why pure parental mediation may be ineffective when young women reach their teenage years. Firstly, as they develop independence, parents traditionally have less influence over what and how their teenagers engage in offline activities. This has been extended to television viewing and video gaming and appears consistent with the above results (Nathanson, 2002; Shin & Huh, 2011). Similar to Lwin, Stanaland, & Miyazaki (2008), these results suggest that parents' mediation strategies lose influence as teenagers gain independence. Secondly, unlike Mishkin (2014), these results do not factor in the relationship between the parent and the child. Clark (2011b) argues that modern mediation's success depends on factors like shared engagement and aspects of participatory learning. While not included in these measures, this again points to the importance of understanding the tenor of parent-teen relationships. Future research should investigate this factor more thoroughly, but this thesis takes an important first step by examining the importance of three aspects of the parent-child relationship: warmth, autonomy, and involvement.

Stepwise regression analyses testing the simultaneous impacts of warmth, autonomy, and involvement onto the development of intrinsic motivation for technology use suggest involvement is uniquely predictive of motivation and Internet self-regulation. The involvement construct seeks to measure parents' interest in, attachment towards, and knowledge of their daughters' offline lives (Grolnick, Benjet, Kurowski, & Apostoleris, 1997). In effect, this measures the closeness of the bond between parent and daughter and a strong sense of parental involvement implies that the child feels cared for (Grolnick, Benjet, et al., 1997). Feeling cared for then helps young women develop intrinsic motivation for their technology use and recognize how technology can help their identity

formation. It is notable that involvement is significantly more predictive than either autonomy or warmth. This suggests that young women both need to be cared for and guided towards technological outcomes. While offline closeness does not predict online opportunities, it leads to psychological states necessary for later opportunities.

Building on this, results from Hypothesis 6 point towards the mild impact that autonomous forms of motivation can have onto the take-up of online opportunities. While introjected motivation never predicts the take-up of opportunities and external motivation negatively predicts the take-up of a small number of opportunities, intrinsic and identified motivation positively predict young women's pursuit of all surveyed online opportunities. These results parallel findings for Internet RAI. This measure, which captures the relative balance of autonomous to controlled motivation within an individual, was found to positively predict the take-up of each online opportunity. This suggests that the more autonomous an individual's motivation, the greater the likelihood that she pursues online opportunities.

These results are consistent with findings on the relationship between autonomous motivation and offline opportunities. Just as autonomous motivation predicts offline academic, prosocial, and emotional wellbeing (Black & Deci, 2000; Hortop, Wrosch, & Gagné, 2013; Weinstein & Ryan, 2010), so too does it predict the take-up of online opportunities. This suggests that individuals pursue constructive uses of new technology when they have an internal drive to do so. Contrary to assertions that skills or parenting may predispose individuals towards online opportunities (Lee & Chae, 2007; Livingstone & Helsper, 2010), motivational disposition was the only predictor that universally predicted the take-up of all forms of digital opportunity. While hypotheses 1 & 2 suggest that environmental predictors are mildly impactful, these results suggest that parents and schools should focus efforts and strategies around creating intrinsic motivation for

use. Future research should focus on identifying how relationships and environments can be designed to promote intrinsic motivation for technology use.

These results also extend our understanding of the mechanisms that support the take-up of online opportunities. Many existing analyses focus on the role of demographic, educational, and rule-based predictors (e.g. Eynon & Malmberg, 2012; Lenhart et al., 2010; Livingstone & Helsper, 2010). The above findings extend this work by showcasing that when individuals are autonomously motivated, they are more likely to take advantage of the opportunities the Internet offers.

3.5.6 Conclusion for Study 2

Analyses within the 2014 cohort note how aspects of the adolescents' individual, environmental, and psychological life predict her use of technology for Internet use. While access and skills are necessary to give adolescent women the means to access online resources, psychological constructs are equally important at supporting the take-up of online opportunities. When individuals feel an intrinsic drive to use technology, they use the Internet for constructive purposes and this intrinsic motivation appears to arise from feelings of social connection, not from access.

3.6 Conclusion

Despite a four-year gap between data-sets, three patterns emerge regarding the relationships between individual factors, environmental support, and the take-up of opportunities. Firstly, results from Research Question 1 suggest that access and skills are necessary precursors for using the Internet for opportunities. However, while access and skills may predispose individuals towards opportunities, it may equally present the potential for risk and harm (Livingstone & Haddon, 2009). While these predictors appear necessary to explore online content, neither aspect of them necessarily

predispose young women towards online opportunities. It is therefore important to identify the other predictors that lead to opportunities.

Towards this, Research Questions 2A and 2B investigated how environmental supports may encourage opportunities. Across cohorts, and consistent with Hypothesis 3 and Livingstone & Helsper (2010), restrictive strategies reduced the take-up of opportunities. While active strategies are somewhat predictive within the 2010 cohort, the effect disappears in 2014. No other relationships were observed. As children mature and develop autonomy, despite evidence that mediation styles influence online behaviour (Shin & Lwin, 2017), parental mediation's influence wanes. By limiting access, restrictive mediation reduces opportunities. Other more supportive styles fail, possibly because peers and teachers hold more influence as teenagers age. Towards this, analyses in both datasets suggest that strong relationships with peers and teachers can lead towards opportunities. This suggests that subjective feelings of closeness with another individual may be more predictive than specific rules or strategies.

Analyses across datasets establish that access, skills, and support predict opportunities. While mediation has little positive impact, psychological predictors only factor into the 2014 cohort. Results from hypotheses 3 and 4 demonstrate how restrictive mediation may prevent the development of intrinsic motivation, but supportive parent relationships help young women develop autonomous motivation. This motivation then leads directly towards online opportunities and explains more of the variation in opportunities pursued than access factors.

Consistent with SDT, feelings of closeness lead young women to develop autonomous motivation that then leads them towards opportunities. In contrast, restrictive mediation, which likely reduces feelings of autonomy, reduces autonomous motivation, which then limits the opportunities explored. By demonstrating that social support can lead to self-efficacy, or competency, the 2010 cohort helps establish one key parameter of this relationship, but without

measuring motivation, analyses are unable to fully explicate the significance of motivation. The 2014 cohort is necessary to explore the full pathway.

These analyses do suffer from two key limitations. Firstly, despite the inclusion of two cohorts, since results are based on cross-sectional surveys, they cannot point to causality. Future research should use longitudinal surveys within the same group of young women or use experimental methodologies to further investigate these relationships. Secondly, while these results point to the importance of creating emotionally close relationships and intrinsic motivation, they do not identify the specific strategies that lead to this internal state. Further study using both qualitative and quantitative measures should identify strategies effective at promoting closeness and motivation.

Despite these limitations, this study contributes to our understanding of online opportunities by demonstrating the protective power of social connections and the predictive power of motivation. While previously, our understanding of opportunities was focused on environmental predictors, this demonstrates how a young woman's psychological resilience is as important as her environment in supporting outcomes from her technology use.

4 A Self-Determination Theory Approach to Computer Science Outreach

4.1 Introduction

Computer science education offers economic opportunity that Americans may be unprepared to capitalize upon. As of 2015, there were over 500,000 unfilled technology jobs in the United States and the number of available jobs continues to grow. In 2012, software-related jobs were growing at the same pace as manufacturing jobs. By 2016, this number had outpaced manufacturing jobs by 206%. According to the US Bureau of Labor Statistics, software engineering jobs are one of the top-five most projected jobs in absolute terms over the next ten years and have the top-three projected growth in percentage terms (Bureau of Labor Statistics, 2017). However, the size of the available workforce remains constant and able to fill only 10% of the demand (Kessler, 2017). This gap is troubling because technology jobs offer higher than average wages and a path to the middle class (Obama White House, 2016). Political and market forces have responded to this economic need by investing in technology training programmes, like General Assembly – a bootcamp designed to rapidly train adult engineers – or by launching government initiatives, like the "CS for All" initiative, which aims to install a computer science teacher in every public school (Rosenberg, 2018; Vogel, Santo, & Ching, 2017). However, despite these efforts, there are still unequal numbers of men and women opting into computer science study. In 1984, 37% of computer science graduates were female, today that number is 18% (Department of Education Statistics, 2014).

Troublingly, while there are no systematic research-backed solutions to the gender divide in computing, overall demand for qualified individuals grows. Despite a history of women in

technology (Ensmenger, 2010), females are currently less likely to select into engineering or technical study and disciplines. Even when equally qualified or exposed to computer science, women seldom express interest in technology careers and/or persist in the field (Accenture Research, 2017; Camp, 1997; Cheryan, Master, & Meltzoff, 2015; Hill, Corbett, & St. Rose, 2010). Amidst this disparity, new NGOs, government programmes, and corporate initiatives aim to prime the pipeline specifically for women in engineering. Organizations like Girls Who Code and HackBright Academy create opportunities for young women to study technology (Ha, 2012; Stern, Reid, & Bancroft, 2015). Other programmes, such as Google BOLD and Women Who Code, focus on creating programmes to increase women's career opportunities and professional network (Google, 2018; Percival, 2016).

However, while these PR and government campaigns target the potential economic disparity, little is known about how to effectively motivate women into computer-related paths, the impact that entering a field as an underrepresented minority might have on the young individual's psyche, and the psychological impacts that learning technical skills might have on young women's overall technology use. The discussion about women in engineering is driven by economic and moral arguments and ignores the psychological and sociological impacts that female-oriented technology education might have. Thus, this chapter investigates these gaps to determine effective solutions for priming the pipeline and to explore how new initiatives might influence young women. It has three principal goals 1) Identify which factors influence motivation for women in technology, 2) Explore how female-focused outreach initiatives impact computer science motivation, and 3) Evaluate the impacts of traditional female-focused outreach initiatives.

To address these, it relies on self-determination theory, a macro-level motivational theory whose tenets have been used to describe broad phenomena ranging from video game play to human resource management to science education (Gagné & Deci, 2005; Niemiec & Ryan, 2009; Ryan, Rigby, & Przybylski, 2006). According to SDT's basic needs theory, when the human needs for

competency, autonomy, and relatedness are satisfied, individuals become intrinsically motivated, and, by extension, empowered in that domain. Thus, to predispose individuals towards the take-up of technology education, one should encourage intrinsically-motivated study. And, to encourage such study, one must create climates that produce feelings of competence, autonomy, and relatedness. Amidst this need, women-only events appear to foster relatedness and the sense of social fit needed to create intrinsic technology uses. As such, this study uses experimental and cross-sectional methodologies to determine the connection between needs-satisfaction, intrinsic motivation, and young women's computer science study.

4.2 Literature Review

While girls and boys display similar interest in computing at young ages, as they mature, young women leave computing at higher rates than their male counterparts. In 1997, Tracy Camp coined the phrase "leaky pipeline" to describe the comparative rates at which women leave the computing track relative to men (Camp, 1997). Women "leak" from the pipeline when entering high school, at the undergraduate level, and again at both the graduate education and career level (Blickenstaff, 2005). And, even if they make it to the computing industry, women in STEM are currently 45% more likely than men to leave the industry within the year (Hewlett, Sherbin, Dieudonne, Fargnoli, & Fredman, 2014). The ratio of men to women in computing decreases over the life stage. When women start by being under-represented within undergraduate study, by the time they reach leadership roles, just 5% of these positions are held by women. This problem appears unique to computing. While the number of women enrolled in all engineering degrees increased from 1980 to the early late 1990s, the number of women in computing degrees decreased over this same period (Camp, 1997). However, currently only 40% of United States high schools offer a computer science class, which limits the places where girls might be exposed to computer

science or develop early skills in it. Young women are 13% less likely than men to use online or other digital education resources to teach themselves these skills (Google Gallup, 2016). Taken together, these statistics demonstrate the many places where women miss out on potential opportunities.

In response to these findings, over the past twenty years, advocacy groups, politicians, educators, and researchers have transitioned from trying to encourage more women to enter the pipeline towards plugging its holes. While Camp (1997) identified *when* individuals leave the pipeline, emerging research identifies *why* they leak or may never even enter it (Barker, McDowell, & Kalahar, 2009; Cheryan, Master, & Meltzoff, 2015). However, most research and policy recommendations for women in technology focus on addressing structural and not internal obstacles. Indeed, most interventions focus on expanding access to computing education or on offering role models. While these may address the sociological barriers that keep women from computing, they don't necessarily address the psychological experience of being a minority in computing. By necessity, this psychological experience will emerge as the sociological barriers are removed. However, a psychological focus is necessary in order to develop interventions that change and sustain behaviour (Ryan & Deci, 2004). Additionally, despite an explosion of outreach programmes, there exist few evaluations for existing programmes. This contributes to a static gender ratio over the past 20 years, despite two decades of research in this area (Craig, 2016).

In what follows, this chapter explores the psychological experience of being a minority in computer science. It begins by outlining the importance of belonging, particularly for minorities in educational settings, then connects belonging to motivation through the lens of self-determination theory, and finally, reviews typical interventions and their supposed impact.

4.2.1 The Importance of Belonging

As a minority in computing, women face a lesser sense of social fit, at best, and direct hostility and exclusion, at worst. When an individual identifies as a minority within an educational setting, she may question her belonging and therefore choose not to pursue certain educational realms or underperform within them. This phenomenon has been observed in practice when underrepresented races enter higher education (Fries-Britt & Turner, 2001), individuals of low socioeconomic status enter private schools (Kramer, 2008) or when women enter STEM fields (Beasley & Fischer, 2012). The impacts that minority status may have on an individual's psyche are exacerbated when the individual is fighting against or within stereotypes about him or herself. Perceptions of minority status may subtly dissuade minorities from opting into or persisting in the minority setting (Fisher, Margolis, & Miller, 1997; Powell, Dainty, & Bagilhole, 2012). However, fostering a sense of belonging can improve motivation and performance for stigmatized minorities.

The need for belonging and social connection has historically been linked to broader human motivation. It first appeared in Freudian psychology and was then the bridge between the basic needs like food and shelter and more abstract needs like self-fulfilment and esteem in Maslow's Hierarchy of Needs (Maslow & Green, 1943). In a review of the links between varied theories of belongingness and its outcomes, Baumeister & Leary (1995) note the feeling's wide array of correlates, including physical well-being, emotional adjustments, how individuals process information, and academic performance. They argue that the need to belong is the fundamental driver of human motivator. This theory contrasts with needs-based motivational theories, such as Maslow's. Needs-based theories argue that humans have a set of basic needs that, when met, motivate their pursuit of a goal. Of note, across needs-based models of learner motivation, the need for social connection acts as a fundamental motivator (e.g. Eccles et al., 1983; Niemiec & Ryan, 2009; Wentzel, 1999). Therefore, given the connection between social connection and motivational

outcomes, it becomes crucial to explore how social connection may influence minorities' persistence in computer science and whether, by influencing social connection, we may improve motivation towards computer science.

4.2.1.a Belonging and Its Correlates

Belonging uncertainty emerges when students doubt their sense of social fit or the likelihood of having friends in a domain. When students do not have connections or fear being alone, academic performance decreases (Baumeister, Twenge, & Nuss, 2002). The importance of belonging is heightened for minority communities. In one series of experiments, when black students were lead to believe they would have few friends in a class, they underperformed relative to their white peers who were lead to believe the same (Walton & Cohen, 2007). When the same experiment was given but instead focused on skills, a stereotype shown to influence women in STEM (Shapiro & Williams, 2012), women showed a lower sense of social fit (Walton & Cohen, 2007). Sensing social fit produces a state of belonging which increases motivation, persistence, and achievement in settings where individuals might feel unwelcome or underrepresented.

While student belonging appears linked with subsequent motivation, it develops from developmental, social, and interpersonal clues.

4.2.1.b The Development of Belonging

A student's sense of belonging emerges from signs within her socio-cultural environment. Parents, friends, teachers, and the media set expectations for what girls can achieve. Within school, students may pick up clues from teachers, comments from peers, presence of friends, extra-curricular activities, and other sources to construct a sense of belonging (Faircloth & Hamm, 2005). Yet, given the persistent masculine stereotypes of computer science and limited access to computer science instruction before college, there exist few places for girls to create a sense of belonging within computer science or technical communities (Beyer, 2014).

The lack of female role models in computer science has been offered as an explanation of the gender gap in computing since the 1980s. Early research recognized the role that gendered stereotypes and expectations from teachers and peers played in decreasing women's interest. Within American culture, engineering and computing are stereotyped as male-dominated and jobs are perceived to be largely anti-social, require innate ability, and focus on minute technical details – traits that typically alienate women (Lewis, Anderson, & Yasuhara, 2016). However, breaking down stereotypes has the power to broaden participation, because these views are largely fictitious yet still decrease women's interest in the industry (Cheryan et al., 2015). Indeed, by the time they enter university, students' stereotypes of computer science are largely incompatible with female gender roles and interests (Cheryan, Drury, & Vichayapai, 2013; Cheryan, Plaut, Handron, & Hudson, 2013). These cultural expectations around computing not only influence young women, but also their role models, parents, and teachers.

While little research documents how parents and teachers' expectations influence girls' study of computing, existing work on how social support systems gender career paths and the way that girls develop expectations of math and science suggests that adult figures can strongly impact girls' motivation. Roles become gendered across the lifespan. Parents gendered attitudes towards computers impact their children's gender perceptions, and, troublingly, the lower the individual's socio-economic status, the stronger the gender stereotypes and lower the computer confidence (Shashaani, 1994; Shashaani & Khalili, 2001). Children develop early expectations of their potential and competencies from their parents. Across studies, parents' lowered expectations of girls' scientific ability or of traditional gender roles often trickle down to their children. In one study of Iowa grade school students, girls underperformed in and attached lesser importance to science than they did to other subjects and parents both expected higher results from boys in science and saw it as more important for boys to study (Andre, Whigham, Hendrickson, & Chambers, 1999). This early

quantitative work demonstrated how parent views influence their children's performance and interests from a very young age. Meta-analyses confirm these findings. Across studies, there exists a significant and positive correlation between parents' gender cognitions and children's gendered attitudes towards themselves and others (Tenenbaum & Leaper, 2002). These attitudes and subsequent performance may later be influenced by teachers. In one study of female teachers, the more anxious the teacher was about math, the more likely her female students were to underperform (Beilock, Gunderson, Ramirez, & Levine, 2010). This longitudinal study is supported by a recent review which found that both parents *and* teachers' expectations and attitudes influenced girls' math attitudes. Particularly because math and science are considered related to computer science, it appears likely that young girls might develop early expectations that they do not belong in computing. Indeed, while 46% of young boys are told by a parent they might be good at computer science, only 27% of girls are told the same (Google Gallup, 2016). Therefore, as girls develop, much of their social environment may be offering subtle clues that they do not belong in computing.

Just as social environments set belonging cues, girls pick up cues about STEM from their physical environments. The ambient belonging, or "feeling of fit in the environment and similarity to the people imagined to occupy it," is a necessary predictor of young women's motivation and decision to study or pursue computing (Cheryan et al., 2009, p. 1049). In a series of experiments, Cheryan and her colleagues demonstrated how by changing the design of classrooms from being filled with objects associated with "computer science geeks" to neutral objects, girls' interest in computer science became equal to their male peers. Moreover, even when all-female teams were in male-gendered classrooms, their actions were perceived to be as masculine as when the same teams were in un-gendered classrooms and girls evidenced reduced interest (Cheryan et al., 2009). In a related study, Ramsey, Betz, & Sekaquaptewa (2013) identified environments where women receive messages about women in STEM, have peer role models, and carried objects relevant to their field

of study. They then exposed women to these welcoming environments and this changed women's stereotypes of the industry and increased their identification with computer science (Ramsey et al., 2013). Together, these studies demonstrate the extreme power that physical space and belonging can have in predicting motivation and the extent to which masculine stereotypes can undermine this belonging.

Not only do settings and situations hold power, but so too do stereotypes. When an individual is knowledgeable that his or her behaviour may be viewed in terms of stereotypes of her gender, race or other identifier, she is vulnerable to *stereotype threat*. The phenomenon was first identified in 1995 when Steele & Aronson found that black students performed worse than their white counterparts on standardized tests when their race was emphasized before test-taking than when they simply took the test. In this situation, "the existence of a negative stereotype about a group to which one belongs…means that in situations where the stereotype is applicable, one is at risk of confirming it as a self-characterization, both to one's self and to others who know the stereotype" (p. 808). This risk, and its tendency to nudge students towards opting out of and underperforming in potentially stereotype-confirming settings, has since been observed with students from low socioeconomic backgrounds (Croizet & Claire, 1998), women in math (Spencer, Steele, & Quinn, 1999), and with women using computers (Koch, Müller, & Sieverding, 2008). A series of experiments have pointed at many variables that may mediate the stereotype and subsequent performance under it. Hypothesized factors include anxiety (Bosson, Haymovitz, & Pinel, 2004; Osborne, 2001), working memory (Schmader & Johns, 2003), and arousal (Ben-Zeev, Fein, & Inzlicht, 2005; O'Brien & Crandall, 2003).

The stereotypes and beliefs that students hold influence their career choices. A sense of computer self-efficacy is highly correlated with later decisions to pursue computer science. Early computing research found large differences between boys' and girls' self-efficacy but that, when self-

efficacy was held constant, they were equally likely to be interested in computing (Miura, 1987). Yet, while boys are much more likely to report and believe in their ability, in practice, boys and girls often have the same ability (Hargittai & Shafer, 2006). While boys have higher perceived self-efficacy, they are also much more likely to report support and encouragement from parents and friends (Busch, 1995). While a more recent study found that boys maintain higher self-efficacy but few sources of social support (Rosson, Carroll, & Sinha, 2011), there exists a continued and non-decreasing difference between boys' and girls' senses of self-efficacy. In fact, the stronger the identification with a gender role, the stronger the self-efficacy belief (Huffman, Whetten, & Huffman, 2013). This awareness and young women's beliefs that boys are more able than they are continues to keep girls from computing, but self-efficacy is necessary for motivation. Additionally, self-efficacy can be spread through classrooms. Peers and friends may give clues to a learner that she is capable of achieving (Schunk, 1991). This effect is stronger for same gender peers (Schunk & Hanson, 1985). Peers signal that achievement is possible and when one expects she is capable of success, her self-efficacy grows (Schunk & Pajares, 2002). This suggests that young women need to be surrounded by others or feel that they belong to develop self-efficacy. Yet, the gender divide in computing limits young women's ability to see what they are trying to be. It is therefore likely that environments limit young women's self-efficacy in computing.

Adults, schools, stereotypes, and masculine role models all undermine girls' sense of social fit within technical domains. A critical problem thus emerges. If girls struggle to create a sense of belonging, but feelings of fit are inextricably linked to motivation, how can girls enter the technical fields?

4.2.1.c Creating a Sense of Belonging

Acknowledging that stereotypes influence minorities' sense of psychological safety and result in reduced motivation and poor performance, interventions to mitigate stereotypes' impacts fall

broadly into two categories: those that target belief in the stereotype and those that target individual's general psychology. By teaching individuals directly about stereotype threat (Johns, Schmader, & Martens, 2005) or about malleable intelligence (Aronson, Fried, & Good, 2002), students show lesser effects of stereotype threat. Meanwhile, by asking students to reflect on their sense of adequacy and self-integrity before taking a test, researchers both improved outcomes and lessened the stereotype's influence (Cohen, Garcia, Apfel, & Master, 2006). In a similar experiment, by saying a self-affirming statement before a math test, women were unaffected by stereotype threat and performed well (Martens, Johns, Greenberg, & Schimel, 2006). In both of these interventions, students were given coping mechanisms and tools that they could use in the future. This suggests that psychological interventions may be as powerful as direct educational solutions. Focusing on psychological interventions is valuable because even after being taught coping strategies, students will continue to be in situations that force them to confront stereotypes about their inclusion (Good et al., 2003). As such, by equipping students with the psychological resilience to resist stereotype threat and believe in their own competence, researchers and practitioners can prepare them for continued success.

In the successful psychological interventions, students re-affirmed their self-integrity to persist through the stereotyped obstacle. The techniques used were designed to limit the stress felt when encountering troubling situations and to help students develop self-resilience. A similar intervention both offered psychological training and a sense of inclusion by using college-aged mentors to teach the students different self-affirming messages. In all treatments where students were coached on relevant strategies, they outperformed their peers in a control treatment who were lectured on anti-drug strategies (Good et al., 2003). While the authors attribute the psychological coping mechanisms and not the mentorship with the change, because the dependent variable was related to the psychological coping mechanism, it is impossible to measure the mediating influence

of the supportive peer and mentorship environment. Additionally, the study was focused on stereotypes unrelated to gender.

Indeed, mentors and female role models are often used to dispel stereotypes and increase senses of belonging. To improve the persistence of women in undergraduate and graduate computing, several universities successfully adopted peer mentorship programmes (Newhall et al., 2014; Powell, 2008). At the University of Massachusetts Amherst, a peer mentoring programme improved women's belonging and confidence, which then predicted persistence (Dennehy & Dasgupta, 2017). Mentors can serve as role models, dispel myths about computer science, and cultivate a sense of belonging. Persistence in other STEM disciplines has been linked both to role models and to a sense of belonging in that discipline (Rosenthal, Levy, London, Lobel, & Bazile, 2013). Goal-congruity theory argues that women may be less interested in STEM careers because they do not believe it is communally-oriented (Diekman, Weisgram, & Belanger, 2015). Again, mentors and exposure to computer science from a young age may help debunk this myth. However, given the already limited number of women in computing, sources of mentorship are few and far between. Acknowledging that mentorship and peer support may be sufficient to create belonging but are not readily available for most youth, Dawson, Bernstein, & Bekki (2015) outline an online resilience training programme that can equip women with the persistence skills and attitudes often given through in-person mentorship.

Mentors and their implicit role modelling may help foster the belonging necessary for motivation and persistence. Yet, while belonging is necessary for motivation, only motivation can sustain students through the difficult obstacles they may encounter while pursuing technology.

4.2.2 Self-Determination Theory

Self-determination theory, a macro theory of human motivation, unites the need for belonging and its motivational outcomes into a unified framework. It argues that intrinsic motivation is necessary to sustain interest and positive outcomes. Emerging research posits that intrinsic motivation for academics increases persistence and performance (Vansteenkiste et al., 2006; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). One review of self-determination theory within education found that intrinsic motivation for learning may also lead to affective, creative, and challenge-oriented outcomes (Guay, Ratelle, & Chanal, 2008). Thus, intrinsic motivation may act a buffer by allowing teenagers to overcome difficult situations and to take advantage of the opportunities technology offers. This finding is particularly important as it suggests that to reduce pipeline leaks, rather than focusing efforts on increasing the number of women entering technology, one should identify strategies to teach and instil resilience in them.

Levels of persistence and performance are tied to one's motivation when performing a task. Just as they shape gendered beliefs, parents, teachers, and social circumstances can shape motivation. SDT posits that personal and contextual factors facilitate this psychological well-being (Deci & Ryan, 2000). According to SDT, all individuals desire to feel *competent*, *autonomous*, and *related to others* (Ryan, 1995). When these basic needs are satisfied, individuals pursue constructive engagement across media (Deci & Ryan, 2000). When children and adolescents feel their social settings display *warmth*, they develop the intrinsic motivation necessary to seize opportunities available to them (Roth, Assor, Niemiec, Deci, & Ryan, 2009). Similarly, when education systems promote learner autonomy and student engagement, students increase their self-regulation (Reeve & Lee, 2014). Thus, social support and motivating educational systems have the potential to produce resilient children capable of persisting in technology settings.

Needs satisfaction leads to intrinsic motivation, which then influences persistence. Much research establishes how needs satisfaction supports intrinsic motivation for and performance within learning settings, across academic subjects. Intrinsic motivation prepares students for optimal engagement in learning contexts. Two foundational studies establish the theoretical connection between needs satisfaction and persistence within educational domains. When teachers and learning environments support students' needs for competency, autonomy, and relatedness, students can self-regulate their learning and be intrinsically motivated to develop knowledge (Niemiec & Ryan, 2009). When students create internal goals, they are more likely to persist in and perform well within educational settings (Vansteenkiste et al., 2006). While neither study focused exclusively on women, they establish a theoretical relationship between needs satisfaction and motivation within academic domains and this theoretical relationship has since been demonstrated through experimental studies. Longitudinal analyses demonstrated that intrinsic motivation was the only form of motivation that could consistently predict academic achievement (Taylor et al., 2014). Looking more specifically at needs satisfaction, for both genders, when science teachers supported students' learning autonomy, the students perceived greater autonomy and competency, which then increased their interest in studying and working within scientific domains (Lavigne, Vallerand, & Miquelon, 2007). Despite deep documentation of the role that autonomy support plays in supporting intrinsic motivation (e. g. Jang, Reeve, & Deci, 2010) and that perceived competency can support motivation (Ntoumanis, 2001), relatedness remains largely unexplored in SDT studies of motivation. However, Trenshaw, Revelo, Earl, & Herman (2016) conducted interviews with engineering students and discovered that relatedness was a more salient predictor of intrinsic motivation and persistence in engineering than was autonomy support. As such, it becomes necessary to explore how relatedness may support motivation.

Drawing on self-determination theory's links between relatedness and resulting motivation, Beachboard, Beachboard, Li, & Adkison (2011) found that cohort programmes can create supportive environments that produce feelings of relatedness in teenagers and that this relatedness supported learning outcomes. They argue that institutions must work to design learning environments that are conducive to relatedness-development. Meanwhile, Walton & Cohen (2007) coined the term *belonging uncertainty* to demonstrate how, by increasing a sense of belonging, they could improve intellectual achievement and motivation. When students hold the hypothesis that they might not belong in a domain, clues towards this outcome lead to higher dropout rates and underachievement. Most notably, as an abstract psychological state, it can be triggered by a wider variety of settings than stereotype threat, which typically emerges in evaluative settings. The greater the belonging students feel, the greater their motivation to succeed and persist in the before-questioned path (Walton, Cohen, Cwir, & Spencer, 2012). Social belonging acts as a psychological barrier that, when supported, reduced racial minorities' achievement and health gaps and allowed them to frame adversity as a common experience, not a reflection on their worthiness (Walton & Cohen, 2011). Therefore, it becomes critical to focus on sources of belonging uncertainty and resolving this state to equip gender-minority students with the resilience to persist within the pipeline.

4.2.3 Interventions

Belonging uncertainty may emerge because women do not see others like them within their communities and do not have representative role models to look up to. Without a role model, individuals may feel unwelcome within a field or community and thus feelings of belonging decrease. Indeed, companies (e.g. Microsoft's Digigirlz), non-profits (e.g. DotDiva), and Universities (e.g. Harvard's WeCode) increasingly create programmes to expose young women to positive role models

in the hopes that such exposure might predict interest and persistence (Charlesworth, 2011; Harvard WeCode, 2018; Powell, 2008; Rowland, 2010). These outreach initiatives focus on short exposure to successful and relatable women in technology. Inherent within these models are two assumptions 1) that limited access to role models limits women's interests in technology and 2) that exposure to these missing role models can improve interest in technology. However, despite ample theory and anecdotal evidence on the importance of such interventions, there exists little evidence on their efficacy. In what follows, I review popular programmes, their design, and their goals to situate this study's results within this marketplace. These results are summarized in Appendix A, which includes a list of programmes, types, and design.

4.2.3.a Corporate Interventions

Several corporate actors, including Google, Microsoft, and Two Sigma, run programmes designed to expose girls to computer science. Google's "Made with Code" programme aims to bridge creativity with coding to interest girls in computer science. It hosted a celebratory event where celebrity Mindy Kaling worked with girls to "code" digital bracelets. The programme now offers digital mentoring where inspiring women in technology share their stories online and Made with Code has a variety of gendered online resources to teach girls coding principles, such as an Emoji mixer, where girls can create their own emojis[4], and an Accessorizer where girls can digitally edit their selfies[5]. Microsoft created a DigiGirlz programme to expose girls to coding initiatives and bring Microsoft employees into their communities. During DigiGirlz Workshops, women working in technology speak to young women about their role, the industry, and why they like computer science. During DigiGirlz Day, Microsoft invites any high school age girl to learn about roles in computer science, interesting coding projects, and career planning. These corporate programmes

[4] Digital emoticons, smileys, or small images used in digital communication
[5] A photo one has taken of him or herself

range in length from day-long to month-long initiatives and sometimes offer branded online programmes.

4.2.3.b Educational Interventions

To expand their reach, several universities host outreach events in their local communities. In the majority of university-led programmes, student clubs and/or administrators invite the local community to the university to encourage young women to pursue technology. For example, at schools such as the University of North Carolina, the University of Pennsylvania, New Mexico State University, and others, groups of students and professors invite young women from the surrounding area to the school to learn about computer science, university life, and the benefits of a computer career. A similar structure exists at schools such as the University of Rochester and Purdue University. However, instead of inviting students to the University, students and faculty go directly into the community to speak with young women about computer science and encourage them to seek out classes for it. In both of these cases, it is assumed that access to non-stereotyped role models and the broader understanding of computer science that they present will change attitudes about whether or not girls may fit in the field, thereby changing their intention to study it.

In addition to speaking opportunities, some Universities host summer programmes for young women. Schools maximise the campus utilization rate by having undergraduates, sometimes with professors' help, teach local women computer science. These programmes aim to prime the pipeline for women in computing and serve as a marketing tool for the University. Again, they hope that young students will recognize that higher education is an attainable goal and that women in technology are just like them.

More recently, schools have broadened the range of activities supported. Harvard hosts an annual conference for college women in Computer Science that aims to expand the "community" of technical University women. For its students, the University of Michigan created a Girls Encoded

initiative where students and faculty could propose their own ideas to broaden participation in computer science. Funded programmes included a pre-orientation week for accepted women and invited talks by senior technical women to inspire the current undergraduates.

4.2.3.c Non-Profit Interventions

In response to the gender gap, several non-profits and NGOs work to expand access to computer science. Several US-based national organizations bridge education with industry exposure. Black Girls Code offers short workshops and longer coding programmes where students are taught a short technical lesson and mentored by women of colour to complete the tasks. Girls Who Code, offers weekly "Clubs" where girls in middle and high school learn skills and create an impact-oriented project. These clubs are often led by female employees of technology companies or hosted at schools. One must identify as a female to participate. Girls Who Code also offers a Summer Immersion Program where 10th and 11th grade students spend the summer working on coding projects, visiting technology companies, meeting professional engineers, and learning about the technology industry.

In contrast to Black Girls Code and Girls Who Code, which combine programming on coding and exposure to the industry, Code.Org focuses on expanding access through its annual "Hour of Code," where they release a simple non-gender-stereotyped computing activity and encourage schools across the US to spend one hour of time programming. Such programming assumes that 1 hour of non-stereotyped computing activity can change attitudes and entice young women to pursue computing, because it becomes more readily available.

Across the three funding categories, programmes vary in terms of their length and what they offer. Some focus on teaching computer science, others on mentoring, and others on changing industry perceptions. A full taxonomy is developed and offered in Appendix A.

As a minority in computing, women must contend with self-doubt, social pressures, and environments that may discourage them from pursuing the field. At the same time, if they can develop intrinsic motivation for their study, they may develop the resilience necessary to persevere amidst the stereotypes and to make professional and personal choices in line with their goals. Existing interventions do not focus on this psychological transformation and also do not subject themselves to robust or peer-reviewed evaluation. Therefore, it is critical to determine whether by combatting stereotypes, one can increase participants' sense of belonging and to determine what predicts intrinsic motivation for computing.

4.3 Present Study

The present study looks at the relationship between needs satisfaction and motivation for women in computer science to explore the impact of the learning environment onto subsequent motivation. Additionally, across interventions and funders, women are exposed to mentors, role models, and peer groups, all in an effort to improve their feelings of relatedness. The study also explores whether these supposed methods positively impact belonging or motivation by investigating the efficacy of Bit by Bit, one such intervention.

4.4 Methods

4.4.1 Research Overview

Founded in 2015 by a New York City school and myself, based on the successes of the Grace Hopper Conference and inspired by Deci and Ryan's (2000) research on social support and relatedness, Bit by Bit is a conference for high school women in the New York City area that aims to inspire and prepare women for a technical career. It exposes them to career paths and inspirational women in the field and therefore combats stereotypes and attempts to remedy belonging

uncertainty. Designed for 400 students from a variety of technical and educational backgrounds, this day-long event intends to foster social support for underrepresented genders in STEM. By focusing on the sense of belonging, it creates a setting where intrinsic motivation for studying technology may arise. While the original conference design and interventions were designed by this researcher based on a review of existing interventions and theories, the event is entirely coordinated by seven high school girls, who manage logistics and administration of the conference.[6] The young women in charge select the speakers and program, match students with mentors, and act as the voice for the event. By selecting the speakers, they can choose individuals with maximum resonance for attendees, and by managing interaction with attendees, they can act as peers and create belonging for the attendees.

The conference design brings together three forms of social support intended to foster feelings of competency and relatedness: 1) an audience of young adolescent women to whom attendees can relate, 2) lectures and panels from senior women in technology and on topics that attendees select, 3) mentorship from junior technologists who share their stories and encourage individual attendees that they belong in technology. Together, these interventions aim to improve students' sense of belonging in computer science and increase their interest in the field. Unlike educational interventions, which focus on remedying skills within or access to a field, the event targets the psychological theories that keep women from computing. While some researchers argue that a one-day event will not lead to large behavioural changes, one-day events can make a psychological difference (Morin & Latham, 2000; Smokowski & Kopasz, 2005). Furthermore, regardless of their efficacy, as discussed in the literature review, this is one of the most common

[6] I did not design the conference knowing I was going to research it. I was offered the opportunity to design the event early in my DPhil experience and later decided to include it in my final thesis. An ethics review approved of my involvement and, knowing that I would be collecting data in the 2nd year of the event, I limited my involvement during year 2 so that the respondents were not aware of me. While I am compensated for my time by Bit by Bit, I received no money for my research or towards my education.

educational interventions and commands large corporate spending. Therefore, its impacts need to be evaluated. Therefore, this study queries whether, by offering a sense of social fit, the conference can improve student motivation. Additionally, Bit by Bit attendees were surveyed on basic needs satisfaction and intrinsic motivation to explore how self-determination theory's principles interact with computer science.

4.4.2 Sampling and Recruitment Strategy

As Bit by Bit aims to support a diverse student population, participants were recruited through direct and indirect means. From December through April of 2017, the conference team regularly posted on social media to encourage attendance. The high school women went to 6 schools and presented to each about the event. They hosted a booth at the NYC Computer Science Opportunity Fair, which attracts over 2,000 students, to reach out to students across the city. They separately met with the leaders of over 5 different computer science outreach and professional development organizations. In addition to outreach from the student leaders, the New York City Department of Education sent information about the event to teachers in the New York City Public Schools. Celebrities including Karlie Kloss and Alexis Maybank tweeted about the event to their network. While it is difficult to quantify the direct impact of this outreach, the students used these methods both to raise awareness through influencer networks and to directly convert awareness into registration.

4.4.3 Study Format

This study used a delayed treatment quasi-experiment to explore the connection between needs satisfaction and intrinsic motivation for computer study and to explore whether common interventions for women in technology impact feelings of belonging and motivation. By measuring

needs satisfaction between the three treatment conditions, the methodology assessed whether targeted interventions of lectures and mentoring influence young women's basic psychological needs. Additionally, by collecting data on young women's experiences in computer science, the dataset also allows for exploration of the relevance of key SDT theories for this demographic.

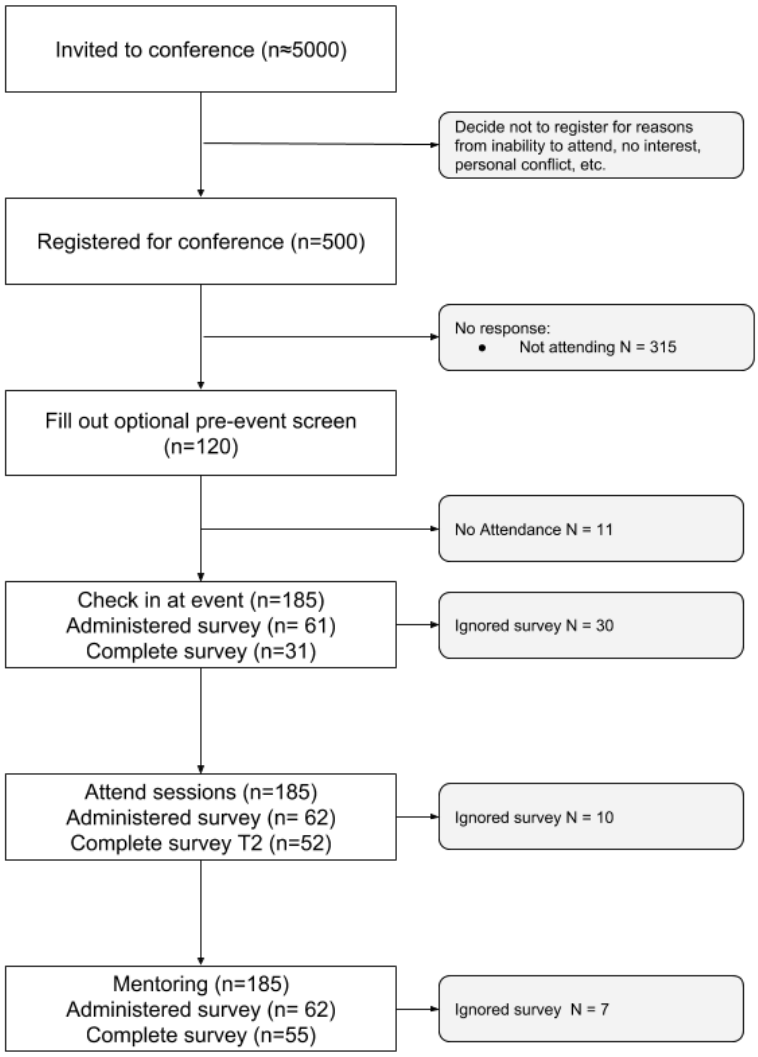
4.4.4 Eligibility

Any student enrolled in high school who identified as a woman was deemed eligible for the study. As the hypotheses were directly concerned with the feeling of being an underrepresented gender in computing, it was deemed important to limit participation in the conference and, by extension, the research study to those who identified as a woman. As such, conference organizers could guarantee a safe space, protect attendees against stereotype threat, and isolate a key independent variable. Moreover, organizers aimed to emphasize the importance of all female communities in supporting identification with and performance of women in computing. 500 students registered for the conference and 191 attended.

One week before the event, all registrants were emailed a survey on their technical background and interest. This window was selected as initial responses so close to the event signalled intention to attend the event. Subsequent data was collected on the day of the event within a New York City school, which hosted the conference. However, the initial surveys were not analysed for this study due to the low response rate (See Figure 2).

Figure 2

Consort Flow Diagram



4.4.5 Experimental Procedure

Participants were randomly assigned to one of three conditions. Participants were surveyed before and after each intervention to determine the relative influence of each intervention technique. Using block randomization, students were allocated to control groups based on arrival times (the first student going into group 1, the second into group 2, the third into group 3, the fourth into group 1, etc.). Block randomization was selected to seamlessly integrate group allocation into the

conference structure. This strategy allowed students to focus on the event, unaware of the experiment, and therefore to focus on the interventions. While block randomization may increase the likelihood that the groups' covariates are not comparable, by comparing these in analyses, one can control for this risk (Pocock & Simon, 1975). All groups were given the same survey. Group 1 was given the survey upon checking in, Group 2 was given the survey after the morning lectures and panels and right before mentoring, while Group 3 was given the survey directly after mentoring. This methodology avoided ethical concerns over not administering potentially beneficial conference events to all participants.

4.4.5.a Registration

In the first condition, students were given a survey immediately upon checking-in and before the day's events started. This established a baseline for belonging and motivation before the event. While the girls taking the survey were possibly excited for the event and surrounded by girls who looked like them, the survey was given before any interaction or formal intervention began.

4.4.5.b Motivational Lectures

In the second treatment condition, students were surveyed after attending three panels focused on different paths within computer science. The first panel featured a fireside chat between Ursula Burns, the first black female CEO of a Fortune 500 company, and Ruthe Farmer, responsible for former President Barack Obama's CS4All Initiative. Farmer interviewed Burns about her experiences as a racial and gender minority in computing and Burns' speech focused on the rewarding joy she found in computing and the importance of all girls having the opportunity to "solve the world's toughest problems." This keynote was followed by a panel of female engineers in varying technical roles at companies of different sizes and scope – from makeup start-up BirchBox to financial giant Goldman Sachs. The engineers showcased different paths within technology and this panel was designed to showcase to the attendees that there was an engineering role that they

would fit into and that they could follow their own path towards computing. Finally, girls were able to select into a panel on computer science and one of its core intersections: Entrepreneurship, Arts, Community Service, and College. These panels were selected based on research that girls are particularly drawn towards computing when it intersects with altruism, solving other business needs, the arts, or role models (BarNir, Watson, & Hutchins, 2011; Dennehy & Dasgupta, 2017; Jessup, Sumner, & Barker, 2005; Kvande & Rasmussen, 1989). Additionally, by offering students' choices, the attendees could exercise autonomy over their computing education and were given an opportunity to see themselves in the role of an engineer.

Following these three panels, students were sent to a room where they would begin mentoring. Before meeting their mentors, students were handed the survey and asked to complete it. This tested baseline excitement and sense of belonging after lectures aimed at improving belonging and interest in computing.

4.4.5.c Mentoring

In the third treatment condition, students were randomly assigned in groups of 8-10 students to two mentors who held different posts within the technology industry and came from 30 different companies. Mentors were divided into pairs based on their age, position, background, and interests. The mentor matching process deliberately matched diverse pairs to showcase the options within the industry. This aimed to increase the likelihood that the students had a mentor to whom they could relate (Ensher & Murphy, 1997). Mentors were asked to prepare thoughts on being a woman in a male-dominated field, their journey through computer science, and advice for their teenage self. They were also asked to answer students' questions about the industry and their field. As such, students could feel their needs and concerns addressed and gain the support of a smaller group pursuing the field. Following 45 minutes with their mentors, students were administered the survey.

The day continued after mentoring with an additional lecture and an "opportunities fair," which resembled a careers fair where students could interact with non-profits that teach coding and companies who offer high school training programmes. However, as these opportunities mirrored the two principal treatment avenues (learning and interaction), surveys were not administered after these activities.

4.4.6 Hypotheses

Findings from self-determination theory and its sub-theory on basic needs satisfaction suggest that both relatedness and, particularly a sense of relatedness within scientific communities, can influence motivation and persistence within technical fields. This study extended self-determination theory and Walton (2007)'s findings on minority groups' motivation to female technology communities to determine the influence of the belonging offered by Bit by Bit onto overall motivation and interest in computer science.

Based on the importance of belonging and social support within technology communities, analyses both extended the principles of needs satisfaction towards this academic domain and explored whether by offering interventions, one could improve young women's sense of social fit and intrinsic motivation:

> *Hypothesis 1:* Compared to baseline upon arrival, targeted interventions of lectures and mentoring can improve participants sense of belonging.
>
> *Hypothesis 2:* Sense of belonging predicts intrinsic motivation towards and interest in technology.
>
> *Hypothesis 3:* It is more important to have a sense of social connection and have general non-domain relatedness satisfied for minority communities in technology.

As discussed above, there exist large gender differences in young women and men's senses of computing self-efficacy. Women cannot be what they cannot see, but seeing peers succeed in academics contributes to a feeling of self-efficacy in that domain (Schunk & Hanson, 1985). Self-

efficacy in turn leads to motivation (Bandura & Schunk, 1981; Zimmerman et al., 1992). Therefore, this study hypothesizes that:

Hypothesis 4: Sense of belonging improves motivation by increasing the student's self-efficacy.

4.4.7 Survey Design

One week before the event, students were emailed a survey and asked to fill it out with regards to their experiences in computer science and, if not applicable, in other STEM settings. On the day of the event, students were given a paper copy of the same survey. All questions were on a uniform 7-point Likert scale, with relevant anchors, to simplify questioning. Subscales are explained below and the survey is provided in Appendix B.

4.4.7.a Basic Needs

Autonomy. To query needs satisfaction within the learning domain, students were assessed on their levels of perceived competency, autonomy, and relatedness. To assess the level of autonomy students felt they had over their technical education, students were given a shorter 6-item index of the Perceived Autonomy for Learning Scale (Black & Deci, 2000). Items included "I feel understood by my instructor" and "My instructor listens to how I would like to do things." Items were averaged to create a composite score ($\alpha = .879$).

Competency. To assess whether students felt competent about learning technical material, participants were given the 4-item Perceived Competency for Learning scale (Williams & Deci, 1996) with items such as "I feel confident in my ability to learn the material" and "I am able to achieve my goals in these classes." Items were averaged to create a composite score ($\alpha = .931$).

Relatedness. Relatedness satisfaction was assessed using 8 items from the Basic Psychological Needs Satisfaction and Frustration Scale (Chen et al., 2015). Relatedness items included "I feel close and connected with other people who are important to me" and "I experience a warm feeling with

the people I spend time with." Items were averaged to create a composite item (α= .773). Students also responded to items specifically about their relatedness to others in computer science. These items included "I feel close and connected with other people in technology who are important to me" and "I experience a warm feeling with the people I spend time with when learning about technology." These items were averaged to create a Relatedness to Others in Computer Science measure (α = .853). Two items were initially included to survey relatedness because the traditional relatedness measure focuses on general feelings of relatedness, whereas the autonomy and competency measures focus on domain-specific relatedness. The inclusion of the domain-specific relatedness measure better aligns the instrument with other measures in this study and with theories about belonging in computer science.

Sense of Social Fit. Students' sense of social fit in computer science was adapted from Walton & Cohen (2007). It was assessed with 18 items including "I feel like an outsider in technology-related settings and "Compared to most other students, I fit in computer science" (α = .780).

4.4.7.b Motivational Factors

Motivation. Motivation was assessed along one intrinsic dimension and two extrinsic domains: grades and careers. Intrinsic, grade, and career motivations were each assessed with 5-item subscales. Using items adapted from the Science Motivation Questionnaire (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011), items included: "Learning computer science makes my life more meaningful" and "My career will involve computer science or technology." Items were averaged to create composite items for intrinsic motivation (α = .838), career motivation (α = .860), and grade motivation (α = .822).

Self-Efficacy. Five items adapted from Glynn et al. (2011) assessed students' self-efficacy using items such as "I believe I can master technology knowledge & skills" and "I am sure I can

understand computer science." Self-efficacy items were averaged to create a composite score (α = .857).

Single items assessed students' intentions for further study, both in school, in college, and as a major. Students were also queried on demographic information including grade in school, computer science background, race, and school type. These were used to control for any observed motivational effects and frequencies are offered in table 4.1.

Table 4.1

Frequency Tables and Descriptive Statistics for Variables of Interest

School Type	Frequency	Unweighted Percent
Public	68	49.3
Private	62	44.9
Missing	8	5.8
Total	138	100

Race	Frequency	Unweighted Percent
White	98	71.0
Non-White	28	20.3
Missing	12	8.7
Total	138	100

Construct	N	Min	Max	Mean	SD
Basic Needs					
Autonomy Support	134	2.83	7	5.503	1.111
Perceived Competency	134	1	7	5.802	1.129
Relatedness to others	136	2	7	5.950	1.010
Relatedness to others in Science	137	2	7	5.2813	1.165
Sense of Social Fit	133	2.89	7	4.529	.659
Motivational Factors					
Self-Efficacy	133	2.4	7	5.673	1.002
Intrinsic Motivation	134	1.8	7	5.807	1.029
Career Motives	135	3.6	7	5.954	.923
Grade Motives	130	3	7	5.862	.964

4.4.8 Analytical Strategy

Study 2 had two goals: Firstly, to explore whether by manipulating sense of belonging, one can improve intrinsic motivation (Hypothesis 1) and secondly, to explore the connection between needs satisfaction and intrinsic motivation within technical domains (Hypotheses 2, 3, 4).

To test Hypothesis 1, a series of one-way analysis of variances (ANOVAs) looked at the differences between subjects on the day of the event to explore whether the interventions influenced sense of social fit beyond the initial boost from attending.

To test Hypotheses 2 and 3, regression models explored how principles of self-determination theory interact with computer science. An exploratory demographic regression model queried the relationship between student experience, background, and the dependent and independent variables. Following these initial tests, regression analyses explored how perceived autonomy support, competency, and relatedness influenced motivation for and interest in studying computer science. This model evaluated the connection between needs satisfaction and intrinsic motivation, drawing on Katz, Kaplan, & Gueta (2009). These tests also controlled for demographic variability, consistent with Mesch's (2009) approach to studying cyberbullying. Similar regression models explored the direct effects of relatedness constructs on motivation.

Finally, to test Hypothesis 4, the indirect effects of self-efficacy, a mediation analysis looked at the mediating role self-efficacy holds for feelings of connection. Guided by Hayes (2013) and Baron & Kenny (1986), self-efficacy was treated as a mediator that explained the relationship between social connection and motivation.

4.5 Results

4.5.1 Preliminary Analyses

Before testing the hypotheses, bivariate correlations were calculated between all of the variables surveyed. Results are summarized in table 4.2

Table 4.2

Pearson Correlations for Variables of Interest

	1	2	3	4	5	6	7	8	9	10
1. Perceived Autonomy Support	--									
2. Perceived Competency	.392**	--								
3. Relatedness	.397**	.131	--							
4. Sense of Social Fit	.295**	.582**	.217*	--						
5. Intrinsic Motivation	.243**	.340**	.313**	.624**	--					
6. Job Motivations	.211*	.144	.194*	.520**	.637**	--				
7. Grade Motivations	.074	.182*	.185*	.378**	.386**	.356**	--			
8. Self-Efficacy	.346**	.559**	.291**	.718**	.648**	.532**	.411**	--		
9. Interest in Future Study	.261**	.245*	.199*	.446**	.647**	.475**	.320**	.447**	--	
10. Perceived Understanding	.142	.377**	.065	.484**	.390**	.354**	.292**	.467**	.155	--

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

4.5.2 Hypothesis 1: Lectures and Mentorship impacts

A one-way ANOVA was calculated on participants' sense of social fit based on the pre-event, post-lecture, and lecture with mentorship conditions. The analysis was not significant (F (2, 130) =.385; p = .681). A one-way ANOVA also explored how the interventions influenced interest in future study and perceived understanding of the discipline. While neither condition improved interest in taking a computer science class (F (2, 99) = .193; p = .825), there was a statistically significant difference in understanding of computer science jobs (F (2, 126) = 3.451; p = 035).

4.5.3 Hypothesis 2: Belonging and Motivation

4.5.3.a Demographics and Motivation

A regression model including predictors for race and school type explored the influence of demographic factors onto intrinsic motivation for computer science. Model predictors reflected a student's race (coded = 0 for white; = 1 for non-white) and school (coded = 0 for public school; = 1 for private school) . Both school type and racial minority status predicted intrinsic motivation for studying computer science. Non-white students and private school students were less likely than were white public school students to be intrinsically motivated in computer science (R^2 = .084; F = 3.408; p = .02). Computer science experience showed no effect on interest. No statistically

significant relationship was observed between demographics and any other dependent or independent variable.

Table 4.3

Demographic Predictors Influence onto Intrinsic Motivation

	b	*β*	*SE*	95% CI	*p*
Intrinsic Motivation					
Race	-.543	-.212	.233	-1.004 to -.083	.021
School Type	-.402	-.193	.189	-.777 to -.027	.036
CS Experience	.015	.007	.203	-.388 to .417	.942

4.5.3.b Social Connection and Motivation

Controlling for demographics, a young woman's sense of social fit significantly predicted intrinsic motivation, while feelings of general relatedness had a much smaller effect (R^2=.487; F =20.482; $p < .001$). This relationship was stronger for public school students. Similar regressions were run for both job motivations (R^2=.335; F = 10.894; $p < .001$) and grade motivations (R^2=.137; F = 3.406; p = .007). Sense of social fit also showed a stronger influence than relatedness did onto career motivations. Sense of social fit also predicted grade motivations, but school type was non-significant in this analysis. Predictor results are summarized in Table 4.4.

Table 4.4

The Influence of Relatedness and Sense of Social Fit onto Motivational Constructs

	b	*β*	*SE*	95% CI	*p*
Intrinsic Motivation					
Sense of Social Fit	.816	.518	.114	.591 to 1.042	< .001
Relatedness	.293	.275	.077	.141 to .446	< .001
Race	-.445	-.175	.177	-.796 to -.094	.013
School Type	-.381	-.183	.147	-.672 to -.091	.011
CS Experience	.039	.018	.156	-.271 to .349	.804

	b	*β*	*SE*	95% CI	*p*
Job Motives					
Sense of Social Fit	.701	.502	.115	.474 to .929	< .001
Relatedness	.100	.106	.078	-.054 to .254	.199
Race	-.159	-.070	.179	-.513 to .196	.398
School Type	-.300	-.163	.148	-.593 to -.007	.045
CS Experience	.138	.070	.158	-.175 to .451	.354

	b	*β*	*SE*	95% CI	*p*
Grade Motives					
Sense of Social Fit	.426	.293	.137	.155 to .697	.002
Relatedness	.127	.129	.093	-.057 to .311	.173
Race	.008	.003	.214	-.418 to .433	.972
School Type	-.234	-.122	.176	-.582 to .115	.187
CS Experience	.033	.016	.190	-.343 to .409	.863

4.5.4 Hypothesis 3: Needs Satisfaction and Motivation

Sense of social fit significantly predicts all forms of motivation, but neither competency nor perceived autonomy support predicted motivation subtypes. A linear regression model regressing intrinsic motivation onto basic needs was statistically significant, although sense of social fit's predictive relationship accounted for the relationship ($R^2 = .426$; $F = 12.089$; $p < .001$). Similar results were observed for both career motivations ($R^2 = .353$; $F = 9.476$; $p < .001$) and grade motivations ($R^2_{job} = .119$; $F = 2.318$; $p = .039$). Results for all predictors are summarised in Table 4.5.

Table 4.5

The Influence of Basic Needs onto Motivational Constructs

	b	*β*	*SE*	95% CI	*p*
Intrinsic Motivation					
Sense of Social Fit	.748	.482	.145	.460 to 1.037	< .001
Autonomy Support	.158	.167	.081	-.003 to .319	.054
Competency	.075	.074	.093	-.110 to .260	.422
	b	*β*	*SE*	95% CI	*p*
Job Motives					
Sense of Social Fit	.763	.547	.139	.488 to 1.038	< .001
Autonomy Support	.153	.190	.077	.000 to .306	.050
Competency	-.138	-.151	.089	-.314 to .039	.125
	b	*β*	*SE*	95% CI	*p*
Grade Motives					
Sense of Social Fit	.439	.305	.169	.104 to .774	.011
Autonomy Support	-.063	-.072	.094	-.248 to .123	.504
Competency	.046	.049	.108	-.167 to .259	.670

4.5.5 Hypothesis 4: The Mediating Role of Self-Efficacy

Given the effect that the presence of same-sex peers has on feelings of self-efficacy (Schunk & Hanson, 1985), Hypothesis 4 tested whether self-efficacy acts as a mediator between an individual's basic needs and later self-efficacy. Results indicate that self-efficacy mediates the relationship between sense of social fit and intrinsic motivation. As Figure 3 illustrates, sense of social fit was a significant predictor of self-efficacy (b =1.08; SE =.09; $p < .001$) and self-efficacy significantly predicted intrinsic motivation (b =.40; SE =.09; $p < .001$). There still exists a significant direct relationship between sense of social fit and intrinsic motivation (b = .52; SE=.14l; $p < .001$). A bootstrapped approach with 5000 samples was used to test the indirect effect and it indicated that the indirect effect was significant (b = .43; SE = .16; CI (.14, .78)).

A smaller but similar effect was observed between relatedness and intrinsic motivation. Relatedness predicts self-efficacy (b = .20; SE = .09; p =.02) and, in turn, self-efficacy predicts intrinsic motivation (b = .62; SE = .07; $p < .001$). Relatedness' effect on intrinsic motivation is nearly significant (b = .13; SE=.07; p = .06) with an indirect effect of .13 (SE=.05; CI (.03, .24)).

Figure 3

Mediation models for Sense of Social Fit and Relatedness

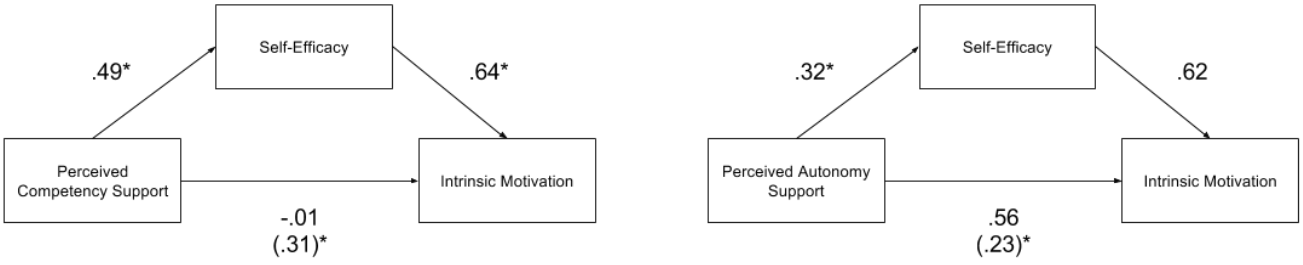


A similar relationship was observed between competency, self-efficacy, and intrinsic motivation. There exists a statistically significant relationship between perceived competency support (PCS) and self-efficacy (b = .49; SE = .07; p < .001) and between self-efficacy and intrinsic motivation (b = .64; SE = .08; p < .001). There was not a direct relationship between PCS and intrinsic motivation (b = -.01; SE = .07; p = .88). I performed bootstrapped analysis with 5000 samples and observed an effect of .32 (SE=.09; CI=.17, p = .52)

Finally, a similar effect was observed for autonomy. A statistically significant relationship emerges between perceived autonomy support (PAS) and self-efficacy (b =.32; SE = .08; p < .001) and between self-efficacy and intrinsic motivation (b = .62; SE = .07; p < .001). There was no direct relationship between PAS and intrinsic motivation (b = .04; SE = .06; p=.58). The same bootstrapped analysis demonstrated an effect of .2 (SE = .20; CI= (.09, .32)). Results from both competency support and autonomy support are summarized in Figure 4.

Figure 4

Mediation Models for Perceived Competency Support and Perceived Autonomy Support



4.6 Discussion

This study makes three principal contributions to our understanding of how to facilitate the take-up of computer science study by young women. Firstly, it tests a model of intervention commonly used to motivate young women. Secondly, it explores how basic needs support

influences women's motivation. Finally, it explicates the mechanism through which needs support leads to motivation.

Across outreach programmes designed by for-profit and educational institutions, female engineers introduce young women to computing and, in doing so, aim to persuade attendees to study computer science. However, upon administering this programme design at Bit by Bit, no effect was observed onto either sense of belonging, motivation within computer science, or interest in the field. Hypothesis 1 tested these dependent variables across the day's events, but found no statistically significant results. Despite a plethora of for-profit and non-profit interventions that express their aim in terms of priming the pipeline for women in computing, it appears that the model currently being employed does not remedy the core factors that prevent women from pursuing computing. Future research should explore longer-term outreach programmes or explore the rates of computer science take-up by programme attendees to see if the benefits are not observed until longer after the program.

While the role that autonomy and competency play in supporting motivation for learning is well established (e.g. Reeve & Lee, 2014), relatedness and sense of inclusion has been under-emphasized. However, findings from Hypothesis 2 suggests that, for young women in technology, an educational minority, sensing social fit in computer science or belonging (as Walton & Cohen (2007) term the measure) is both a necessary condition for motivation and is a significantly stronger predictor of motivation than is autonomy or competency. This contrasts with findings from Sierens et al., (2009) and Goudas, Biddle, & Fox, (1994) that suggest that all needs are equally predictive or that autonomy is uniquely important. However, it aligns with general findings around minorities in educational settings. When minorities feel this sense of belonging or when stereotype threat is lessened, they are motivated to persist in academic settings (Rosenthal & Crisp, 2006; Walton &

Cohen, 2007). Such findings are consistent with the belief that belonging, above all, is necessary to promote motivation.

Additional results explored the impact of demographic features onto intrinsic motivation and identified that both race and school type influenced intrinsic motivation for computer science. Results identified that private school students had lower levels of intrinsic motivation for computer science. Self-determination theory contends that external pressures can undermine intrinsic motivation. In support of this, private school students, who are subject to increased performance pressure from their environments (Feld & Shusterman, 2015), showed lower intrinsic motivation. Further research should more deeply explore the relationship between school climate, student demographics, and subsequent motivation for study to better explore how to create supportive computer science environments.

In addition to establishing the importance of belonging for young women in technology, and, by extension, minorities in educational settings, Hypothesis 4 explored the mechanism by which belonging influences motivation. Mediation analyses of belonging, self-efficacy, and intrinsic motivation suggest that belonging produces a sense of self-efficacy, which, in turn, influences motivation.

The mediating role of self-efficacy supports earlier findings that establish self-efficacy as a correlate and predictor of interest in studying computing (Hargittai & Shafer, 2006; Miura, 1987). Boys and those who identify as male have higher perceived self-efficacy in technology and computer science (Beyer, 2014; Huffman et al., 2013). Results from Hypothesis 4 may partially explain these higher rates since girls receive less encouragement to pursue technology and this research suggests that without this support, they may have fewer places to develop the crucial sense of self-efficacy. When young women's sense of belonging is fostered, they develop a sense that they are not an "other" and are capable of achieving their goals.

Such finding is troubling because it suggests a paradox. To feel efficacious enough to pursue computing, women need to feel a sense of belonging. Sense of belonging emerges when women view people like them in the field. Yet, without an existing base of women in computing, it may be difficult to establish the critical mass necessary for widespread belonging. This contradiction has been observed in other scientific contexts (Etzkowitz, Kemelgor, Neuschatz, Uzzi, & Alonzo, 1994) and suggests that families, schools, and media must shift to appear more welcoming to women, as these may act as other sources of belonging and self-efficacy (Zeldin & Pajares, 2000). Future research should evaluate the role that these other sources can play in promoting belonging.

While the natural experiment facilitated the direct manipulation of variables of interest within an environment similar to one where successful interventions might be piloted, it presents two primary limitations. Firstly, it utilized a convenience sample. Students registered participation in the event, showing a likely interest in the material. However, by working with a convenience sample, this intervention was also piloted within a population likely to participate in other outreach. Future research should explore similar mechanisms both within representative samples and within classroom environments to control for any selection bias. Secondly, this experiment altered feelings of relatedness by showcasing and focusing on women. This subtly assumes that all attendees identify with the experience of being female and that it is their experience being female that potentially dissuades them from pursuing technical fields. Despite the historic connection between exclusionary practices relating to women (Ensmenger, 2010), I acknowledge that issues of race, sexual orientation, socio-economic status, and other minorities may also perceive feelings of exclusion from technology-based settings (Riegle-Crumb & King, 2010). Further research should include measures directly related to gender identity, to measure the strength of gender's impacts. However, this thesis chooses to focus on gender, regardless of an individual's identified feelings both because it has shown the most resistance to similar targeted interventions and because feelings of relatedness,

regardless of what identity it is related to, have been shown to improve persistence for intersectional feminists (Espinosa, 2011; Price, 2010).

Despite these limitations, this research has design implications for policy and outreach efforts. Firstly, it suggests that outreach programmes should emphasize feelings of belonging through hiring minority workers and focusing on both community building and skill building. By designing outreach efforts around promoting belonging, the non-profit and technical communities can best support the psychological resilience necessary for long-term commitment to computer science. Media narratives and social settings should avoid replicating technical stereotypes. Secondly, this research highlights that psychological predictors are as significantly related to computer science study as demographic factors. At present, most research around women in computing focuses on barriers to entry or on the reasons for exit. However, this research suggests that psychological as well as demographic factors play a significant role in motivating computer science study. Future research should more closely explore how to create psychologically-supportive educational environments and outreach programmes as well as on their evaluation.

4.7 Conclusion

Amidst growing demand for computer science-trained workers and decreasing numbers of women in computer science, identifying the role that outreach can play in engaging women in technical pursuits and the psychological factors that predict success in this field appears as an urgent research need. Yet, despite literature on the importance of belonging for minorities in educational settings, few studies explore how senses of belonging influence intrinsic motivation for learning. As outlined in self-determination theory, identifying the factors that support intrinsic motivation is crucial because only when learning is intrinsically motivated and self-regulated do individuals persist amidst obstacles. By applying self-determination theory to the experience of women in computing,

this study applied post positivist methods to explore motivational correlates for women in computer science. This study used a quasi-field experiment within a common outreach programme to explore its influence on teenage girls. It then utilized cross-sectional surveys to identify the psychological factors that predispose one to computer science motivation. The analysis contained four parts. The first analysis exploring the influence of an outreach programme found no impact of the intervention before or after the event on any variables of interest. The second and third analyses identified that more than autonomy or competency, sense of social fit predicts intrinsic motivation for computer science study. Finally, the fourth analysis identified that sense of social fit improves a young woman's sense of self-efficacy which then influences feelings of intrinsic motivation.

While these results demonstrate that traditional one-day interventions may be ineffective, they identify the mechanisms through which one can improve feelings of intrinsic motivation. This significant contribution towards understanding motivational correlates for young women contributes to our understanding of how to support women in technology because it identifies the most important factor that supports learning. While self-determination theory suggests that autonomy, competency, and relatedness equally predict motivation, this study shows how, for minorities, relatedness is uniquely important for supporting motivation. By showcasing how psychological theories differentially impact young female communities this research makes important strides in our understanding of how to best support young women's technologically-mediated interactions.

5 Parenting Adolescent Technology Use: The role of Parents' Autonomy Support and Anxiety

5.1 Introduction

Parenting theorists broadly agree that parents should encourage children's autonomy. When parents are autonomy supportive, they socialize their children towards intrinsically-motivated behaviour and implicitly signal to their children that their ideas and interests are worth-while (Reeve, 2006). Adolescents whose parents encourage their autonomy evidence intrinsic motivation, healthy psychological development, and strong academic outcomes (Turner, Chandler, & Heffer, 2009; Vansteenkiste, Soenens, Van Petegem, & Duriez, 2014). While aspects of a parent's personality or culture may interact with his or her autonomy provision, the concept recognizes that individuals may have different ways of encouraging autonomy. However, it argues that, regardless of a child's culture, parenting behaviours that a child perceives as supporting his or her autonomy lead towards positive outcomes. This allows the specific ways that parents provide autonomy to differ globally (Soenens, Vansteenkiste, & Petegem, 2014). While autonomy is regarded as necessary for all children, parents are often more willing to support their sons' autonomy than their daughters' (Bumpus, Crouter, & McHale, 2001; Pettit, Laird, Dodge, Bates, & Criss, 2001; Smetana & Daddis, 2002). Given autonomy-support's universal importance, parenting manuals and the parenting advice industry make blanket recommendations that parents should encourage autonomy and stay involved in all children's lives (Barr et al., 2012; Geinger, Vandenbroeck, & Roets, 2014). However, by encouraging parents to be autonomy supportive so they can be labelled "good parents" or so that their children develop normally, the parenting advice industry taps into and feeds parents' anxieties

around their children's outcomes, and this anxiety can negatively impact adolescents, particularly adolescent females.

There are growing media and technological pressures on parents. The past few decades have witnessed the rise and growth of the parenting advice industry – books, TV programmes, and content geared at advising and criticising parenting styles (Lee, 2014). While the parent advice industry encourages parents to be autonomy supportive, it often does so by tapping into their anxieties about being a respectable parent. Parenting guidance and parenting communities create expectations around what parenting means and reinforce traditional narratives, anxieties, and gender roles (Madge & O'Connor, 2006). Indeed, the rhetoric is particularly strong with respect to raising young women. Narratives cast parents as responsible for curtailing and controlling female deviance (Assarsson & Aarsand, 2011; Cassell & Cramer, 2007). This is exacerbated by a technology sector that profits from selling parents tools to track, surveil, and monitor their children (Richtel, 2006; Wisniewski, Ghosh, Xu, Rosson, & Carroll, 2017). These tools signal to parents that surveillance and concern are necessary (Leaver, 2017). Combined, these contribute to increased parental anxiety, especially around technology, and this influences their parenting decisions.

Anxiety can interfere with parents' abilities to nurture and encourage their children's individuality. Troublingly, much technological advice inadvertently socializes parents towards traditional gender roles (Rashley, 2005), and this may perpetuate mothers' anxieties, as they are often characterised as the primary care-givers (Valentine, 1997). Indeed, gender differences have emerged in how mothers and fathers treat their daughters and sons. Both mothers and fathers are likely to view their daughters as more at-risk (Cassell & Cramer, 2007; Valentine, 1997), even though mothers and fathers engage in different child-rearing roles and are therefore exposed to different aspects of their children's lives (Milkie, Bianchi, Mattingly, & Robinson, 2002; Pedersen, 2012). Amidst this

divide, it is crucial to nudge parents of both genders away from fear and towards autonomy supportive practices in ways that can support their children's functioning.

To this end, self-determination theory contends that competency, autonomy, and relatedness lead individuals towards self-regulation and emotional well-being. Rich literature documents how parents and teachers can support children's autonomy and competency (e.g. Brooks & Young, 2011; Flamm & Grolnick, 2013; Joussemet et al., 2008; and reviews in Reeve, 2006; Soenens & Vansteenkiste, 2005b). Providing choices for young learners, being empathetic to children's decisions, and staying involved in children's lives are a few of the ways that parents satisfy children's needs for autonomy, competency, and relatedness (Grolnick, 2002). Similarly, the theory contends that a parent's motivation for parenting and involvement in his or her child's life will best support the child's functioning. When parents needs are supported, they develop autonomous motivation for parenting, which then predicts their autonomy supportive practices and their children's outcomes (Jungert et al., 2015). According to SDT, this motivation develops when parents feel competent, autonomous, and related. Yet, despite this, little scholarship within SDT explores the antecedents and consequences of parents' relatedness. This study hones in on parents' relatedness to their children and explores the impacts of this important concept.

SDT's model of relatedness conceptually links to other psychological theories which have extensively documented the emotional and developmental correlates to relatedness (Baumeister & Leary, 1995). The parent-child relationship helps adolescents develop prosocial skills and informs how both parents and children develop the ability to integrate into new relationships (Fuligni & Eccles, 1993; Peterson & Rollins, 1987). Across theories, parent-child relatedness predicts adolescents' academic, emotional, and developmental outcomes (Clark & Ladd, 2000; Grolnick & Apostoleris, 2004). Yet, while these studies demonstrate relatedness' influence onto adolescents' development, little research focuses on how the relationship impacts parents and parenting styles.

Towards this, the following analyses investigate the relationship between parents' relatedness, autonomy support and anxiety. Recognizing the importance of encouraging parents' autonomy supportive practices and discouraging their anxieties, these studies explore whether parents' feelings of relatedness to their children influence their parenting practices. To do so, it runs two online experiments to explore the causal links between relatedness and parenting decisions in two parent cohorts.

In each experiment, it queries whether parents treat adolescent daughters differently than sons. In doing so, it determines whether young women's support systems are distinct from young men's and explores whether their support systems can be designed to offer more relatedness. Recognizing how parents' technology-related decisions influence children's outcomes (Livingstone & Helsper, 2010; Vekiri & Chronaki, 2008), by testing differences in gendered practices, it also tests the origins of potential differences in technology use and opportunities. Together, this study extends SDT to explore whether adolescent men and women are treated differently by their support systems and the influence that parents may have on their development.

5.2 Literature Review

Researchers across sociology, developmental psychology, and communications note the important protective role that parents play in guiding a child's development, regardless of that child's gender. As an early socialising agent, parents are tasked with providing structure, support, and values that prepare children for adulthood. Yet, despite literature and media focused on advising parents, little research focuses on how or why parents develop good practices. In what follows, this chapter explores two parenting habits – autonomy support and anxiety – and outlines how relatedness may influence their onset. It then outlines how both autonomy support and anxiety influence parents' Internet mediation decisions.

5.2.1 The Importance of Autonomy Support

Self-determination theory posits that when an individual's needs for competency, autonomy, and relatedness are satisfied, one will develop internal well-being and orient oneself towards self-regulating his or her actions. Based on this, SDT offers a framework from which researchers can evaluate whether settings will lead to individual well-being and optimal development. Namely, when environments help meet these needs, individuals will develop self-regulation, but when these needs are thwarted, individuals will suffer. According to SDT's framework, when both the rules parents make and the interpersonal environments they foster are designed to encourage competency, autonomy, and relatedness, adolescents develop optimal functioning.

While autonomy support figures into SDT, it is also a component of most notable parenting theories. Across theories, providing childhood autonomy and structure characterizes the optimal developmental climate. Grolnick & Farkas (2002) note conceptual links between SDT's framework and other parenting theories such as Baumrind's Parenting Style theory (Baumrind, 1980) and Steinberg's definition of Authoritative Parenting (Steinberg, Elmen, & Mounts, 1989). Yet, despite similar theoretical conclusions, Baumrind and Steinberg's theories focus exclusively on parenting, while SDT looks broadly at human functioning and applies its principles to parenting. And, unlike these other theories, SDT makes recommendations for *how* parents can provide structure, autonomy, and a supportive climate. Namely, to foster children's well-being, parents must offer their children autonomy-support, competency-support, and involvement. Therefore, this study relies on SDT to explore parents' practices.

A variety of sources, including peers and teachers, influence adolescent development. Yet, from an early age, parents are uniquely responsible for socialising children's motivation and encouraging their self-regulation from an early age. Research from a variety of psychological

methodologies identified that those whose parents offer autonomy support reflect better self-regulation, autonomous motivation, and emotional well-being. Children's self-regulation emerges when parents engage in autonomy supportive parenting, defined as "parental support for children's volitional functioning" (Soenens et al., 2014, p. 44) Parents are the primary source from which children develop their ability to self-regulate behaviour and achievement goals (Pomerantz, Cheung, & Qin, 2012). In one cross-sectional study with both parent and child subjects, parents who reported autonomy-oriented motivational styles had children who evidenced greater self-regulation, even when the children were performing less fun activities like brushing teeth or doing homework (Grolnick & Ryan, 1989). In studies across cultures, parents' autonomy support predicted self-determination, academic outcomes, and self-regulation in multiple domains (Chirkov & Ryan, 2001; Soenens & Vansteenkiste, 2005). Laboratory and longitudinal studies support and mirror these findings (Froiland, 2011; Joussemet, Koestner, Lekes, & Landry, 2005). Together, these point to the behavioural and emotional ways children benefit when their parents encourage their autonomy.

Emerging research suggests that adult-to-child autonomy support can also predict children's online self-regulation. In exploring teachers' motivation for using e-learning platforms, Sørebø, Halvari, Gulli, & Kristiansen (2009) demonstrate that teachers' perceived autonomy influences their decision to use new technologies. They argue that even though principles of SDT were first developed to describe offline behaviours, the theory is equally effective at describing online activities. In line with this conclusion, and extending research linking parental autonomy support to offline self-regulated learning (eg. Froiland & Worrell, 2017), Sha, Looi, Chen, Seow, & Wong, (2012) found that perceived parental autonomy support also predicted achievement and self-regulation in mobile learning environments. Video game players who felt autonomy support were less likely to develop a compulsive need to play (Przybylski, Weinstein, Ryan, & Rigby, 2009). Perceived autonomy support may also protect adolescents from some of the hypothesized dangers

of online engagement. Students in China who believed that their teachers were autonomy supportive were less likely to develop problematic Internet and gaming use (Li, Li, & Newman, 2013; Yu, Li, & Zhang, 2015). These studies all demonstrate the importance of authority figures providing autonomy support around online practices as they do with offline practices.

Yet, despite ample research into the benefits of parents' autonomy support for adolescent men and women, there is no consensus around how parents develop this orientation. This crucial gap must be remedied if researchers want to foster and encourage autonomy supportive parenting. In what follows, I outline current theories about how parents develop this practice before justifying this chapter's focus on relatedness.

5.2.2 Why Parents Encourage Autonomy

Several aspects of the relationship between the parent and child predict parents' willingness to support their adolescent's autonomy. Believing a child's choices to be evidence of one's self-worth – or ego-involvement – appears to mildly reduce a parent's willingness to be autonomy supportive. While laboratory experiments suggest that ego-involvement reduced parents' autonomy supportive practices, when researchers looked directly at families' behaviour, ego-involvement appeared to be only mildly predictive of parents' decisions to foster an autonomy supportive versus controlling environment (Grolnick, Gurland, DeCourcey, & Jacob, 2002). They concluded that ego-involvement predicts decisions to control, but not to be autonomy supportive.

Others posit that trust in a child's developmental outcomes influences the take-up of autonomy supportive parenting. Trust influences a parent's practices regardless of individual child traits (Landry et al., 2008). When parents have faith in their child's developmental path, they are more likely to encourage their child to pursue it in their own way. Extending this, Joussemet, Landry, & Koestner (2008) offer a framework applying SDT to parenting. By extending research on

teachers and schools, they contend that while external pressures, ego-involvement, and exhaustion can all undermine parents' autonomy-support, trust predicts it. Trust emerges as a protective barrier that safeguards parents from making decisions that reduce a child's autonomy.

Trust cannot develop unless a parent feels related to his or her child. While trust is not explicitly called out in SDT, Pomerantz et al., (2012) conceptually link SDT to attachment theory, another developmental theory, to showcase that despite differences, many developmental theories support the link between trust and relatedness. Similarly, in their review article of SDT, Deci & Ryan (2000) outline how empirical psychological theories imply that relatedness is important, but that SDT is unique in articulating this need. Relatedness facilitates children's internalization of parents' goals, because when children feel close to their parents, children trust that their parents have their best interests at heart and internalize their values and directives. Thus, on the child side, relatedness helps children develop autonomous motivation. And, as everyone orients towards relatedness, one can expect that relatedness to children can also help parents develop autonomy supportive practices.

5.2.3 Relatedness and Autonomy

As applied to students, much research has identified how relatedness-satisfaction in parent-child relationships predicts children's well-being and motivation. In the academic domain, students who report emotional closeness to their parents develop stronger intrinsic motivation for learning (Bao & Lam, 2008). Feeling related to one's parents predicts autonomous motivation, which in turn predicts adolescents' self-efficacy and resilience during life events (Shahar, Henrich, Blatt, Ryan, & Little, 2003). Additionally, maternal support predicts an adolescent's empathy, which then predicts their friendship quality (Soenens, Duriez, Vansteenkiste, & Goossens, 2007). This research is notable because it establishes that even during a period noted for emerging independence, adolescents still

require parental support and closeness to develop psychological, interpersonal, and academic functioning.

Although adolescents explore their independence, relatedness continues to be crucial for ensuring adolescents' healthy adjustment. While teenage girls and boys test their autonomy and distance themselves from their parents during adolescence, the relationship can still be marked by emotional closeness and personal disclosure (Pinquart & Silbereisen, 2002). When compared to feelings of autonomy and competency, feeling related to one's parents significantly predicts adolescents' educational outcomes and motivations (Hennan, Dornbusch, Herron, & Herting, 1997). Feeling related to one's parents in adolescence also predicts feelings of autonomy and relatedness within academic environments (Ratelle, Larose, Guay, & Senécal, 2005). Relatedness' significance in adolescence extends outside of academic environments. A longitudinal analysis found that adolescents whose parents offered high-support for autonomy and relatedness witnessed greater self-esteem and emotional well-being (Allen, Hauser, Bell, & O'Connor, 2004). These authors argue that relatedness is what allows adolescents to develop their independent identity and experiment with independence during adolescence. Yet, while autonomy support is beneficial for both boys and girls, parents are more likely to support boys' autonomy (Bumpus et al., 2001). This is troubling because it suggests that young women may thus develop lower technological well-being.

While parent relationships help adolescents develop the skills necessary for well-being and experimentation, less is known about how the relationship with the child influences parents' choices and decision-making. Given the demands that children place onto parents' time, parents' overall well-being declines when children are first born, despite rising again by the time they reach adolescence. And, while individual activities may lead to parents' stress or fatigue, on balance, parents report emotional well-being and happiness after relating to their children (Musick, Meier, &

Flood, 2016). This is critical because it implies that parent-child closeness in adolescence leads both to parent well-being and to their adopting supportive parenting styles.

Indeed, when parents feel close to their child, it protects the child and leads to greater well-being for both parents and children (Coatsworth, Duncan, Greenberg, & Nix, 2010). Yet, often in adolescence, parents and children may grow apart and feel less connected to one another (Collins & Laursen, 2004). When parents feel discouraged or upset by the relationship with the adolescent, they are more likely to show reduced self-esteem and life satisfaction, while simultaneously evidencing increased anxiety (Steinberg, 2001). Steinberg (2001) reviews research on the parent-adolescent relationship and notes a need for more research documenting whether parents impacted by relationship changes not only show reduced mental health but also use more ineffective parenting strategies – such as discouraging children's autonomy. Towards this, Dishion, Nelson, & Bullock (2004) identified that when the parent-adolescent relationship is characterized by conflict, parents may disengage, which can lead to further adolescent problem behaviours and potentially reinforce a negative cycle. In contrast, parents are more comfortable involving themselves and sustaining a relationship with their adolescent when they have a strong bond with him or her (Collins & Laursen, 2004). This suggests that parents' relatedness will increase their willingness to parent their adolescent.

Two factors inform Hypothesis 1. Firstly, recognizing the relationship between trust in a child and provision of autonomy supportive parenting (Joussemet et al., 2008) and, secondly, that relatedness influences both trust in the child and the willingness to parent during adolescence (Collns & Laursen, 2004) leads directly into Hypothesis 1. Despite evidence that parents are more likely to support their sons' autonomy than their daughters (Bumpus et al., 2001; Frank, Avery, & Laman, 1988), the connection between emotional intimacy and subsequent autonomy support is hypothesized to apply to both genders because of SDT's universal approach. While parents' baseline

autonomy support may differ based on a child's gender, the psychological pathway between relatedness and autonomy support should be constant, according to SDT. Yet, the following hypothesis, and other hypotheses tested in this chapter, deliberately measured effects by gender to explore the relative difference of young girls' developmental climate.

> *Hypothesis 1:* Feelings of relatedness to one's child predict parents' autonomy support in a technological context for both genders.

While self-determination theory contends that autonomy support around technology is necessary for teenagers to develop intrinsic motivation for technology use, many parents evidence fears and insecurities around technology use. Indeed, the risks that adolescents may encounter online lead many parents to restrict Internet use and other types of media (Lee, 2013; Nikken & Jansz, 2006). This fear is problematic, as both study 1 and Livingstone & Haddon (2009) argue that restricting media use limits the opportunities that an adolescent may encounter through it. And despite variations in what parents fear, Internet anxiety is widespread (boyd & Hargittai, 2013). 49% of parents of teenagers report concern about the time their children spend online, and 40% of parents of teenagers are worried about the content that their teenage children access (OfCom, 2017). Recognizing that fear may interact with a parent's ability to provide autonomy-support, it is important to contextualize parents' technology-related worries to understand their veracity and whether to limit them. In what follows, I outline a brief history of parent concerns before demonstrating the link between these concerns and relatedness.

5.2.4 Parental Anxiety

Notions of childhood risk stem from its construction as a 'special' life stage. Risk anxieties surrounding childhood typically arise in periods of social change (Jackson & Scott, 1999). Beck's (1992) definition of a 'risk society' argues that risk is endemic to and that the narrative results from

technological changes. Notions of 'risk' and invisible harm then spread through mass media to both construct and exacerbate public fears (Cottle, 1998). While both Beck (1992) and Giddens (1991) focused on the increase of fear narratives due to technological change, neither scholar noted how periods of technological change have historically led to gendered moral panics. Yet, primary sources and popular media in the time of the telephone and telegraph focused on the risks to young women, not men, as they developed autonomy and explored spaces outside of their parents' control (Cassell & Cramer, 2007). Nowhere does this narrative appear more potently than with young women and technology.

This media rhetoric specifically targets parents who are also very susceptible to internalising it. A growing media market for parenting advice created a culture of paranoid parenting (Furedi, 2002). Amidst this, parents increasingly worry about their children and the many risks facing them. According to Furedi (2002), paranoid parenting has become a new form of parenting in which parents develop overblown fears of contact and conduct risks to their children from engaging in even the most innocent activities. At the time of his writing, parenting experts and parent-focused media was growing in popularity and scale (Lupton, Pedersen, & Thomas, 2016; Simpson, 1997). Furedi argued that this culture of parenting experts and mass media for parents convinces them that they are bad and immoral parents if they do not develop strong anxiety around their child.

While Furedi wrote before widespread Internet use, he noted that parenting advice about the Internet focused on developmental and safety risks to children, instead of on the many educational opportunities that such use offered them (2002). Furedi and followers took issue with media fear-mongering because its narratives consistently cast children as helpless and positioned parents as their protectors. While children of the 1970s could walk freely outside, the spaces of play available to children have slowly shrunk as risk anxiety has grown (Valentine & McKendrck, 1997). They imply that parents should lower their anxiety, because many of these risks are exaggerated, particularly as

they relate to young women. Instead, they aim to interrogate the fear-mongering (boyd & Hargittai, 2013). Parents themselves have begun noticing and complaining of the judgmental attitude of many online experts (Strange, Fisher, Howat, & Wood, 2018). Despite critiques of this narrative, it remains prevalent and is the dominant perspective of parenting and technology.

However, while mass media may exacerbate parents' risk perceptions, the Internet still presents new risks to developing children. As an example, children come into more contact with hate speech through their Internet consumption and social media use than they did offline (Livingstone, 2016). Hate speech can also take the form of online bullying. Here too, there exists a divide between rhetoric and experience. Recent findings suggest that while only 1-5% of all youth experience cyberbullying, far less than traditional bullying estimates, the media and parents still continue to fear and exaggerate this phenomenon (Mehari et al., 2018; Przybylski & Bowes, 2017). Additionally, parents continue to cite inappropriate or pornographic content as a principle fear of online use (Livingstone & Smith, 2014). Yet, while 93% of adolescent boys and 63% of adolescent girls experienced online pornography, only roughly 5% of boys and 20% of girls experienced this accidentally (Sabina, Wolak, & Finkelhor, 2008; Weber, Quiring, & Daschmann, 2012). This risk prevalence suggests that parents may be overestimating children's unwanted online encounters and over-concerned about their Internet habits. Both of these imply that parents have low understanding of how children actually engage online.

There are several reasons to be troubled by parents' concerns, particularly as they relate to young women. A culture of risk blinds us to the opportunities available to young women. It limits children's perception of opportunities, which then influences political decision making (Byron, 2008). Historical literature on the domestication of communications technologies portrays women as victims of or having their virtue threatened as a direct result of unrestricted access to new devices (Cassell & Cramer, 2007). Narratives then emerge surrounding parental deficiencies precisely

because of what parents let their daughters access (Cassell & Cramer, 2007). The media argues that parents bring risks to their daughters and not their sons. This rhetoric continues, despite limited evidence that young women are more susceptible to risk than their male counterparts. Parents still develop imbalanced fears and place unfair burdens on their daughters (boyd & Hargittai, 2013). This increased fear has large influence upon how young women develop.

There are several ways in which a gender-imbalance in fear influences young women. Firstly, the media narrative around the Internet and young women disproportionately frames them as victims (Thiel-Stern, 2009). Young women are often explicitly singled out as 'at risk' but they are rarely asked this directly or individually featured in reports (Cassell & Cramer, 2007; Kelly & Pomerantz, 2009). This contributes to a singular perception of vulnerable women and particularly influences and scares parents, who can then see their daughters as the victims (Jacobs & Eccles, 1985; Valentine & Holloway, 2001). This prevents girls from sharing their experiences, refuting these claims, and asserting their agency. This omission is particularly jarring because the same research that noted the media imbalance, found that most qualitative reports showcase young women using the Internet for self-expression and personal enrichment (Cassell & Cramer, 2007). Yet, without this important analogue, parents may respond to discomfort about the natural ageing process by increasingly restricting or blaming new tools (Cassell & Cramer, 2007). This example speaks to how the media rhetoric influences paranoid parenting but requires investigation. This paradigm requires quantitative study to explore the supposed gendered differences between parent responses to fear and ways of mitigating this divide.

While a new phenomenon, parents' technological anxiety is analogous to math anxiety, a concept first outlined by Dreger & Aiken Jr. (1957) and operationalised by Richardson & Suinn (1972). Math anxiety constitutes an acute fear of mathematics and involves avoidance and lowered performance, regardless of one's skills in the area (Ashcraft, 2002). Research on math anxiety has

documented the extra burden that it places on young women, who are significantly more likely to have math anxiety and gendered math expectations (Hyde, Fennema, Ryan, Frost, & Hopp, 1990). Young women develop math anxiety due to their parents' gendered stereotypes, but mothers can also play a protective force limiting the extent to which young women suffer as a result of this anxiety (Tomasetto, Alparone, & Cadinu, 2011). Math anxiety research highlights the gendered nature of anxiety and how parents' fears hold real-life consequences.

Parents' Internet-related fears may be excessive when compared to the Internet's riskiness and hold negative consequences for adolescent women. Therefore, it is necessary to investigate ways of reducing their prevalence. Just as relatedness may increase parent autonomy-support, it may also reduce parent anxiety.

Close parent-adolescent relationships are characterized by information-disclosure and feelings of unconditional support (Grolnick & Farkas, 2002). In their review of how parent-child relatedness improves adolescent motivation, Pomerantz et al., (2012) note how relatedness correlates with information-disclosure and trust. As relatedness increases, parents may trust that their children will share their experiences or have better insight into the Internet's actual riskiness and therefore be less susceptible to media rhetoric. This leads directly into Hypothesis 2.

> *Hypothesis 2:* Relatedness decreases parents' anxieties about their children's Internet use, particularly for young women.

5.2.5 Parenting Technology Use

As outlined in Chapter 3, parental mediation encompasses the decisions parents make around their children's technology access. While a deeper explanation of this theory is offered in the 3rd chapter, in what follows, I offer a brief review of relevant definitions, before relating mediation theory to parents' autonomy support and anxiety.

Parental Mediation Theory identifies six ways that parents can establish rules and structure around their children's Internet use (Clark, 2011; Livingstone & Helsper, 2008; Nikken & Jansz, 2014). These strategies fall within two dimensions: Restrictive and Supportive. Restrictive strategies forcibly limit what children can access. Parents might create rules *restricting* what, when, or how children can access the Internet. They might also choose to install software or apps to *filter* what child can access or directly *monitor* what their children access. In contrast, supportive strategies focus on working with one's child to support and advise their Internet use. Parents might offer *safety guidance* through conversations around online risks or *actively* mediate technology by talking with their adolescents about what they do online. Finally, parents might *co-use* new tools together with their children, to share experiences or indoctrinate their children to their values. While these are concrete strategies that parents might employ with their children, emerging research suggests that they stem from parents' psychological orientation.

Restrictive strategies appear conceptually similar to the ways that parents limit autonomy and instead exert psychological control. Towards this, chapter 3 found that restrictive mediation reduced children's autonomous motivation for Internet use. Parent autonomy support involves encouraging independence or intrinsically-motivated behaviours (Soenens et al., 2007). By prohibiting behaviours, restrictive strategies are conceptually similar to the ways that parents control their adolescents by creating rules and formal structures (Joussemet et al., 2008). Therefore, this study hypothesizes that parents who do not feel close to their children, and are therefore not autonomy supportive, are more likely to favour restrictive strategies. However, parents who are autonomy supportive of their children will favour active strategies. Feelings of relatedness will produce the trust that you can be effective at actively mediating technology. In support of this, Ghosh et al., (2018) used online survey methodology to determine that non-autonomy supportive parents were more likely to install monitoring apps on their children's smart phones.

Just as autonomy supportive parents may adopt active strategies, anxious parents might be more likely to restrict media use. In one study of restrictive mediation, Lee (2013) found that parents who believed that the Internet negatively impacts child development were more likely to restrict their children's Internet use. Nikken & Jansz (2014) expanded Lee's approach and looked at all forms of mediation and identified that anxious parents were more likely to employ all strategies, including restriction, as they looked to minimize risk. In response to this, this study hypothesizes:

> *Hypothesis 3:* Autonomy support lowers use of restrictive strategies, and increases incidence of supportive strategies.
>
> *Hypothesis 4:* Parents' anxiety increases parents' use of restrictive strategies, and reduces the use of active strategies.

This chapter theorizes that autonomy support and anxiety arise from parents' feelings of relatedness to their children. When the need for relatedness is satisfied, parents trust their children and learn more about them (Pomerantz et al., 2012). This knowledge likely impacts parents' beliefs around mediation. If they know they will learn what their children are accessing or are not concerned their child will want to access negative content, they will be less likely to endorse restrictive strategies. Therefore, I hypothesize that relatedness – the root of both anxiety and autonomy support – will indirectly influence mediation styles.

5.3 Present Studies

A series of studies with parent samples examined relatedness's role in predicting parents' attitudes. More specifically, present studies tested two hypothesized outcomes of parent-child relatedness: autonomy supportive practices and gendered parent anxiety. It also surveyed parents' subsequent decisions to mediate Internet activity. Using experimental methods, the following studies explore whether parent-child relatedness predicts the conditions that can support teenage girls'

development. In doing so, the chapter also demonstrates the psychological underpinnings of parents' decisions around their children's technology use.

The literature review established the protective and influential role that parent-child relatedness plays in adolescent development. While relatedness to parents improves adolescent outcomes across domains and predicts positive outcomes from their technology use, less is known about how this relatedness influences parents. The following studies take this as its central focus and put forth the following research question.

> *RQ: How do parents' feelings of relatedness predict their attitudes and decisions around their teenage children's technology use?*

The studies within Chapter 3 and Mishkin (2014) demonstrated how feeling related to one's parents influences teenagers' feelings of autonomous motivation for Internet use. Relationships marked by psychological feelings of relatedness are characterised by information disclosure, trust, and belief that the other party has one's interests at heart (Pomerantz et al., 2012). Trusting in their children's decisions, parents who feel related to their children would trust them to disclose and share their experiences on the Internet and may therefore encourage their autonomous use of it. Similarly, the literature review explored qualitative work examining how parenting advice may lead parents to develop overblown concerns about technology use, particularly for daughters. Relatedness may help parents cut through the media's noise and lower their anxiety. Responding to these, this study tests the following hypotheses.

> *Hypothesis 1:* Feelings of relatedness to one's child predict parents' autonomy support in a technological context.
>
> *Hypothesis 2:* Feelings of relatedness decrease parents' anxiety about children's Internet use, particularly for daughters.

Psychological constructs manifest themselves in concrete behaviours. Parents who are afraid of the Internet may want to limit access, whereas parents who support their children's autonomy are more likely to encourage them to use the Internet or possibly counsel them on how to use it. This

chapter therefore puts forth hypotheses 3 and 4 which query the psychological basis behind parent mediation decisions and looks at how mediation may stem from parent psychology.

> *Hypothesis 3:* Autonomy support lowers use of restrictive strategies, and increases incidence of supportive strategies.
>
> *Hypothesis 4:* Parents' anxiety increases parents' use of restrictive strategies, and reduces the use of active strategies.

In what follows, I test the above hypotheses in 3 experiments. A pilot study tested the efficacy of a writing task designed to manipulate parents' relatedness to their children. As subsequent experiments required causally manipulating parents' feelings of relatedness, the pilot study ensured that I can claim causality between the independent variable – relatedness – and the dependent variables. Experiment 1 tested hypotheses 1 and 3 by manipulating relatedness and measuring subsequent levels of autonomy supportive parenting and endorsement of mediation strategies. Following this, experiment 2 tested hypotheses 2 and 4 by measuring how the relatedness manipulation influenced parents' anxiety about their children's Internet use and endorsement of mediation styles.

5.3.1 Recruitment Strategy

Participants for all studies were recruited from Amazon's Mechanical Turk. Mechanical Turk (MTurk) is an online labour forum where researchers (or requesters) can recruit participants for paid tasks (called Human Intelligence Tasks or HITs). When offered fair monetary compensation, MTurk responses are as reliable as traditional data collection, come from a more diverse subject pool than University or traditional online samples, and do not affect data quality (Buhrmester, Kwang, & Gosling, 2011). Not only do MTurk samples offer reliability and high-quality data, they allow the researcher to quickly and inexpensively gather large samples of a desired demographic, which can otherwise be difficult for the student researcher to obtain (Holden, Brown, Baldwin, & Croft

Caderao, 2014; Sheehan, 2018).

For ease of recruitment, promotion of reliability, and response quality, participants for all experiments were recruited through MTurk. Participation was open to all MTurk workers based in the United States who self-identified as a parent of a 13-18-year-old. To ensure workers were legitimate, they were required to have successfully completed at least 50 prior HITs and to have had their work verified by the requester for at least 98% of all HITs they had completed. Based on a power analysis conducted in G*Power, with a desired effect size of .6 in Cohen's D, it was concluded that a minimum of 150 participants were needed for each study. Therefore, groups of at least 150 were recruited for each study. Each participant was paid US minimum wage for the time spent on the experiment. Ethical clearance for all studies was obtained through the University of Oxford.

5.4 Pilot Study

5.4.1 Purpose

Before running experiments 1 and 2, which aimed to manipulate parent relatedness to explore its influence onto autonomy support and anxiety, a manipulation check measured the efficacy of the relatedness manipulation I designed. Measuring and validating the treatment allows for causal inference between dependent and independent variables. The pilot study ran the experimental treatment with an online sample of parents and then measured their self-reported feelings of relatedness to their teenage child.

5.4.2 Methods

5.4.2.a Participants

Consistent with above, participants were recruited online through MTurk and the final sample included 180 valid responses. Anyone who self-identified as a parent of a 13-18-year-old could participate. The final sample contained 68 mothers and 77 fathers with children ranging in age from 13 to 18 (M = 14.924; SD = 1.649). Descriptive statistics and frequencies for the pilot are summarized in Table 5.1.

5.4.2.b Experimental Procedure

The pilot study manipulated parents' feelings of relatedness to their teenage child and then measured their subsequent relatedness satisfaction to explore whether the experimental manipulation lead to significantly different feelings of relatedness.

For the manipulation, participants engaged in a five-minute writing and reflection task, based on Strack, Schwarz, & Gschneidinger (1985). Parents were asked to focus on their teenage child and, if they had more than one teenage child, were told to select their eldest one. In the *Needs Support* condition, parents were asked to reflect on a time in the past month when using technology helped bring them closer to their child and to spend five minutes writing about that time. In the contrasting *Needs Thwart* condition, parents were asked to reflect on a time in the past month when technology made them feel disconnected from their child and spend five minutes writing about that experience. A final *control* condition told parents "People have a lot of experiences engaging with the Internet with their children. Reflect on something you did online in the past month and spend five minutes writing about it." All three conditions required five minutes of writing and the online survey software would not let participants move on until at least five minutes had passed. Following the prompt and the writing exercise, parents filled out a brief 3-item survey measuring feelings of

relatedness to their child. All vignettes were read to ensure that participants completed the prompt appropriately, and could therefore receive MTurk credit for their response, and sample responses are offered in Appendix E.

5.4.2.c Survey Design

Demographics. Parents reported demographic data for the child they were reflecting upon in the study. Parents were asked the age of their child (from 13-18) and to make a binary choice on their child's gender identity and their own gender identity.

Relatedness. Relatedness to one's child was assessed using the Basic Needs Satisfaction in Relationships scale (La Guardia et al., 2000). Three measures focussing on how the relationship with the child fills the parent's need for relatedness were averaged to create a composite *Relatedness* score. Following the prompt "When I am with my child[7]…" items included "I feel loved and cared about; I often feel a lot of distance in our relationship; I feel a lot of closeness and intimacy." Measures were averaged to create a composite relatedness score (α = .704). Table 5.1 summarizes the descriptive statistics for the pilot study sample and treatment frequencies for the manipulation check.

Table 5.1

Treatment Frequencies and Descriptive Statistics for the Pilot Study

Child Gender	Frequency	Valid Percent
Son (1)	109	59.6
Daughter (2)	74	40.4
Total	183	100

Treatment	Frequency	Valid Percent
Control (1)	51	28.5
Support (2)	56	31.3
Thwart (3)	72	40.2
Total	179	100

Construct	N	Min	Max	Mean	SD
Child Age	183	13	18	14.924	1.649
Relatedness	180	1	5	3.774	1.049

[7] When taking the survey, the word "child" was replaced with either daughter or son depending on the child's gender identity (which the parent had previously supplied)

5.4.2.d Analytical Strategy

To determine the efficacy of manipulating relatedness – the independent variable for subsequent studies – a manipulation check evaluated whether the writing task influenced parents' feelings of relatedness. A one-way Analysis of Variance (ANOVA) measured how relatedness, the dependent variable, differed across treatments.

5.4.3 Results

A one-way ANOVA of treatment by relatedness measured whether the writing task manipulated parent's feelings of relatedness. Results determined the treatment to be statistically significant ($ETA^2 = .173$; $F(2,176) = 18.435$; $p < .001$). Post-hoc comparisons indicated that both Needs Support and Control conditions significantly differed from the Needs Thwart condition ($p < .001$), but that Needs Support and Control did not significantly differ from one another ($p = .902$). Table 5.2 summarizes the means for each treatment.

Table 5.2

Descriptive Statistics for Relatedness across Treatment Conditions

Treatment	Mean	SD	Std. Error	95% CI
Control	4.170	.847	.119	3.932 to 4.408
Support	4.089	.900	.120	3.848 to 4.330
Thwart	3.241	1.075	.127	2.988 to 3.493
Total	3.771	1.051	.079	3.616 to 3.926

5.4.4 Discussion

Results from the emotional elicitation writing task produced different levels of relatedness based on the condition to which participants were assigned. Reflecting on a time that using

technology with one's adolescent made one feel close to his or her child produced a general satisfaction with and feeling of emotional closeness within the parent-child relationship. Reflecting on a time that using technology made you feel disconnected led to low relatedness-satisfaction. However, there was no statistically significant difference between the control condition and the relatedness support condition. In the written responses to the reflection task, parents assigned to the control condition wrote about a positive experience using technology with their child. When not anchored to a negative thought, parents were more likely to recall a general positive memory. This is consistent with Philippot, Schaefer, & Herbette (2003) who found that specificity and anchoring are required to effectively induce emotions.

Meta-analyses on emotional elicitation from clinical and social psychology indicate that writing tasks of varying lengths, subjects, and subjects are capable of inducing emotion both off- and on-line (Ferrer, Grenen, & Taber, 2015; Smyth, 1998; Westermann, Spies, Stahl, & Hesse, 1996). Based on these, the writing task was designed to encourage reflection and therefore induce emotion. However, to limit biasing participants' post-task responses, individuals were not surveyed on their levels of relatedness before the manipulation. Yet, levels of processing theory suggests that the methodology encourages reflection on the memory of interaction, which then increases the saliency of the emotion in question (Craik & Lockhart, 1972). Based on this theory and previous studies employing online emotional elicitation (Ferrer, Grenen & Taber, 2015), the manipulation appears effective at influencing self-reported feelings of relatedness.

Results from the manipulation check also correspond with its clinical definition. Deci and Ryan (2002) explain that as traits, individuals either experience needs satisfaction or needs thwarting, in which case the need is not satisfied. There does not exist a neutral condition to experiencing emotional connections. Therefore, experiments that aim to manipulate relatedness typically work to elicit this emotion through only two conditions (e.g. Pavey, Greitemeyer, & Sparks, 2011; Sheldon &

Filak, 2008). Based on the results of the elicitation task's manipulation check, subsequent studies used two conditions: needs support and needs thwart.

5.4.5 Conclusion

Results from the manipulation check confirmed that a five-minute writing task could manipulate feelings of relatedness. Specifically, there appear to be two states: feeling high connection and low connection. Based on this, the two specific and anchoring prompts were used in experiments 1 and 2.

5.5 Experiment 1: Relatedness and Autonomy-Support

5.5.1 Purpose and Hypotheses

In response to research on trust and autonomy-support, experiment 1 tested Hypothesis 1, on relatedness and autonomy-support, and Hypothesis 3, on autonomy support and mediation practices. Using an online experiment, this study manipulated parents' feelings of relatedness and then measured subsequent endorsement of autonomy supportive parenting practices and intentions to mediate Internet use. This aimed to establish the direction of causality between relatedness and environments and environments and subsequent mediation decisions. In doing so, it laid out the following hypotheses:

> *Hypothesis 1:* Feelings of relatedness to one's child predict parents' autonomy support in a technological context.
>
> *Hypothesis 3:* Autonomy support lowers use of restrictive strategies, and increases incidence of supportive strategies.

5.5.2 Methods

5.5.2.a Participants

Consistent with the pilot study, participants were self-identified parents recruited from MTurk. Individuals who participated in the pilot study were excluded from signing up for experiment 1. The final sample included 154 participants, 70 mothers and 84 fathers. Their children ranged in ages from 13-18. Descriptive statistics for the population are outlined in Table 5.3.

5.5.2.b Experimental Procedure

As outlined above, an online experiment was run through MTurk and Qualtrics. To measure whether relatedness influences parents' feelings of autonomy-support, the online survey software randomly assigned parents to one of two conditions: (1) relatedness need supportive and (2) relatedness need thwart. Consistent with the pilot study's manipulation check, the support condition asked parents to spend five minutes reflecting on and writing about a time that using technology made them feel close to their child and the thwart condition asked participants to write about a time that using technology made them feel disconnected from their child. The online experiment would not let participants move on until at least five minutes of reflection and writing had passed. Following the manipulation, parents filled out a brief survey that measured feelings of relatedness, the extent to which they endorsed autonomy supportive parenting practices, and their Internet mediation preferences. Parents also provided their gender identity and their child's gender identity and age.

5.5.2.c Survey Design

Demographics. For the treatment and the survey, parents were asked to select their eldest teenage child. Based on this, parents specified that child's age and gender. Parents were also asked to give their own gender identity.

Parent's Autonomy Support. Parent's relative autonomy support was measured using an adapted version of the Problems in Schools version of the Motivators' Orientation questionnaire (Deci, Schwartz, Sheinman, & Ryan, 1981). Four vignettes depicted possible ways that a parent might engage with their child over technology use. Each vignette was followed by four possible responses that corresponded to a different motivational orientation: Highly Autonomous, Moderately Autonomous, Moderately Controlling, or Highly Controlling. For each response, parents were asked to rate how appropriate they believed it to be on a scale of 1-7. Parent's ratings for each motivational orientation were averaged to create individual scores for each motivational orientation. Consistent with Deci et al. (1981), a composite Relative Autonomy support scale was constructed by HighlyAutonomous*2 +ModeratelyAutonomous-ModeratelyControlling-ModeratelyControlling*2. The vignettes and responses are provided in Appendix D.

Mediation Styles. Inspired by Duerager & Livingstone (2012) shortened items measured 6 of the mediation styles studied in Chapter 3: Active Mediation, Safety Guidelines, Co-Use, Restrictive Mediation, Filtering, and Monitoring. On a five-point Likert Scale from Strongly Disagree to Strongly Agree, parents were asked to say how likely they would be to employ each tactic in the coming month. Each mediation style was measured with one item, with the exception of restrictive mediation which was measured by two items. All items can be found in Appendix D and Table 5.3 summarizes descriptive statistics and frequencies for the experiment.

Table 5.3

Descriptive Statistics and Frequencies for Experiment 1

Child Gender	Frequency	Valid Percent
Son (1)	83	53.9
Daughter (2)	71	46.1
Total	154	100

Treatment	Frequency	Valid Percent
Support (1)	72	46.8
Thwart (2)	82	53.2
Total	154	100

Construct	N	Min	Max	Mean	SD
Age	154	13	18	14.49	1.54
Relatedness	154	1	5	3.69	1.04
Autonomy-Support	154	-10	17.25	0.18	4.57
Active	154	1	5	4.29	0.90
Safety Discussions	154	1	5	4.10	1.04
CoUse	154	1	5	3.76	1.13
Restrict	151	1	5	3.74	1.11
Filter	152	1	5	3.53	1.34
Monitor	154	1	5	3.84	1.22

5.5.2.d Analytical Strategy

General linear models in the form of one-way and two-way ANOVAs tested Hypothesis 1 that relatedness leads to parents' technological autonomy-support. Firstly, a one-way ANOVA measured feelings of autonomy support across the two treatment conditions. Following this, a two-way ANOVA measured the influence of treatment conditions and child gender onto parents' autonomy supportive practices.

Following this, Hypothesis 3 evaluated whether parents' autonomy support predicted their mediation preferences. To test this, regression models measured the direct effect of autonomy support onto each mediation style, while controlling for child age and gender.

5.5.3 Results

5.5.3.a Preliminary Results

Zero-order bivariate correlations were calculated between all surveyed variables. No significant patterns emerged amongst the correlations and all correlations were small. Results are summarised in Table 5.4.

Table 5.4

Pearson Correlations for Experiment 1 Variables

	1	2	3	4	5	6	7	8	9	10	11
1. Parent Gender	--										
2. Child Gender	.216**	--									
3. Child Age	.077	.021	--								
4. Relatedness	-.038	.059	-.184*	--							
5. Relative Autonomy Support	-.097	.020	-.047	-.014	--						
6. Active Mediation	.050	.076	-.273**	.216**	-.045	--					
7. Safety Discussions	.048	.114	-.283**	.301**	-.047	.633**	--				
8. Restrictive Mediation	.044	.133	-.330**	.147	-.289**	.521**	.512**	--			
9. Co-Use	.025	.117	-.173*	.370**	-.162*	.321**	.293**	.314**	--		
10. Filtering	.082	.171*	-.278**	.144	-.223**	.405**	.398**	.672**	.165*	--	
11. Monitoring	.167*	.155	-.333**	.253**	-.104	.513**	.495**	.546**	.247**	.612**	--

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

5.5.3.b Hypothesis 1: Feelings of relatedness to one's child predict parents' autonomy support in a technological context.

A one-way ANOVA by relatedness manipulation conditions measured the extent to which parents endorsed autonomy-supportive strategies. Contrary to the hypothesis, results suggest that parents were less likely to endorse autonomy supportive parenting when feeling related to their child. There was a statistically significant difference between treatment conditions ($ETA^2 = .039$; $F = 6.155$, $p = .014$), however, relative autonomy support decreased as relatedness increased ($Mean_{support} = -.781$; $Mean_{thwart} = 1.018$). Following this, two-way ANOVA analyses separately explored the effect for each gender. There was no statistically significant effect of gender ($p_{interaction} = .243$).

5.5.3.c Hypothesis 3: Autonomy support lowers use of restrictive strategies, and increases incidence of supportive strategies.

To test whether parents' autonomy support influenced their mediation styles, a series of regression models regressed autonomy support onto each mediation style. When controlling for a child's age and gender, autonomy supportive parenting did not predict the take-up of active mediation, safety discussions, or monitoring strategies. However, autonomy support lowered the likelihood of supporting restriction ($R^2 = .223$; $F = 14.073$; $p < .001$), filtering ($R^2 = .662$; $F = 9.814$; $p < .001$), and slightly of co-use ($R^2 = .075$; $F = 4.025$; $p = .009$). Parents who were more controlling were more likely to endorse restricting, filtering, or using the Internet with their children. While a child's gender did not influence endorsing co-use, active mediation, or safety discussions, parents were more likely to support all three restrictive strategies when they had daughters. Table 5.5 outlines autonomy support's significance for each regression model.

Table 5.5

The Influence of Autonomy-Support onto Parents' Mediation Decisions

	b	*β*	*SE*	95% CI	*p*
Relative Autonomy Support					
Restrictive Mediation	-.074	-.307	.014	-.108 to -.145	<.001
Filtering	-.069	-.328	.022	-.113 to -.026	.002
Co-Use	-.043	-.173	.019	-.081 to -.004	.029
Active Mediation	-.012	-.060	.015	-.042 to .019	.444
Safety Discussions	-.014	-.063	.018	-.049 to .021	.421
Monitoring	-.033	-.123	.020	-.073 to .007	.104

Note. Rows summarise the influence of one predictor (autonomy support) onto each outcome.

5.5.4 Discussion

Contrary to Hypothesis 1, results suggested that, regardless of the child's gender, when parents feel related to their adolescent child, they are less likely to endorse autonomy supportive parenting strategies and to instead support controlling practices.

The vignettes measuring autonomy support all focus on forms of discipline and structure. They measure whether parents respond to potentially problematic parenting situations by encouraging their child's autonomy or by controlling their children's responses. Both genders develop independence in adolescence, which influences parents' comfort responding to problem-situations (Smetana, Campione-Barr, & Metzger, 2006). Therefore, closeness may empower parents to speak up, because they know how they will be received. Further research should more deeply explore the relationship between autonomy-support, discipline, and independence for adolescents. As an alternate explanation, relatedness contributes to children's internalization of parent rules and values (Grolnick, Deci, & Ryan, 1997). The vignettes presented to parents did not explore whether the children endorsed or agreed with the parenting strategies. However, it is possible that parents assumed implicit child endorsement, because they felt closer to their children. As parents may be struggling to manage their adolescents, given their independence, closeness may signal to parents that they will have an impact. Despite a strong

history documenting the impacts and validity of vignette research (Aguinis & Bradley, 2014; Baard, Deci, & Ryan, 2004), future research should move from vignettes towards diagnosing parents' actual behaviour with their children, to further explore these results. Additionally, despite evidence that parents are more likely to support their son's autonomy than their daughter's, this did not appear in these results. This speaks to SDT's universal relevance. Pathways emerge between relatedness and autonomy because the theory governs our macro-behaviours.

While there were no observed differences between parents' provision of autonomy support for daughters and sons, parent autonomy support predicts the ways in which they intend to mediate their daughters' technology use. In line with Hypothesis 3 and Ghosh et al. (2018), parents who endorse autonomy supportive parenting, are significantly less likely to mediate their children's Internet use through restrictive rules or filtering technology. No effect was observed for active mediation, monitoring, or safety-discussions. Additionally, parents' endorsement of restrictive strategies was much stronger for daughters. These results suggest that several mediation strategies stem from a need to control children's lives, which is problematic as restrictive strategies decrease the take-up online opportunities (Livingstone & Smith, 2014). Just as control may decrease academic achievement and well-being outcomes, it can decrease online opportunities. Therefore, this finding links offline SDT theory with digital decisions to demonstrate the repercussions of parental control.

Parents' willingness to control their daughters' online activities suggests that young women may receive less support and encouragement for their online activities. While consistent with parents' offline autonomy-granting habits (Bumpus et al., 2001), the willingness to remove young women's digital agency is particularly troubling because it suggests that young women are less likely to experience digital opportunities. Additionally, when compared to their male peers, young women are less likely to have support systems that encourage technology exploration (Vekiri & Chronaki, 2008). This is supported by experiment 1's finding that as parents'

autonomy support decreases they are more likely to endorse restricting their daughters' internet use than their sons'. The studies in chapter 3 identified how this restriction may reduce daughters' take-up of opportunities. While future research should explore the outcomes of parents' decisions by including samples of young women, this research showcases how parents' autonomy support influences parents' decision-making around technology in ways that hold severe consequences for developing women.

5.5.5 Conclusion for Experiment 1

Experiment 1 manipulated parents' feelings of relatedness to their child to demonstrate a change in autonomy-support. Contrary to hypothesis 1, parents who felt close to their children were more likely to control their online behaviour. Parents who are not autonomy supportive prefer to use a range of restrictive strategies, particularly when they have daughters. This showcases the psychological underpinnings behind parents' actions. This study noted how relatedness influences parents' practices and comfort taking action with regards to their children's online behaviour. Yet, recognizing that parents' fears may interact with or lead to parents' actions (Lee, 2013), it is necessary to explore why parents develop fears and how they influence their behaviours. For this, I turn to experiment 2.

5.6 Experiment 2: Relatedness and Parent Anxiety

5.6.1 Purpose and Hypotheses

Recognizing the gendered nature of parents' fears (boyd & Hargittai, 2013) and that these gendered fears are often overblown (Cassell & Cramer, 2007), experiment 2 built on experiment 1 by examining the link between relatedness and parents' anxiety (Hypothesis 2) and between anxiety and subsequent mediation decisions (Hypothesis 4).

Explicitly, to measure relatedness' causal role, the study assigned parents to one of two conditions that manipulated their relatedness. Following this, it measured feelings of anxiety about a teenage child's internet use and hypothesized that relatedness decreases parents' anxieties about their children's Internet use, particularly for young women. It also measured parents' intentions to mediate their adolescents' Internet use and hypothesized that parents' anxiety increases parents' use of restrictive strategies and reduces the use of active strategies.

5.6.2 Methods

5.6.2.a Participants

Consistent with the pilot study and experiment 1, participants were self-identified parents recruited via MTurk. Subjects were excluded if they had already registered for the previous studies. The final sample included 157 parents: 88 fathers and 69 mothers.

5.6.2.b Experimental Design

As in experiment 1, the written manipulation task with Needs Support and Needs Thwart conditions was given to parents recruited through MTurk. To determine causality, the online software randomly assigned participants to each condition. Following the written emotion elicitation task, parents took a brief survey measuring their anxiety about their child's Internet use and whether they intended to use each mediation strategy.

5.6.2.c Survey Design

Demographics. Consistent with experiment 1, parents reported their child's age and made a binary judgment on his or her gender identity. Parents also reported their gender identity.

Parent Anxiety. Parent anxiety was measured along two constructs: generalized anxiety around Internet use and concrete fears. Adapted from Joiner, Brosnan, Duffield, Gavin, & Maras (2007), 6 items assessed a parent's feelings of anxiety about their teenage child's Internet use. Items included "I always feel anxious when my child is using the Internet; I go out of my

way to make my child avoid using the Internet," where child was replaced with the either daughter or son based on the participant's child's gender identity. Items were averaged to create a composite *Internet Anxiety* score (α = .814). In addition to querying generalized anxiety, 12 items measured specific fears parents might have about their child's Internet use. Adapted from Madden, Cortesi, Gasser, Lenhart, & Duggan (2012) and Sorbring, (2014), items included fears such as "How my child manages their reputation online; The amount of information advertisers can learn about my child's online behaviour; My child will come into contact with inaccurate information." Responses were based on a five-point scale from 'Not at all concerned' to 'Highly concerned' and all items were averaged to create a composite *Concrete Fears* score (α= .932).

Mediation Styles. Parent mediation styles were measured using the same 7-item scale as in experiment 1. Items are summarized in Appendix D and descriptive statistics are offered in Table 5.6.

Table 5.6

Descriptive Statistics and Frequencies for Experiment 2

Child Gender	Frequency	Valid Percent
Son (1)	99	63.1
Daughter (2)	58	36.9
Total	157	100

Treatment	Frequency	Valid Percent
Support (1)	82	52.2
Thwart (2)	75	47.8
Total	157	100

Construct	N	Min	Max	Mean	SD
Age	157	13	18	14.64	1.62
Relatedness	157	1.67	5	3.64	.91
Internet Anxiety	157	1	4.17	2.42	.87
Specific Concerns	157	1	6	3.56	1.18
Active	157	1	5	4.03	1.044
Safety Discussions	157	1	5	3.97	1.086
Co-Use	157	1	5	3.76	1.161
Restriction	157	1	5	3.36	1.24
Filter	156	1	5	3.26	1.387
Monitor	157	1	5	3.48	1.352

5.6.2.d Analytical Strategy

Hypothesis 2 queried whether reducing relatedness lowered parents' anxiety over their children's Internet use. To explore the general effect of the relatedness manipulation onto parents' anxiety, a one-way ANOVA measured the difference in anxiety across treatment

conditions. Following this, separate two-way ANOVAs by parent's gender measured the influence of treatment conditions and child gender onto parent anxiety.

To explore Hypothesis 4, that parents' anxiety predicts their mediation decisions, a series of regression analyses measured the direct effect of parent anxiety onto each mediation style, while controlling for a child's age and gender.

5.6.3 Results

5.6.3.a Preliminary Results

Pearson correlation coefficients were calculated for each variable in Experiment 2. While mediation subtypes were mildly correlated with one another, no significant patterns were observed. Results are summarised in Table 5.7

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Table 5.7

Pearson Correlations for Experiment 2 Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Child Gender	--											
2. Parent Gender	.226**	--										
3. Age	-.210**	.023	--									
4. Relatedness	.125	.078	-.056	--								
5. Internet Anxiety	-.090	-.209**	-.155	-.435**	--							
6. Specific Concerns	.083	-.163*	-.076	-.193*	.498**	--						
7. Active	.172*	.040	-.275**	.038	.150	.324**	--					
8. Safety Discussions	.177*	-.038	-.263**	.089	.122	.386**	.634**	--				
9. Restriction	.105	-.018	-.358**	-.139	.488**	.534**	.527**	.571**	--			
10. Co-Use	.076	-.019	-.144	.167*	.106	.315**	.338**	.412**	.367**	--		
11. Filter	.077	.011	-.281**	-.123	.419**	.506**	.382**	.483**	.710**	.322**	--	
12. Monitor	.071	-.009	-.217**	-.154	.365**	.444**	.396**	.545**	.668**	.342**	.739**	--

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

5.6.3.b Hypothesis 2: Feelings of relatedness decrease parents' anxiety about children's Internet use, particularly for daughters.

A one-way ANOVA measured parents' anxieties across the relatedness treatment. Results from hypothesis 2 suggest that relatedness reduces parents' anxiety about their children's Internet use. Regardless of the child's gender, there was a statistically significant difference between treatment conditions unto both generalized fears ($Mean_{support}$ = 2.224; $SD_{support}$ = .878; $Mean_{thwart}$ = 2.625; SD_{thwart} = .818; ETA^2 = .053; F = 8.718, p = .004) and specific anxieties ($Mean_{support}$ = 3.378; $SD_{support}$ = 1.111; $Mean_{thwart}$ = 3.767; SD_{thwart} = 1.235; ETA^2 = .027; F = 4.333; p = .039).

Following this, two-way ANOVAs explored the interaction between children's gender and anxiety, by parent's gender. As regards generalized anxiety, the effect for fathers' anxiety fell away and there was no impact by gender ($p_{treatment}$ = .070; $p_{interaction}$ = .665). However, there was a significant effect for mothers (F=5.016; $p_{treatment}$ = .013; $p_{interaction}$ = .029). While mothers were not anxious about their sons' Internet use, they were significantly concerned about their daughters. The means are summarized in Table 5.8 and graphed in Figure 5. When tests were repeated for concrete fears, fathers were not anxious about either gender ($p_{treatment}$ = .254; $p_{interaction}$ =.126), while mothers were highly anxious, regardless of child gender ($p_{treatment}$ = .010; $p_{interaction}$ =.807).

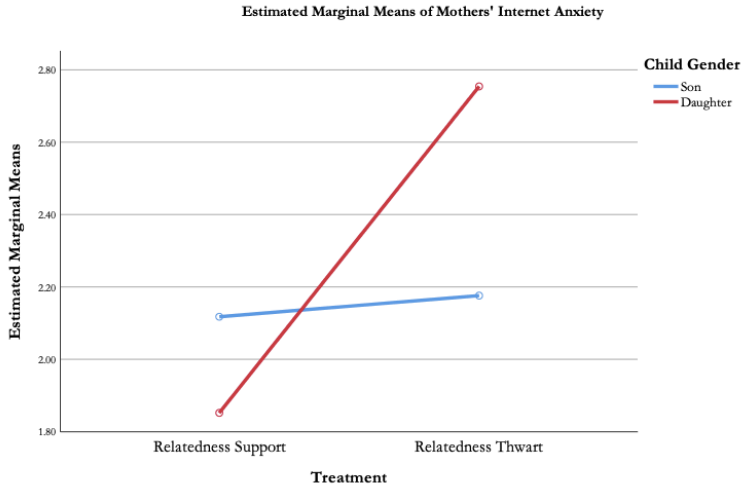
Table 5.8

Descriptive Statistics for Parent's Generalized Anxiety Across Treatment Conditions

Parent Gender	Child Gender	Treatment	Mean	Std. Error	95% Confidence Interval
Father	Son	Support	2.507	.152	2.205 to 2.809
		Thwart	2.802	.152	2.500 to 3.104
	Daughter	Support	2.189	.222	1.748 to 2.630
		Thwart	2.667	.286	2.097 to 3.236
Mother	Son	Support	2.118	.190	1.739 to 2.496
		Thwart	2.176	.184	1.808 to 2.544
	Daughter	Support	1.852	.184	1.484 to 2.220
		Thwart	2.754	.195	2.364 to 3.144

Figure 5

Estimated Marginal Means for Mothers



5.6.3.c Hypothesis 4: Parents' anxiety increases parents' use of restrictive strategies, and reduces the use of active strategies.

Linear regression models explored the direct effect of a parent's anxiety onto his or her mediation preferences. Parents' generalized fear about Internet use predicts their decisions to restrict ($R^2 = .328$; $F = 14.907$; $p < .001$), filter ($R^2 = .227$; $F = 14.907$; $p < .001$), and monitor ($R^2 = .164$; $F = 10.014$; $p < .001$) their children's Internet use. When fears focus on specific aspects of Internet use, parents are more likely to use all mediation strategies available: restrictive mediation ($R^2 = .387$; $F = 32.141$; $p < .001$), filtering ($R^2 = .316$; $F = 23.400$; $p < .001$), monitoring ($R^2 = .231$; $F = 15.340$; $p < .001$), active mediation ($R^2 = .117$; $F = 10.974$; $p < .001$), co-use ($R^2 = .114$; $F = 6.566$; $p < .001$), and safety discussions ($R^2 = .214$; $F = 13.857$; $p < .001$). Despite controlling for gender, no effect was observed for gender. Results from these tests are summarized in Table 5.10.

Table 5.9

The Influence of Generalised Anxiety and Concrete Fears onto Parents' Mediation Decisions

	b	*β*	*SE*	95% CI	*p*
Generalised Anxiety					
Restrictive Mediation	.645	.455	.096	.456 to .835	< .001
Filtering	.628	.394	.116	.398 to .858	< .001
Monitoring	.541	.348	.117	.309 to .772	< .001
Co-Use	.124	.093	.108	-.089 to .033	.252
Active Mediation	.153	.127	.095	-.032 to .337	.105
Safety Discussions	.126	.101	.098	-.067 to .320	.199
	b	*β*	*SE*	95% CI	*p*
Concrete Fears					
Restrictive Mediation	.532	.51	.066	.401 to .664	< .001
Filtering	.572	.489	.079	.416 to .728	< .001
Monitoring	.492	.431	.081	.331 to .653	< .001
Co-Use	.298	.304	.075	.149 to .446	< .001
Active Mediation	.263	.298	.065	.134 to .391	< .001
Safety Discussions	.331	.361	.066	.201 to .462	< .001

5.6.4 Discussion

Experiment 2 makes three primary contributions to our understanding of relatedness, parents' fears, and mediation decisions. Firstly, it establishes a causal link between relatedness and fear. Secondly, it establishes a gender difference between this link and parents' behaviour. Finally, it showcases how relatedness and fear lead to parents' mediation decisions.

Results from hypothesis 2, testing the relationship between relatedness and anxiety, demonstrated that feeling close to your child reduced feelings of anxiety around his or her Internet use. In the online experiment, parents assigned to the relatedness-support condition evidenced lower feelings of both generalized anxiety and concrete fears. Pomerantz et al. (2012) correlates relatedness with parent and child behaviours, and this study builds on these findings by showing how relatedness causes parents' behaviours. Yet, while the treatment was statistically significant, this stems from the effect that relatedness has on mothers' perceptions of daughters. Further

investigation of generalized anxiety via two-way ANOVAs found no effect for sons, despite a large effect for daughters.

Mothers may be falling prey to media rhetoric around girls and technology. When mothers feel unrelated to their child, they only report high anxiety about that child's Internet use if that child identifies as a woman. Results from hypothesis 2 found that mothers report similarly low generalized anxiety about sons, regardless of the emotional bond, despite little evidence suggesting that boys are less susceptible to generalized risks than girls (e.g. Livingstone, 2016; Livingstone & Smith, 2014). These results imply that when mothers are emotionally intimate with their daughters, they do not fear new technology. Cassell & Cramer (2007) note that because research and writing about women and technology often ignore young women's voices during production, women are unable to dispute risk perception and have no agency. When emotional closeness emerges, mothers can move away from rhetoric and towards supporting their daughters.

Mothers' imbalanced fears over their daughters' Internet use is troubling because of the ways in which anxiety passes through families and limits what women can access. Research on math anxiety, whose construct was the basis for several Internet anxiety scales (Powell, 2013), identified that parents uniquely pass their math anxiety and stereotypes onto daughters. This influences young women's math attitudes and anxiety, which in turn influences their outcomes and performance (Gunderson et al., 2012). Notably, when daughters' perceive mothers' support or mothers' lowered anxiety, girls show lowered math anxiety and higher performance, but mothers' anxieties have little effect on sons (Casad, Hale, & Wachs, 2015; Tomasetto et al., 2011). This is supported by findings showcasing how gender role expectations pass from mother-to-daughter, regardless of the mother's employment and education level (Jan & Janssens, 1998). Given the difference in parents' fears, it is possible that parents' concerns will uniquely pass on to daughters, impacting their ability to pursue online opportunities. To explore causality, and establish how relatedness influences parents, this

research design excluded children, but further research should replicate this design but also survey children on their generalized anxieties. Additionally, it is possible that mothers are concerned about daughters because of the hostility they have felt online or their negative experiences using technology. While this was difficult to test with MTurk workers, who are often Internet savvy, further work should explore parents' Internet-related experiences in a more representative sample.

While a child-gender effect was observed for generalized anxiety, a child's gender did not impact mothers' concrete fears for their child's Internet use. The scale measuring concrete fears was adapted from boyd & Hargittai (2013) who created their list based on media rhetoric and actual risks from using the Internet. Feeling related to one's child reduced a mothers' belief in these fears and points to how media fear-mongering may lead parents to overestimate specific risks for both genders.

Risk perceptions influence how parents mediate the Internet. As Chapter 3 demonstrates how restrictive strategies limit opportunities, these results point to the ways in which overblown fears may limit young women's opportunities and adolescents' technical successes. Future research should explore whether parents' gendered risks differentially influence daughters and the effect that risk perception has on both genders' opportunities by looking at parent-child dyads.

Results testing hypothesis 4 on anxiety and mediation habits found that parents develop restrictive habits in response to their concerns about children's technology use. Generalized fears relating to the Internet prompt parents to adopt all restrictive strategies. By demonstrating the link between all restrictive strategies, these results build on Lee (2013), which found that parents' anxieties predict their use of pure restriction. This study established a divide between generalized fear of technology and specific technology-related concerns. Those with generalized fear of technology focus on restrictive tools. Yet, when dealing with specific fears such as cyberbullying or contact risks, parents are much more likely to employ all strategies, consistent with Nikken & Jansz

(2014). While parents are still responding to these fears with restriction, they also utilize supportive strategies like safety discussions and co-use. This suggests that parents respond to specific concerns with the breadth of tools available to them and are comfortable using the autonomy supportive strategies that psychologists encourage because they are responding to specific items not internalised rhetoric. The breadth of strategies employed suggests that parents may be looking for solutions to mitigate what they can name (Nikken & Jansz, 2014). It may be easier for parents to discuss their discrete nameable fears with their adolescent children, which increases their ability to use supportive strategies. Future research should determine effective ways parents can name and tame their fears.

Additionally, these findings establish a distinction between generalized anxiety and concrete risks. Parents respond differently to each type of fear, suggesting that parent education initiatives should view these as distinct constructs each requiring different mitigation strategies. Future research should explore the efficacy of parent education programmes that nudge parents to use autonomy supportive strategies instead of restrictive tools. If done supportively and non-judgementally, parent education can help parents adopt emotionally-supportive and involved behaviours (Schaefer, 1991). Notably, while gender influenced parents' endorsing of restrictive mediation practices in response to autonomy-support, gender was not predictive of mediation preferences when exploring the influence of parents' anxiety. This points to anxiety's strong effects onto parents' decisions and that both parent and child gender must be factored into research on parenting practices. Yet, parents' gender roles and gender-based responsibilities are strongly related to cultural identities and practices (Best, House, Barnard, & Spicker, 1994). While this research and others has documented the transmission of parents' anxieties and expectations onto children in predominantly white and western populations (Eccles et al., 1990; Gunderson et al., 2012), future research should replicate this work within other cultures.

5.6.5 Conclusion for Experiment 2

Experiment 2 contributes to our understanding of parent relatedness by showcasing that when they don't feel close to their children, parents fear their Internet use (hypothesis 2) and seek to restrict it (hypothesis 4). Both of these are likely to influence what teenagers then choose to, or are empowered to, access. However, this study is limited in that it does not test the direct influence of parents' attitudes onto their children. Despite this, by establishing the causal importance of relatedness in parents' anxiety, this experiment makes important contributions to our understanding of SDT and parents.

5.7 Concluding Discussion

This study manipulated relatedness to show the causal role that it plays in parents' psychology and subsequent parenting decisions. In two online experiments, parent cohorts participated in a relatedness manipulation before answering brief surveys that established a relationship between relatedness and decreased autonomy support (Experiment 1) and decreased Internet anxiety (Experiment 2). Following this, each parent cohort reported on their mediation preferences. This connected autonomy support and anxiety to parents' mediation decisions. Through these tests, this study links parents' psychology to their parenting habits and explores whether parents make decisions based on their child's gender.

However, as an online experiment, this study was unable to include children in its experimental design. Despite evidence that MTurk experiments are reliable and valid (Buhrmester et al., 2011), this study could not link parents' reported behaviours and attitudes with their in-person decisions. It is possible that parents' self-identified parenting goals are interpreted differently by their children or are difficult to follow through with in practice (Grolnick et al., 2002). Therefore, future research should work with parent-child pairs in homes to further generalize these results. Regardless

of this limitation, this chapter makes an important contribution to our understanding of parents and relatedness by demonstrating the causal significance of relatedness.

Experiment 1 found that parents were equally autonomy supportive of their adolescent daughters and sons, while experiment 2 established that mothers only develop fear around their daughters' Internet use. Despite the risks stemming from gendered parenting practices, these combined results contribute to our understanding of SDT by showcasing how relatedness influences parents. Much research into parent-child relatedness has focused on how relatedness to a parent influences child and adolescent development (e. g. Pomerantz et al., 2012). By demonstrating how relatedness-satisfaction influences parents and the decisions they make, this study offers a theoretical contribution to our understanding of parents' needs satisfaction. Furthermore, hypotheses 3 and 4 found that when parents' relatedness is satisfied, they are less likely to restrict technology. Yet, results from hypothesis 3 identified how parents of daughters are more likely to restrict their children's digital activities than are parents of sons. As restricting technology may lower the take-up of online opportunities and feelings of relatedness may promote the take-up of opportunities (results summarized in chapter 3), these results demonstrate how relatedness can create conditions to promote adolescent development. Further research should evaluate the impact of parents' relatedness satisfaction on a child's relatedness and relatedness satisfaction to explore whether parents' need satisfaction can support teenagers' needs. Despite this, it is evident that to encourage adolescents' development, parents should focus on building close relationships with their children by involving themselves in their lives. This closeness is necessary to ensure that adolescent women grow up in the optimal developmental climate and are not subject to parents' gendered proclivity towards restrictive strategies and anxiety.

6 CONCLUSION

Following the integrated thesis format, this dissertation explored the ways in which self-determination theory could be applied to improve our understanding of young women's take-up of technical opportunities. Specifically, it showcased the role that relatedness plays in encouraging young women's pursuit of both general online opportunities and computer science study, as well as relatedness' role in helping parents create interpersonal contexts to support this take-up. In doing so, it both extends self-determination theory's relevance and increases our understanding of the specific ways to support young adolescent women.

By focusing on adolescent women through three discrete studies, this thesis demonstrates the broad ways that technology and support systems can be used to enhance adolescents' developmental processes. The integrated thesis format is particularly well-suited for advancing theory because together these three studies showcase self-determination theory's broad applicability within this domain. Using the three principal methods available to empirical psychologists – secondary data analysis, an in-person quasi-experiment, and a true experiment – this research demonstrated how self-determination theory applies to the multiple contexts where teenagers engage with technology. The theory's durability across these methodologies points to the robustness of its relevance and underscores the importance of its results. The individual studies each build on each other and each individually deepens our understanding of SDT in young women's lives. Collectively they showcase how SDT can explain young women's experiences with technology. The integrated thesis format was selected purposefully to allow for a mixed-methods approach that considered the multiple areas and contexts where and how social support systems might influence teenage girls' technology behaviours. On top of their individual contributions, when integrated, the three studies make a significant joint contribution to both SDT and developmental literature.

In what follows, I begin by reviewing the individual contributions of each chapter. Following this, I outline the integrated contributions of this thesis' findings. I focus first on describing their joint findings about relatedness, then review their findings about parents, and finally outline how this influences our understanding of SDT. After integrating the findings, I offer ideas for future research that could better unite these results and make policy recommendations that extend from these findings. I finally conclude with two debugging recommendations that could unite the disparate threads discussed throughout the thesis.

6.1 Individual Contributions

In addition to broad implications from the integrated results, each individual study offers discrete conclusions that merit repetition because of their significance to policy debates around young women's digital lives.

Study 1 (chapter 3) identified the importance of social support in encouraging adolescent women's take-up of Internet-enabled opportunities. While parents' restrictive rules limited the opportunities explored, feeling support predisposed young women to use digital technology in line with their goals and values. The study identified that parent, peer, and teacher support mapped onto discrete opportunities, but that parents' involvement and relatedness uniquely predicted the psychological motivation necessary for the take-up of all digital opportunities. Yet, study 1 also foregrounded the importance of digital skills in this take-up. In both 2010 and 2014, results identified that without digital skills, young adolescent women were unable to take up opportunities, regardless of social support. Despite media's continual emphasis on 'digital natives,' these results extend research traditions showcasing that skills are not innate and that intervention and education are needed to build them (Bennett & Maton, 2010; Helsper & Eynon, 2010).

Building on this, to explore the influence of relatedness and the rise of interventions targeting young women's motivation for computer science study – one critical digital opportunity – study 2's (chapter 4) delayed treatment quasi-experiment measured the changes within participants at a day-long conference targeting adolescent women interested in computer science. Contrary to hypotheses and despite similar programmes with this format (see Appendix C), the targeted day-long programme did not improve students' feelings of relatedness or their motivation for studying computer science. While future research should explore the long-term trajectories of participants and the impacts of longer interventions, these results establish the inefficacy of current policy and industry programmes that look to reverse the declining number of women in technical communities. It points to an urgent need for more psychology-based research investigating women in computer science and related outreach initiatives.

Study 1 also identified the importance of intrinsic motivation for taking up digital opportunities. While research on online opportunities traditionally focuses on external structural factors that can hinder or encourage technology use (e.g. Livingstone & Helsper, 2010; Mascheroni & Ólafsson, 2016), these results showcase that one must be intrinsically motivated to sustain constructive technology use. The more autonomously motivated the young woman, the greater her take-up of online opportunities. Results also showcased how motivation to use the Internet can be nurtured by parents' support and rule-setting strategies and that this motivation leads directly into young women's decisions to engage online. By demonstrating how motivational factors also govern our online behaviours, these results extend SDT literature showcasing that intrinsic motivation leads to offline opportunities (e.g. Baard et al., 2004; Grant, 2008). Yet, study 1 also identified that parents' rule-setting limits intrinsic motivation, while parents' support increases it. Therefore, it was critical to explore how to nurture encouraging parents.

In response to this, study 3 (chapter 5) transitioned to focus on parents to explore what predicted the parenting styles necessary for young women's take-up of digital opportunities. Just as relatedness predicted positive outcomes from young women's technology use, results indicated that relatedness reduced both parental autonomy-support and anxiety around young women's technology use and thus fostered the parenting styles necessary for young women's take-up of online opportunities. While it found that mothers were significantly more anxious about their daughters' technology use than their sons, it identified that, regardless of gender, when parents feel related to their children, they stop restricting media content. This speaks to the factors that contribute to and result from the relationship changes that emerge during adolescence (Steinberg, 2001). Critically, these results contribute to both parenting and adolescent development literatures.

6.2 Integrated Contributions

While each study offers individual contributions and insights into ways that social support can be harnessed to support adolescent women's technology engagement, when taken together, these studies combine to offer shared insights into the importance of relatedness, the role that parents play in adolescence, and SDT's relevance across domains.

6.2.1 Relatedness in Adolescent Women

Together, these studies contribute greatly to our understanding of the importance of relatedness and social support in female adolescents' development and decisions to engage with digital opportunities.

Study 1 used cross-sectional data to showcase the importance of relatedness in young women's lives. Results from the 2010 and the 2014 cohorts showed how different sources of social support mapped onto discrete online opportunities. Students who felt close to teachers were likely

to take-up the Internet for learning, while young women who felt supported by their peers were likely to use the Internet for socialising and self-expression. Notably, despite a four-year gap between cohorts, identifying and feeling supported continued to be significantly predictive of online opportunities. Extending findings showcasing the ways that peers, teachers, and parents differentially influence offline adolescent development (e.g. Soenens & Vansteenkiste, 2005), these results indicated that the characteristics of offline relationships can encourage online opportunities. Following this, analyses within the 2014 cohort demonstrated how parental involvement – the theoretical precursor to relatedness (Grolnick & Farkas, 2002) – predicts intrinsic motivation for technology use and general self-regulation of internet use. This motivation and self-regulation then leads adolescents to pursue digital opportunities. Together, these results suggest that social support encourages the take-up of online opportunities and highlights the importance of psychological feelings of relatedness in young women's lives.

Study 2 focused on one specific digital opportunity, computer science education, and explored the factors that influenced young women's intrinsic motivation for the field. While self-determination theory states that competency and autonomy are more important than relatedness for fostering intrinsic motivation (Deci & Ryan, 2000), results from young women exposed to computer science suggested that relatedness is significantly more important than other basic needs in encouraging motivation.

To underscore the significance of relatedness, studies 1 and 2 used regression analyses within cross-sectional data to demonstrate relatedness's importance for young women. However, while this points to relatedness' relevance, the datasets' design prohibited determining causality. Therefore, to assess relatedness' causal ability, study 3 used experimental methodologies to explore whether relatedness influences parents' decisions around their children's technology use.

Study 3 demonstrated that feeling related to one's child decreased parents' use of autonomy supportive parenting strategies. It also decreased maternal fears about their daughters' technology use. While the decrease in autonomy supportive parenting is troubling, given its importance for child development (Eccles, Early, Fraser, Belansky, & McCarthy, 1997; Soenens, Vansteenkiste, et al., 2007), reducing mothers' gendered fears has been previously linked with young women's functioning (Cassell & Cramer, 2007). Therefore, study 3 establishes how changes in relatedness can lead directly to positive adolescent outcomes from technology use.

Taken together, these results speak to the significance of relatedness in young women's lives and digital activities. Supportive and constructive social environments can reduce incidence of offline risks – including smoking and body image concerns – and increase young women's emotional well-being and opportunities – including academic performance and self-esteem (Brown, 2013; Daniels & Leaper, 2006; Dohnt & Tiggemann, 2006; Snow & Bruce, 2003). While this thesis did not focus on risks, its findings on relatedness suggest that relatedness may also safeguard against online risks. Findings from this thesis suggest that these results may be causal and add to our understanding of relatedness' outcomes. In addition to encouraging offline outcomes, relatedness may act as a safe-guard that helps encourage young women to explore their self-concept through digital experiences.

Despite widespread moral panics and negative discourse around young women's technology use (Cassell & Cramer, 2007; Sales, 2013, 2016), these three studies underscore how, when adolescents feel related to others, technology use can enrich their lives, rather than live up to the vision implicit in the media-led moral panic.

6.2.2 Parenting Adolescent Technology Use

While the thesis focused broadly on the role of social support in encouraging and sustaining young women's technology-related motivation, the role of parents' shifting position in adolescence

appeared as a recurrent theme across the three studies. In Study 1's 2010 cohort, parent support reduced incidence of creative Internet uses and the study's 2014 cohort built on these results to find that parent safety discussions reduced incidence of learning outcomes, civic outcomes, and general activities. It appears that feeling close to one's parents may reduce the teenage girl's need for online resources. Similarly, both cohorts identified that parents' restrictive Internet mediation reduced the take-up of all online opportunities. Yet, while these rule-setting strategies repressed Internet opportunities, findings from the 2014 cohort suggested that emotional involvement increased intrinsic motivation for Internet use, which later predicted the take-up of online opportunities. Together, these results showcase that feeling intimate with one's parents increases the positive outcomes from an adolescent woman's technology use and that, just as the parent-child relationship predicts offline well-being (Steinberg, 2001), it can predict online well-being.

Building on these cross-sectional findings, study 3 looked at how parents' feelings of relatedness directly influenced their parenting decisions. Feeling related to one's child decreased anxiety around internet use, which in turn reduced parents' reliance on restrictive mediation strategies. Relatedness therefore emerged as a factor that influences the strategies parents adopt – strategies that study 1 identifies have the power to either reduce or encourage young people's take-up of computer science study and other digital opportunities.

These joint findings demonstrate the continued importance that parents hold in adolescence. Despite research that parents' influence declines during the teenage years (Steinberg, 2001), findings across this thesis suggest that parents continue to serve either a protective or a deterring role in adolescents' lives. While emotional involvement and intimacy can increase the likelihood of intrinsic motivation and subsequent opportunities, when parents don't nurture their children's Internet use and instead involve themselves by restricting and limiting it, they can unknowingly hamper their daughters' developmental uses of technology.

6.2.3 Applying Self-Determination Theory to Young Women's Technology Study

In addition to contributing to our practical understanding of young women's technology use, these three studies make a significant theoretical contribution to self-determination theory. While SDT has previously been applied to adolescent development (e.g. La Guardia & Ryan, 2002) and video games (e.g. Ryan, Rigby, & Przybylski, 2006; Shen, Liu, & Wang, 2013), this thesis marks the first large-scale investigation of SDT as it relates to teenage girls' technology use. While there are many ways to apply SDT to technology use, this study makes a crucial first step by exploring multiple aspects of the theory's framework. Firstly, it applies theories of intrinsic and extrinsic motivation to showcase that intrinsic motivation is necessary for young women to pursue digital opportunities. Building on this, it applies basic needs theory in study 1 to demonstrate how relatedness predicts the take-up of online opportunities and again in study 2 to showcase the unique importance of relatedness in teenage girls' motivation for computer science study. Finally, in study 3, it shows causally how relatedness predicts parents' decisions around their children's technology use. While SDT's previous parenting research identified that parent relationships lead to positive emotional and academic outcomes for teenagers, this crucially demonstrated relatedness' causal impact and how it influences parents. Together, these findings successfully apply SDT to describe the ways in which parents and daughters are motivated to use technology for personal growth and development.

Showcasing self-determination theory's relevance across domains and outcomes suggests the universality of the theory. As a macro-theory of human behaviour, these findings demonstrate how technology use is an extension of teenagers' lives and that the same theories that govern their motivation offline govern their motivation online. This important discovery suggests that future work should apply SDT towards modelling other aspects of our digital lives. It also suggests that SDT can be used as an educational framework to design interventions that motivate continued good

behaviour. While future work can continue to investigate this by working with educators to evaluate new media literacy or computer science educational programmes, this is a crucial first step.

6.3 Avenues for Future Research

By investigating ways to apply self-determination theory towards understanding teenage girls' technology engagement, this thesis advances research across several domains in teenagers' lives. In doing so, it advances the theory to demonstrate the specific ways that motivation and social support lead to positive outcomes for developing female adolescents. Yet, despite these important combined results, to deepen them and determine the best ways to apply their findings, I offer three avenues for future research: ways of fostering relatedness, motivational correlates, and intersectionality impacts.

This thesis identified that young adolescent women must feel related to others in order to enjoy digital opportunities. It also demonstrated that relatedness reduces parents' anxiety and their decision to restrict technology use. However, despite identifying the importance of relatedness, the thesis was unable to discover how it develops in either parents or children. While the Bit by Bit event was modelled off of common technical interventions, it did not change attendees' feeling of relatedness. And, while the writing and reflection task in study 3 effectively manipulated parents' relatedness to their children, it is highly unlikely that the reflection task's impacts will last long after the study. In testing manipulations, this thesis demonstrated the importance of determining their efficacy. However, future research is necessary to evaluate effective and sustainable ways of fostering parents' relatedness to their daughters and daughters' relatedness to their parents and peers.

This presents opportunities across HCI, education, and psychology research traditions. Firstly, researchers should partner with existing programmes for young women such as Girls Who Code, media literacy initiatives, and parent-child programmes to determine if they are effective at fostering relatedness and social support. Then, in addition to exploring the influence of existing

programmes, education and psychology researchers can apply their theoretical understanding towards identifying classroom and psychology-based interventions to foster relatedness. Towards this, HCI research can work within communities to co-design new strategies that harness local knowledge towards developing sustainable interventions. For example, the University of Washington's KidsTeam works with children to co-design tools that foster their development. This points to how researchers can work with students and use their local knowledge towards long-term change. By evaluating the efficacy of existing programmes and by advancing theory and practice for new programmes, researchers can further our understanding of relatedness' importance and ensure that its value is harnessed by diverse communities.

All studies pointed to the importance of intrinsic motivation for the take-up of digital opportunities. Just as intrinsic motivation predicts strong academic outcomes, work performance, and prosocial behaviour (Baard et al., 2004; Grant, 2008; Guay et al., 2010), it may predict the decision to persist in computer science or to use the Internet in line with one's goals and values. While much research on both digital risks and rewards focuses on concrete incidence of either outcome, the motivation behind teenagers' pursuit of online opportunities had previously been ignored. Future research should evaluate the motivation behind technological decision-making across tools and in more diverse samples. Additionally, it is critical that researchers apply other aspects of SDT to identify correlates and predictors of intrinsic motivation. While this thesis identified that relatedness is key for adolescent women, additional research should build on this finding by further exploring how other basic needs and demographic factors may contribute to intrinsic motivation. This will allow policy makers and families to ensure they are best-supporting children's development.

Because of differences in how young women's technology use is framed and how women are treated in digital spaces and technical communities (e.g. Camp, 1997; Cassell & Cramer, 2007; Sales,

2016), this thesis focused exclusively on strategies to change this narrative by supporting adolescent females' outcomes. However, as outlined in the introduction, in applying quantitative psychological methods to its research question and to speak to broader policy narratives, it avoided the intersectional approach and was unable to include young women's voices in the research. Towards this, future qualitative research should highlight how the ideas raised in this thesis intersect with issues of class, race, ethnicity, ability, and other factors to avoid advancing one image of young women's lives over the current narrative. This thesis champions an image of strong opportunity-seeking women. However, having one vision of young women represent the many voices of that generation is inherently problematic, even if that vision corrects the negative discourse within prior images. Therefore, future research should use intersectionality as a lens to represent the diversity within this narrative. In addition to applying the intersectional approach, this research should look closely at gender identity and how the strength of this identification influences women's experiences and the importance of relatedness.

Following these three avenues will help deepen the theoretical and practical understanding of how SDT applies to young women's technological lives, bring nuance to this quantitative work, and build on this thesis's necessary first step in applying SDT to this new area.

Based on this thesis's significant findings, I now offer suggestions that policy makers, educators, and parents can apply to improve young women's trajectories.

6.4 Policy Suggestions to Harness Relatedness

The integrated contributions point to the need for policy interventions that directly harness relatedness to support young women's development. Relatedness, a fundamental tenet of SDT, influences both parents and children. By finding that relatedness is of paramount importance for young women's intrinsic motivation and their take-up of digital opportunities, as well as that

relatedness can nudge parents towards creating optimal developmental climates for their adolescent daughters, this thesis points towards relatedness-harnessing interventions in three domains: education, parents, and the broader media narrative.

6.4.1 Relatedness in Education

Together, these three studies showcase how relatedness to others can help young women develop intrinsic motivation for online opportunities and computer science education. Education systems often target both domains in an effort to improve students' outcomes. This thesis suggests that educational interventions should harness relatedness to motivate young women's persistence in these fields.

This idea has already been applied to offline education communities with great effect. While programmes such as scouting organizations and team sports have long been anecdotally recognized for supporting adolescent development (Coakley, 2011), recent research has tested this hypothesis and demonstrated that these programmes are successful because they harness feelings of relatedness and social connection. Relatedness impacts adolescent girls' motivation for and involvement in Girl Scouts programming (Gillard, Watts, & Witt, 2008). Similarly, while involvement in team sports may improve adolescent females' self-esteem (Pedersen & Seidman, 2004), this is because of the feeling of belonging within a community that one identifies as important, not because sports themselves are inherently good for development (Guest & Schneider, 2003). Together, these results showcase how relatedness can be used to support adolescent development through informal education. Yet, at present, few initiatives in the out-of-school sector rely on relatedness as their theory of change. This thesis suggests that digital literacy, computer science, and other youth-based programming with technology need to build relatedness-building activities into their model to be successful at supporting and retaining women.

Building on this, over the past two decades, relatedness-based education solutions have grown in popularity within the formal education sector. Learning communities, or cohort-based educational groups, improve engagement and retention in higher education settings (Zhao & Kuh, 2004). The importance of collaborative and socially supportive learning environments has been demonstrated across the population and is effective for both majority and minority learners (Lenning & Ebbers, 1999; Vescio, Ross, & Adams, 2008). Yet, supported by results from study 2, collaborative learning can be especially effective at driving minority achievement. For example, the POSSE Program helps groups of low-income minority students adjust to life at an elite college by bringing them to schools with a pre-existing group of peers and preparatory skills training (Cripps, 2018). Participants in the Program have been showed to better adjust to engineering settings (Jones & Were, 2008). These, and other community-education programmes, aim to improve persistence of historically-marginalised groups by creating a built-in support and encouragement network. However, these tactics have only recently been applied towards media literacy and media education. Initiatives that aim to teach digital skills should apply similar cohort-based learning strategies to improve young women's trajectories and interest in these programmes.

Despite few out-of-school programmes designed around relatedness-support, there have been some in-school moves towards relatedness-harnessing computer science classrooms. When STEM classrooms use group work, it improves persistence and interest in both male and female students (Springer, Stanne, & Donovan, 1999). Computer science classrooms in high schools and universities have recently begun using "pair programming" – or working in pairs on computer science projects. This helps retain young women and increases their confidence in the field because they observe that they are not the only individuals who might occasionally struggle with the material (McDowell, Werner, Bullock, & Fernald, 2006; Werner, Hanks, & McDowell, 2004). Pair programming has also been used effectively in extracurricular coding programmes to motivate girls'

learning and decisions to keep coding during out-of-school environments (Denner, Werner, Bean, & Campe, 2005). These three strategies are just some of the ways that educators are harnessing peers to improve persistence in the classroom.

Educational solutions targeting young women need to harness the above strategies and identify new evidence-based ways for young women to work together in problem-solving. This will increase women's relatedness in the classroom and subsequent intrinsic motivation. By reframing early computer science courses around collaborative problem-solving, educators can build relatedness into their lesson plans and retain more women. Yet, while the UK and US governments have both indicated that they want schools to include computer science instruction, there is little guidance on effective ways to teach the subject. This contributes to a teacher shortage and often leaves educators adapting their existing practice to computer science standards (Sentance & Csizmadia, 2017; Whittaker, 2017). To ensure that collaborative learning enters the curriculum, educational organizations and non-profit initiatives should formally recommend strategies that build relatedness in the classroom. Additionally, this points to a market opportunity. Game designers and educational technology developers can create non-gendered tools to teach coding skills that harness collaboration and cooperative work. In doing so, they can ensure that even solitary learning stays relatedness-based. Together, schools and developers can create relatedness-focused educational solutions.

Increasingly, the education sector has called for 'digital literacy.' Results across all three studies suggest that for digital literacy initiatives to be effective across genders, they must encourage relatedness. Given pre-existing disparities between young women and men's technology-related social support and technical self-efficacy (Huffman, Whetten, & Huffman, 2013; Vekiri & Chronaki, 2008; Zeldin & Pajares, 2000), young women are likely to enter technology-related settings at a perceived social disadvantage relative to their male peers. If educators don't then work to correct

this imbalance by helping students feel related to others and that they belong, young women will likely disengage from the learning setting. By creating collaborative and socially supportive digital learning environments, study 2 suggests that educators can help women feel that they belong in these environments and this will improve their intrinsic motivation for learning. Yet, without this intrinsic motivation, findings from study 1 and Black & Deci (2000) indicate that women will not take-up or continue to engage with this important content. To be effective at motivating young women's adherence and motivation within digital literacy initiatives, it is critical that these initiatives harness relatedness. While the definitions, bounds, and responsibilities of digital literacy programmes vary (Livingstone, 2018), findings across the thesis suggest that the designers of these programmes should find ways to make them communal and supportive. This thesis suggests that when media literacy becomes collaborative and nurturing, students will be more motivated to retain its message.

Yet, while this thesis suggests that both computer science and digital literacy programme designs must include opportunities to foster social connection, it is necessary that these programmes are given to rigorous analysis. At present, few out-of-school interventions and targeted educational efforts are subject to rigorous peer-reviewed research or any pre-registered programmatic evaluation (Feldman & Matjasko, 2005; McLaughlin, 2000). In line with study 2's goals, new programmes should be subject to open-access and thorough research to ensure that young women's time and funders' money are not wasted.

6.4.2 Relatedness and Parents

Effective media education and coding programmes can also harness parents. In doing so, they should create collaborative environments to equip parents and guardians with the skills to foster supportive technology environments. Towards this, a small pilot programme called Family Creative Learning used family connections to improve parents and young children's digital skills

(Roque, 2016). The success of this initiative sparked a related programme run by the University of Washington that targeted English Language Learners at three community centres in Washington state (Banerjee et al., 2018). Both were effective at improving children's skills, parents' skills, and parent-child relationships, three aspects which this thesis identifies as critical for young women's outcomes. However, they were small-scale programmes focused on younger populations and run by University researchers who had no funding or staffing to scale their impacts. And, at present, there are few large-scale programmes that have measured their impacts in harnessing parents towards young women's learning. Still, the success of these pilots suggests that policy makers and practitioners should look for formal ways to involve parents in their daughters' digital learning. This may improve parent-child bonds, improve parents' competence with machines (Brennan et al., 2011; Roque et al., 2016), and help build the supportive environments that this thesis shows are necessary for adolescent success.

Still, despite political and educational interventions targeting teenagers' digital lives or parents' of 'at-risk' groups (Colwell, Hunt-Barron, & Reinking, 2013; Martin & Grudziecki, 2006; Mills, 2010; Roque, Lin, & Liuzzi, 2016), few large-scale programmes target parents. While further research is necessary to evaluate the efficacy of parent-focused messaging, results from this thesis suggest that parents have the potential to support their adolescent daughters' technical well-being (study 1) but that media messaging and general fears may prevent them from doing so (study 3). To combat these dual effects, education efforts that normalize parents' media use or equip parents with general tools to discuss technology can help parents feel comfortable involving themselves in their children's digital lives.

This presents opportunities for education professionals, technology organisations, and the non-profit sector. Schools engage with parents and have been effective at nudging their involvement (e.g. Rogers & Feller, 2018). Educational institutions should give parents techniques to engage with

their children through digital media. This will both help parents' practices and signal to them that technology can support their daughters' development (Schaefer, 1991). Initiatives targeting parents should give them specific tips and tricks to support their adolescent daughters'. In doing so, by attempting to normalize and neutralise technology use, they can nudge parents away from restriction and help build parents' competence when engaging with their daughters. Similarly, instead of building tools for parents that track and monitor their daughters' behaviours (Wisniewski, Ghosh, Xu, Rosson, & Carroll, 2017), technology companies can and should build tools such as shared accounts or collaborative games that bring families together. Finally, further initiatives should target families or children's broader support systems to educate everyone together about new technology.

Yet, in building tools and educating parents, developers and educators run the risk of exacerbating biased narratives around technology use. Towards this, I offer policy suggestions to change how we talk about technology and young women.

6.4.3 Reframing Narratives around Technology and Young Women

At present, popular narratives around women and technology highlight both threats and isolation due to technology. Media representations of young women and technology either focus on the negative aspects of technology for women or leave women out. Across academic literature and popular media, young women are framed as victims or victimisers (Cassell & Cramer, 2007; Sales, 2013, 2016). They are often left out of or marginalised from technology communities and rarely have the agency to reclaim their space in this discourse (Paaßen et al., 2017). With regards to digital opportunities, study 3 and boyd & Hargittai (2013) suggested that this influences parents' anxieties about their daughters' technology use. Media representations of hostile digital environments may dissuade girls from involving themselves in the rewards that digital spaces may offer (Berg, Sharpe, & Aitkin, 2018; Cote, 2017). This influences parents' and daughters' expectations of technology

culture and of the opportunities technology might offer (Dill-Shackleford et al., 2017). And, as these studies indicate, if they do not feel that they will belong or enjoy the environment, young women will shy away from and not be intrinsically motivated towards engaging with technology.

This isolating narrative also extends to computer science communities. Silicon Valley technology culture has begun shaping young women's expectations of the field (Beyer, 2014; Cheryan, Plaut, et al., 2013). There are two predominant narratives around technology culture and both exclude women. 'Brogrammer[8]' culture perpetuates expectations that working in computing will be similar to working in a fraternity (MacMillan, 2012). This lies in contrast to expectations that working in computing involves lonely men working on solitary activities (Fisher, Margolis, & Miller, 1997; Staff, 2012). Both narratives have produced strong stereotypes about computing. Unfortunately, the stronger the stereotype she holds, the less likely the young woman is to pursue the field (Cheryan, Drury, et al., 2013). Young women are dissuaded from entering computer science and their parents are unlikely to encourage them, due to images of the stereotypical male programmer. These findings point to an urgent need to reframe how individuals talk about digital spaces and young women.

Across both examples, expectations of digital spaces as isolating deter women and their support systems from engaging in them. Results across the three studies suggest that the technology narrative should be reframed to focus on how technology and new tools can foster relatedness. Indeed, women engaging in digital creation communities support one another and are more likely than researchers hypothesized to offer guidance to others and collaborate with peers (Chandler-Olcott & Mahar, 2003). Girls in coding communities help each other and nurture others' projects

[8] A portmeantau between Bro and Programmer. Brogrammers are male computer scientists who engages in masculine activities and try to be macho. The term brogrammer grew in popularity in the mid-2000s in response to the 'nerdy' programmer stereotype. The term brogrammer can also be used to describe a predominantly male computing culture that excludes women (MacMillan, 2012).

(Beyer, Rynes, Perrault, Hay, & Haller, 2003). Women are not the vicious creatures the media suggests and by building collaborative female communities into media and technology narratives, producers can reduce parents' fears and increase students' interest.

To reframe how parents and young women think about technology and to convince both that young women belong in this domain, I offer a few speculative suggestions. Firstly, media makers must be cautious when perpetuating gendered stereotypes of computer scientists, as those stereotypes may be inconsistent with what women actually seek from a computer science career. News and pop culture frame how developing minds think about gender (Dill-Shackleford et al., 2017). While media production should not be formally regulated, industry standards bodies for children's content should integrate guidelines focused on female representation and stereotypes. At present, despite requirements for educational content, these do not include information about stereotypes and identity.

Similarly, policy makers should require strict evidence when considering new regulations and recommendations around children's digital lives. For example, the World Health Organization recently characterized 'Gaming disorder' as an addiction, similar to drugs or gambling, despite little-to-no reproducible evidence on the phenomenon (Aarseth et al., 2016; Przybylski, Weinstein, & Murayama, 2016). These actions repeat a series of moral panics around young women and technology and likely exacerbate parents' anxiety (Cassell & Cramer, 2007). Yet, as parents' anxiety directly relates to the decisions they make around their children, study 3 demonstrates why it is crucial that NGOs and governments work to reduce and not inflame anxiety.

There is a particular need for non-profit organizations and educational institutions to work on changing the discussion around young women and technology. Media representations of stereotypical computer scientists and vicious young women continually reappear because there is a market for them. Because parents fundamentally want to care for their children, it can be easy to sell

them advice and products that claim to help. It is even easier to do this, as Furedi (2002) points out, when you can scare them into behaviours. This conundrum perpetuates media fear-mongering and moral panics. Similarly, emerging technology firms face a tension when trying to attract top talent. They want to embed aspects of a "fun" culture to retain their employees, but are unaware of how this culture trickles down towards deterring young women – Promoting "Bro" Culture may help attract male computer scientists but promoting a relatedness culture will attract more female computer scientists. Figuring out how to promote both elements of a culture may attract the best computer scientists. Finally, media producers continue to perpetuate stereotypes of computer programmers because they are relatable tropes that can attract an audience. In all three cases, market forces make it difficult for large firms to reframe how consumers think about young women and technology.

The solution requires the work of non-profit initiatives, educators, and social enterprises. The non-profit sector can play a large role in offering new materials that combat traditional stereotypes. Educators are necessary to work within the classroom and speak directly to children to change their perceptions of each other and of technology. Finally, social enterprises or start-ups should develop new media and tools that support child development or reduce parents' anxieties. While traditional firms are not incentivized towards such risk-taking, new players have successfully turned a profit by selling narrative-questioning tools (Weiss, 2013). Therefore, this sector particularly requires non-market actors to foster change.

Together, non-profits, educational institutions, and emerging businesses can work together to reframe how individuals perceive young women and technology. In doing so, they can build on necessary educational interventions targeting students and parents.

6.5 Debugging These Findings

I believe this thesis's findings are promising. Study 1 identifies that young women who are nurtured and skilled will use technology for their developmental needs and Study 3 demonstrates that it is possible to lower parents' anxieties and change their parenting practices. While the intervention surveyed in Study 2 was ineffective in influencing young women's motivation for studying computer science, by demonstrating the importance of relatedness for young women, these results offer insight for NGOs and policy makers for future intervention designs.

At the same time, it is evident that young women are still disproportionately left out of digital communities. Based on this, I close this thesis by making a few debugging recommendations for the observed gender and social divides.

Results from this thesis demonstrate that, regardless of skills and access divides, supportive communities are necessary for young women to take up digital opportunities and that parents can easily be manipulated towards reduced anxiety and supportive parenting. However, wealthy and middle class parents are more likely to have the time and resources to involve themselves in their children's lives (Lee & Bowen, 2006). This implies that the psychological precursors and consequences from beneficial technology use may inadvertently reproduce existing digital divides along class lines. To avoid this outcome, parent training initiatives should showcase to parents how to speak with their children about technology. At present, many policy initiatives focus on training and teaching parents how to support their children's education outside of school time. While parents who feel skilled and efficacious are more likely to sustain involvement in their children's lives (Grolnick, Benjet, Kurowski, & Apostoleris, 1997), there are a number of recent interventions within low-income communities that aim to inform and empower parents to get involved in aspects of a child's schooling that they may otherwise be uncomfortable or not feel skilled enough to tackle

(Kraft & Rogers, 2015; Rogers & Feller, 2018). These programmes seem particularly well-suited to tackle parents' misconceptions or discomfort around involving themselves in their children's digital lives. Given large divides between parents' and children's technology skills, and the anxieties that this may cause (Connell, Lauricella, & Wartella, 2015), by reducing parents fears through text-messaging programmes or positive media messaging, governments, schools, and NGOs can successfully motivate parents across race and class divides towards parenting styles that encourage positive outcomes from teenage technology use.

Given the importance of parent-child relatedness in supporting young adolescent female development and the generalized importance of relatedness for young women's technology study, the technology industry should create polices and products that encourage co-use. Even techniques as simple as shared accounts (such as on Amazon and Netflix) can help keep parents informed without monitoring and give parents the tools to more comfortably actively mediate their children's digital lives. Emerging design research has demonstrated the efficacy of technology tools and apps that promote shared experiences (Ko, Choi, Yang, Lee, & Lee, 2015). Yet troublingly, a review of apps that aim to promote healthy adolescent technology use identified that the majority of features and products within these apps are aimed at restricting use, instead of at giving teenagers' self-regulatory skills or building features that help parents and teens collaborate (Wisniewski et al., 2017). This points to a market need for tools and services that encourage collaboration.

Finally, particularly for young women in technical communities, feeling related to others is of paramount importance. Building on findings from study 2, initiatives that aim to tackle the gender divide in computing must recognize the difficulty of tackling stereotypes and be willing to make a lengthy investment through role models and community-based education strategies. While the media rhetoric often removes young women's agency (Cassell & Cramer, 2007), media standards should

promote women's achievements to help influence young women and their parents. Together, media and policy makers need to change the narrative around women in computing.

Grace Hopper debugged machines and paved the way for women in technology by removing unnecessary creatures from complex systems. In contrast, to debug the current system, we need to add new features. Specifically, only by nurturing parents' competencies around technology use, creating digital tools and programmes that support relatedness, and by fostering female technical icons can policy makers begin to debug the gender gap. Towards this last goal, this thesis opens and closes by elevating Grace Hopper. While Hopper is the only female coder most know by name, hopefully, by responding to the needs this thesis mentions, there will be several more Hoppers in the years to come.

APPENDIX A

Study 1 applied secondary data analysis within two representative datasets – one collected in 2010, the other in 2014. This allowed me to explore persistent patterns between individual factors, social support, and individual psychology. The following table outlines each construct and the items that measured it in each dataset. In cases where a cell is blank, it indicates that that construct did not appear in that dataset.

Construct	2010 Cohort	2014 Cohort
	Individual Factors	
Device Access	Where you use the internet for the following places: Bedroom (or other private room) at home, Living room (or other public room) at home, At school or college, In an internet café, in a public library or other public places, at a friend's home, at a relative's home, when 'out and about'	Either owning, sharing with sibling, or having one at home for the following devices: Mobile phone, smartphone, laptop, desktop, e-reader, or tablet
Device Frequency	How often do you use the internet?	
Kid Skills	Compare different websites to decide if information is true Change filter preferences Bookmark a website Block unwanted adverts or junk mail/spam Delete the record of which sites you have visited Change privacy settings on a social networking profile Block messages from someone you don't want to hear from Find information on how to use the internet safely	Finding needed information online. Playing video games. Using social media. Checking a computer's web browser history Uploading documents to an email Changing computer and web passwords. Setting up and accessing proxy servers. Sharing files on peer-to-peer networks (e.g. BitTorrent). Masking your IP address. Software coding (e.g. html, Javascript).
Parent Skills		Finding needed information online. PSK Recoded Playing video games. Using social media. Checking a computer's web browser history Uploading documents to an email Changing computer and web passwords.

Social Support		
Parent Support	When I am bothered about something, I talk to ...: My mother or father	
Sibling Support	When I am bothered about something, I talk to ...: My brother or sister	
Friend Support	When I am bothered about something, I talk to ...: A friend	
Teacher Support	When I am bothered about something, I talk to ...: A teacher	
Parental Involvement		My parents find time to talk with me. My parents don't seem to think of me often. (R)[9] My parents spend a lot of time with me My parents often seem too busy to attend to me. (R) My parents are not very involved with my concerns (R) My parents put time and energy into helping me.
Autonomy Support		My parents seem to know how I feel about things. My parents try to tell me how to run my life. (R) My parents, whenever possible, allow me to choose what to do. My parents listen to my opinion or perspective when I've got a problem. My parents allow me to decide things for myself. My parents insist upon doing things their way. (R) My parents are usually willing to consider things from my point of view. My parents help me to choose my own direction My parents aren't very sensitive to many of my needs. (R)

[9] (R) indicates that the question was reverse-coded during analyses

Warmth	My parents accept me and like me as I am.
	My parents clearly convey their love for me.
	My parents make me feel very special.
	My parents are often disapproving and unaccepting of me. (R)
	My parents are typically happy to see me
	My parents seem to be disappointed in me a lot. (R)
Teacher Lessons	My teachers have taught me how to interact with others online.
	My teachers have taught me about online privacy and safety.
Friend Lessons	I learned how to interact with others online from my friends.
Parent Lessons	My parents have taught me how to interact with others online.
	My parents have taught me about online privacy and safety.

Parental Mediation		
Active Mediation	Does your parent/do either of your parents sometimes … – Helped you when something is difficult to do or find on the internet – Explained why some websites are good or bad – Suggested ways to use the internet safely – Suggested ways to behave towards other people online – Helped you in the past when something has bothered you on the internet – Talked to you about what to do if something on the internet bothered you	My Parents … – Talk with me about online technology (e.g. new websites or social media platforms) – Encourage me to talk about my online activities. – Want to know how I feel when I am online. – Are curious about how I use social media.
Coviewing	Does your parents/do either of your parents sometimes … – Sit with you while you use the internet – Stay nearby when you use the internet	My parents … – Encourage me to use online technologies with them. – Try to be nearby (e.g. in the room) when I am online. – Are nearby (e.g. in the room) when I use social media.
Restriction	Parents never allow: – Use instant messaging – Download music or films on the internet – Watch video clips on the internet – Have your own social networking profile – Give out personal information to others on the internet – Upload photos, videos or music to share with others	My parents … – Do not allow me to use the Internet. – Do not allow me to use social media.
Light Restriction	Parents only allow with permission/supervision… – Use instant messaging – Download music or films on the internet – Watch video clips on the internet – Have your own social networking profile – Give out personal information to others on the internet – Upload photos, videos or music to share with others	My parents … – Do not let me use some kinds of social media (e.g. Tumblr or Tinder). – Do not let me visit some kinds of websites (e.g. adult sites). – Set rules about when I can use online technology (e.g. not at dinner, until homework done, etc.) – Set rules about how much time I can be online. – Set rules about how much time I can use social media. – Do not let me use my digital devices (e.g. phone or games) in my bedroom.

Monitoring	Does your parent/either of your parents sometimes check any of the following things afterwards?: – Which websites you visited – The messages in your email or instant messaging account – Your profile on a social network or online community – Which friends or contacts you add to social networking profile	My parents… – Regularly check my browsing history/emails/texts. – Have my social media password(s).
Parental Controls	Does your parent/do your parents make use of the following?: – Parental controls or other means of blocking or filtering some types of website – Parental controls or other means of keeping track of the websites you visit	My parents have set up filtering/parent controls at home. My parents have set up parent controls at home.

		Outcomes
Socialising	Sent/received email Visited a social networking profile Visited a chatroom Used instant messaging Played games with other people on the internet Spent time in a virtual world	Improved an existing friendship. Made a new and meaningful friendship. Connected with my classmates. Built my circle of friends.
Learning		Learned something new and interesting that I never knew before. Searched for information about something that personally interests me. Taught myself something new about computers/technology (e.g. how to code). Learned a new skill such as learning to cook or play an instrument.
Self-Expression		Expressed my feelings about a topic I care about. Learned something important about myself. Expressed my true self. Shared something important about myself.
Civics		Contacted a journalist or politician. Signed an online petition. Made a post/comment about current events or politics. Looked up information about current events or politics.
Creativity		Posted/uploaded a review online (of a movie, product, book, or game). Posted/uploaded a picture or video of a remix, mashup, or meme I made. Wrote a blog entry about something I care about. Wrote something creative (e.g. fanfiction) that I shared on a messageboard.
Consumption	Used the Internet for school work Watched video clips (e.g. on YouTube) Downloaded music or films Read/watched the news on the internet	

Communication	Used a webcam Put (or posted) a message on a website Written a blog or online diary Put (or posted) photos, videos or music to share with others Created a character, pet or avatar Used file sharing sites	
Self-Efficacy	It's easy for me to stick to my aims and achieve my goals I am confident that I can deal with unexpected problems I can generally work out how to handle new situations If I am in trouble I can usually think of something to do	
Internet RAI		=Intrinsic*2+Identified-Introjected-External*2
Intrinsic		Because using the Internet is fun. Because I find doing activities on the Internet simply fun. Because the Internet is engaging.
Identified		The Internet is part of who I am. In some ways the Internet feels like an extension of myself. Using the Internet helps me improve myself.
Introjected		I feel that using the Internet is something I should do I would feel left behind if I did not use the Internet. I would be a disappointment to myself if I stopped using the Internet.
External		I use the Internet so my friends will like me. For the popularity the Internet brings me. Because I have been pressured to use the Internet.
Amotivation		It is not clear anymore why I use the Internet. I used to have good reasons, but now I am asking myself if I should continue engaging the Internet. The Internet is a waste of time.

APPENDIX B

During the 2017 Bit by Bit conference, students were surveyed about their psychological needs support, motivation for computer science, and sense of social fit. Appendix B outlines the constructs surveyed, the source that inspired the questions, and the questions used to measure each construct. Participants were asked to respond to each item on a 7-point Likert scale from Strongly Disagree to Strongly Agree.

Construct	Source	Item
Perceived Autonomy Support	Black & Deci (2000)	I feel that my instructor provides me choices and options.
		My instructor conveyed confidence in my ability to do well in the course.
		My instructor listens to how I would like to do things
		My instructor tries to understand how I see things before suggesting a new way to do things.
		I feel understood by my instructor
		My instructor encouraged me to ask questions
Perceived Competency Support	Williams & Deci (1996)	I feel confident in my ability to learn the material.
		I am able to achieve my goals in these classes.
		I am capable of learning the material in these classes.
		I feel able to meet the challenge of performing well in these classes.
Relatedness	Chen, Vansteenkiste, et al. (2015)	I experience a warm feeling with the people I spend time with.
		I feel that the people I care about also care about me.
		I experience a warm feeling with the people I spend time with.
		I feel close and connected with other people who are important to me.
		I feel connected with people who care for me, and for whom I care.
		I feel that people who are important to me are cold and distant towards me.
		I feel the relationships I have are just superficial.
		I feel excluded from the group I want to belong to.
		I have the impression that people I spend time with dislike me.

Belonging in Science	Chen, Vansteenkiste, et al. (2015)	I experience a warm feeling with the people I spend time with when learning about technology. I feel close and connected with other people in technology who are important to me. I feel connected with people in my STEM classes who care for me, and for whom I care. I feel that the people in my technology, math, and science classes about also care about me. I feel that people who are important to me in technology are cold and distant towards me. I feel excluded from the peers in my technology, math, and science classes I want to belong to. I have the impression that people I spend time with in my technology, math, or science classes dislike me. I feel the relationships I have with my peers in technology are just superficial.
Job Motives	Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011).	Learning computer science will help me get a good job. I will use computer science problem-solving skills in my career. Understanding computer science will benefit me in my career. My career will involve computer science or technology. Knowing computer science will give me a career advantage.
Grade Motives	Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011).	I like to do better than other students on computer science, technology, or other STEM tests. Getting a good grade is important to me. I think about the grade I will get in in computer science, technology, or other related classes. Scoring high on computer science, technology and related tests and labs matters to me. It is important that I get an "A" in computer science, technology, or other related classes.
Intrinsic Motivation	Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011).	Learning about technology is interesting. I enjoy learning about technology and/or computer science. Learning about technology makes my life more meaningful. I am curious about discoveries in technology and computer science. The computer science and technology skills I learn are relevant to my life.

Self-Efficacy	Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011).	I am confident I will do well on computer science projects. I am confident I will do well on computer science examinations. I believe I can master technology knowledge & skills. I believe I can earn a grade of "A" in computer science. I am sure I can understand computer science
Sense of Social Fit	Walton & Cohen (2007)	I do not know what I would need to do to make a computer science or technology teacher like me. I fit in well with computer scientists. I feel like an outsider in technology-related settings. People in technology like me. People in computer science are a lot like me. Other people understand more than I do about what is going on in technology. Compared to most other students, I fit in computer science. I am similar to the kind of people who succeed at technology. I think in the same way as do people who do well at computer science. If I wanted to, I could potentially do very well at computer science. I belong in computer science. I know how to do well in math and science classes. It is a mystery to me how technology works. I feel comfortable in math, science, and computer classes. People in technology accept me. I know what kind of people computer science professors are. I feel alienated from technology. I get along well with people in technology.

APPENDIX C

As part of my literature research for study 2, I reviewed US-based programmes that target women in computer science. The following table outlines all the programmes I identified, their type (Corporate, Non-Profit, For-Profit, or University), their organizer, official description, location (national or regional), and their website. Additionally, upon analysing and reviewing the programmes, I noticed that most had similar structures. Therefore, an additional column outlines what the programme focuses on: conferences, content, educational courses, events, summer programming, mentoring, or one-off workshops. Together, this appendix outlines the girls in tech space, illustrates the market saturation, and showcases that Bit by Bit is substantively similar to many other projects.

Program	Type	Organizer	Structure	Official Description	Location	Link
Built By Girls	Corporate	AOL	Events, Mentoring	At a moment in time where everyone is talking about girls in STEM, we recognize that code is just the beginning: there are countless opportunities for a career powered by technology. We visit cool tech companies, prep you for your internships, and connect you with boss advisors who help you get ahead of the game. We're building a club for the next generation of leaders in technology—a club that embeds young women in tech from the earliest stages. Because there is more work to be done.	NY	www.builtbygirls.com
Code Camp	Corporate	Square	Summer Program	Dive into a five-day immersion program developed to ignite and inspire future female engineers and further their pursuit of a career in computer science.	Atlanta, GA	www.squareup.com/code-camp
Digigirlz	Corporate	Microsoft	Mentoring	DigiGirlz, a Microsoft YouthSpark program, gives middle and high school girls opportunities to learn about careers in technology, connect with Microsoft employees, and participate in hands-on computer and technology workshops.	National	www.microsoft.com/en-us/store/locations/digigirlz
Digigirlz Day	Corporate	Microsoft	Networking	Microsoft is proud to offer technology programs that target youth. This one-day event, held at multiple Microsoft locations worldwide, is designed to provide high school girls with a better understanding of what a career in technology is all about.	National	www.microsoft.com/en-us/diversity/programs/digigirlz/digigirlzday.aspx
Digigirlz High Tech Camp	Corporate	Microsoft	Summer Program	Microsoft is proud to offer technology programs specifically for youth. One of our signature programs, DigiGirlz High Tech Camp for girls, works to dispel stereotypes of the high-tech industry. We continue to look for opportunities to give young people a chance to experience, firsthand, what it is like to develop cutting-edge technology.	National	www.microsoft.com/en-us/diversity/programs/digigirlz/hightechcamp.aspx

Program	Type	Organizer	Structure	Official Description	Location	Link
Girls Power Tech	Corporate	Cisco	Events	Every year, Cisco participates in Girls in ICT Day. We open our doors to young women all over the world and inspire them to pursue careers in STEM through hands-on exposure to the latest technology and engagement with industry professionals.	National	www.cisco.com/c/en/us/about/csr/stories/girls-power-tech.html
Made with Code	Corporate	Google	Content	We started Made with Code because increasingly more aspects in our lives are powered by technology, yet women aren't represented in the roles that make technology happen. If we can inspire teen girls to see that code can help them pursue their passions, whatever they may be, then hopefully they will begin to contribute their voices to the field of technology for the benefit of us all.	National	www.madewithcode.com/faqs/
She Will Connect	Corporate	Intel	Events, Summer Program	At Intel, we are committed to empowering girls and women through technology skills to expand economic opportunities and empower them to innovate in their community. Through Intel® She Will Connect, we focus on closing two key gaps: first, in emerging markets, we are working to connect more women to the Internet and to basic technology skills so they can access information and new economic and social opportunities; and second, in mature markets, we are working to intervene in middle school when girls decide whether to pursue technology careers.	National	www.intel.com/content/www/us/en/corporate-responsibility/social-impact-and-educational-initiatives/she-will-connect.html
Verizon Innovative Learning for girls	Corporate	Verizon	Summer Program	Verizon Innovative Learning launches its first program addressing the need for more girls, especially those in rural America, to be prepared for the science, technology, engineering and math careers of the future. The three-week summer learning experience will be piloted at five community colleges in rural areas across Iowa, Virginia and Tennessee in partnership with the National	Iowa, Virginia, Tennessee	www.verizon.com/about/responsibility/verizon-innovative-learning

Program	Type	Organizer	Structure	Official Description	Location	Link
				Association for Community College Entrepreneurship (NACCE).		
WAVE	Corporate	AOL	Mentoring	A mobile platform connecting the next generation of leaders with expert professionals across a variety of companies and industries using technology to power their businesses.	National	www.builtbygirls.com/wave
Alexa Café	For-Profit	idTech Camps	Summer Program	Inspired by iD Tech co-founder Alexa Ingram-Cauchi, our all-girls program blends tech, entrepreneurship, and social activism in a fresh, café-like setting. Big ideas come to life amidst moon chairs and stylish decor. Whether you want to code an app for charity, design a mobile game, or engineer wearable electronics, you'll collaborate with new friends and create a project you're passionate about.	National	www.idtech.com/alexa-cafe
Girls Make Games	For-Profit	LearnDistrict	Summer Program, Workshops	Girls Make Games is a series of international summer camps, workshops and game jams designed to inspire the next generation of designers, creators, and engineers.	National	www.girlsmakegames.com
#YESWECODE	Non-Profit	Dream Corps	Events	#YesWeCode is a Dream Corps initiative to help 100,000 young women and men from underrepresented backgrounds find success in the tech sector.	National	www.yeswecode.org
AAUW TechTrek	Non-Profit	AAUW	Summer Program	Through hands-on problem solving and encounters with women role models in science, technology, engineering, and math (STEM), AAUW Tech Trek helps girls see their futures while having nonstop fun. This one-week summer camp is backed byAAUW's research and designed to make STEM fields exciting and accessible to girls in middle school — the age when girls' participation in these fields statistically drops. For many girls, the weeklong camp sparks their curiosity and places them on a path toward success.	National	www.aauw.org/what-we-do/stem-education/tech-trek/

Program	Type	Organizer	Structure	Official Description	Location	Link
App Camp for Girls	Non-Profit	--	Summer Program	Engaging Kids In Technology Through Fun And Creative Programs App Camp for Girls is a one-week summer day program where girls and transgender & gender non-conforming youth can put their creative powers to work designing and building apps. They also learn about about the business of software while being inspired by role models in the industry.	Northwest US	www.appcamp4girls.com
Aspirations in Computing	Non-Profit	NCWIT	Events	NCWIT Aspirations in Computing (AiC) provides a long-term community for female technologists, from K-12 through higher education and beyond, encouraging persistence in computing through continuous engagement and ongoing encouragement at each pivotal stage of their educational and professional development.	National	www.aspirations.org
Black Girls Code	Non-Profit	--	Education	Our Vision: To increase the number of women of color in the digital space by empowering girls of color ages 7 to 17 to become innovators in STEM fields, leaders in their communities, and builders of their own futures through exposure to computer science and technology. To provide African-American youth with the skills to occupy some of the 1.4 million computing job openings expected to be available in the U.S. by 2020, and to train 1 million girls by 2040.	National	www.blackgirlscode.com
Brave Initiatives	Non-Profit	--	Workshops, Summer Program	We are on a mission to empower girls ages 14 to 18 to become agents of change in the world. To do so we offer a series of programs focused on solving meaningful community problems through code and design. Our camps and workshops expose participants to expert mentors basic coding classes and leadership development trainings.	Detroit, Chicago, San Francisco	www.braveinitiatives.com
BStem Project	Non-Profit	--	Events, Workshops	Our primary goal is to provide young girls and women with unique programming opportunities that offer a comprehensive and interdisciplinary approach to business and STEM instruction. Our secondary goal is to provide an extension of holistic programming for youth (both girls and boys) in collaboration with educational institutions and organizations nationally. We seek to open pathways for emerging talent to engage, learn and grow on an academic and personal level. All our programs are free, allowing exposure into a variety of industries from entertainment,	National	www.bstemproject.org

Program	Type	Organizer	Structure	Official Description	Location	Link
				advertising and fashion to information technology, agriculture, aerospace and life sciences.		
ChickTech	Non-Profit	--	Events	ChickTech is a national organization serving thousands of girls and women every year through tech programs and events. We facilitate hands-on technology-centric events and programs to empower, support, and increase the confidence of women and girls. Through our events, we build community, empower participants to see themselves as leaders, and provide networking and mentoring opportunities in the rapidly growing high tech industry.	National	www.chicktech.org
Code AND Cupcakes	Non-Profit	--	Events	Code AND Cupcakes A BEGINNING CODING WORKSHOP FOR MOTHERS AND DAUGHTERS IN CHICAGO: Do you want to learn how to make your own web sites and apps? Do you want your daughter to learn, too? Most importantly: do you like cupcakes? Then come join us for a workshop led by a professional web designer/developer and her own daughter, complete with tasty snacks and a fun, supportive learning atmosphere.	Chicago, IL	www.codeandcupcakes.net
Code Liberation	Non-Profit	--	Events	Code Liberation catalyzes the creation of digital games and creative technologies by women, nonbinary, femme, and girl-identifying people to diversify STEAM fields.	National	www.codeliberation.org
Code.org	Non-Profit	--	Education	Code.org® is a non-profit dedicated to expanding access to computer science and increasing participation by women and underrepresented minorities. Our vision is that every student in every school should have the opportunity to learn computer science, just like biology, chemistry or algebra.	National	www.code.org/about

Program	Type	Organizer	Structure	Official Description	Location	Link
CodeNow	Non-Profit	--	Events	CodeNow is a 501(c)(3) non-profit teaching high school students how to solve meaningful problems through coding. Our program has four levels to introduce you to web design, coding, and how to come up with your own app ideas.	CA, IL, NY	www.codenow.org
CoderGals	Non-Profit	--	Mentoring, Education	CoderGals is an organization founded in 2015 which mobilizes female high school mentors to teach elementary school girls how to code through free after school workshops. CoderGals' mission is to spark young girls' interest in coding through fun, creative, and collaborative projects. The projects are designed to demonstrate that code can be used to build anything that a girl can imagine — from games to fashion to robots.	National	www.codergals.org
Digital Youth Divas	Non-Profit	Digital Youth Network	Education	Digital Youth Divas is an out-of-school program that engages middle school girls, especially those from non-dominant communities, in design-based engineering and computer science activities driven by a narrative story. The program supports girls to develop STEM identities by participating within face-to-face and online spaces to design, create, and re-imagine everyday artifacts (jewelry, hair accessories, music) and activities (dancing and talking to friends) using techniques including collaboration, critique, circuitry, coding, and fabrication.	Chicago, IL	www.digitalyouthnetwork.org/divas/
Girl Develop IT	Non-Profit	--	Education	Girl Develop It is a nonprofit organization that exists to provide affordable and judgment-free opportunities for women interested in learning web and software development. Through in-person classes and community support, Girl Develop It helps women of diverse backgrounds achieve their technology goals and build confidence in their careers and their every day lives.	National	www.girldevelopit.com
Girls for Technology	Non-Profit	--	Events	Girls For Technology aims to expose girls in middle school and high school to science, technology, engineering, and math (STEM) through a wide variety of engaging, educational, and career-oriented programs. We do this through a range of programming offered throughout the state of Connecticut.	Connecticut	www.girlsfortechnology.org

Program	Type	Organizer	Structure	Official Description	Location	Link
Girls in Tech	Non-Profit	--	Education, Events	Girls in Tech (GIT) is a global non-profit focused on the engagement, education and empowerment of girls and women who are passionate about technology. Adriana Gascoigne founded GIT in 2007 to create a support framework to help women advance their careers in STEM fields. Today, GIT aims to accelerate the growth of innovative women entering into the high-tech industry and building startups. We achieve this through the creation of proprietary, innovative programming and strategic global partnerships. With headquarters in San Francisco and more than 100,000 members located around the globe, GIT relies on volunteer efforts to lead each of the 60 local chapters. Programming and events vary by chapter based on local interests and needs.	National	www.girlsintech.org
Girls in Technology	Non-Profit	Women in Technology	Events, Mentoring	Girls in Technology is led by a committee of Women in Technology (WIT) members. We offer educational and hands-on STEM programs that promote creativity and innovation, and inspire girls to pursue STEM-related careers.	Washington, DC	www.womenintechnology.org/girls-in-technology
Girls Who Code	Non-Profit	--	Education	What started as an experiment has grown into a national movement Girls Who Code was founded five years ago with the belief that computing skills are a critical path to security and prosperity in today's job market. What began with 20 girls in the heart of New York City, Girls Who Code will reach 40,000 girls in all 50 U.S. states by the end of this year.	National	www.girlswhocode.com
GirlStart	Non-Profit	--	Education, Events, Summer Program	Girlstart aspires to be the national leader in designing and implementing innovative, high quality informal STEM education programs that inspire girls to transform our world.	Texas	www.girlstart.org/about-us

Program	Type	Organizer	Structure	Official Description	Location	Link
IGNITE	Non-Profit		Events	IGNITE (Inspiring Girls Now In Technology Evolution) is a nonprofit 501(c)(3) and is an award-winning State and National Best Practice program. IGNITE introduces girls in grades 6-12 to technology and engineering careers via: IGNITE Panel Presentations, field trips to local companies and colleges, programming workshops, robotics workshops, job shadows and more. IGNITE is during the school day and is managed by teachers, at the school. Girls are encouraged to take Computer Science and Engineering classes while they are in middle and high school. IGNITE partners with schools so that girls can get the support and encouragement they need to pursue these career paths.	National	www.igniteworldwide.org
Latinas in STEM	Non-Profit	--	Events, Mentoring	Our mission is to inspire and empower Latinas to pursue, thrive and advance in Science, Technology, Engineering & Mathematics (STEM) fields. Our primary purpose is to spread awareness about STEM and inspire and encourage middle school and high-school Latinas, especially within underserved communities, to strongly consider pursuing a STEM career. We aim to not only educate students, but most importantly their parents so that they may be better positioned to support their daughters along this challenging journey. Our secondary purpose is to help Latinas in STEM thrive in their college and professional careers through mentorship, networking and recognition.	California	www.latinasinstem.com/about.html
Mission Bit	Non-Profit	--	Education, Mentoring	Mission Bit strives to eliminate the tech divide for youth living in urban poverty and rural areas across the San Francisco Bay Area by building computer programming and professional opportunity pathways for public school students. We provide everything the students need, they just need to show up and be eager to learn. No prior experience required. We give students the opportunity to learn directly from successful engineers and entrepreneurs who enjoy sharing knowledge. We're focused on project based learning and aim to teach both core computer science concepts as well as	San Francisco, CA	www.missionbit.com

Program	Type	Organizer	Structure	Official Description	Location	Link
				the practical skills and technologies that are required to build web sites and applications today.		
National Center for Women and Information Technology	Non-Profit	--	Content	More than 160 NCWIT research-based resources raise awareness, increase knowledge, and build capacity for individuals and organizations to reach out to critical populations and implement systemic change. NCWIT provides resources for reform at every level — K-12, postsecondary, industry — that are attractive, easy-to-use, free, and available in both electronic and print formats.	National	www.ncwit.org
National Girls Collaborative Project	Non-Profit	--	Content	The vision of the NGCP is to bring together organizations throughout the United States that are committed to informing and encouraging girls to pursue careers in science, technology, engineering, and mathematics (STEM).	National	www.ngcproject.org
Oak Ridge Computer Science Girls	Non-Profit	--	Workshops	Oak Ridge Computer Science Girls is a 501(c)(3) non profit corporation and our mission is to inspire middle school girls in East Tennessee to actively explore the possibilities of technology to empower their future careers.	Tennessee	www.sites.google.com/view/orcsgirls
Project CS Girls	Non-Profit	Yahoo	Competition	ProjectCSGIRLS is a 501(c)(3) nonprofit organization working to cultivate a love for technology and computer science in girls and encourage them to pursue their interests and careers in these fields. We believe that nurturing an interest in science, math, and technology during the critical middle school period will help them to better see themselves as the future leaders of tomorrow. We aim to do this through a unique idea - the nation's largest computer science competition for middle school girls. ProjectCSGIRLS is run by high school and college students from around the country who are incredibly passionate about computer science and technology. Simply put, we are here to drive change.	National	www.projectcsgirls.com

Program	Type	Organizer	Structure	Official Description	Location	Link
She's Coding	Non-Profit	Code: Debugging the Gender Gap	Content, Mentoring	She's Coding is an open-source project developed in cooperation with the documentary film CODE: Debugging the Gender Gap. She's Coding provides education, resources, and actionable guidelines for anyone who wants to help bridge the gender gap in the field of computer science. Whether you're a woman currently working in tech, a girl interested in learning to code, a male ally for women in computer science, or a company trying to find ways to increase diversity, you've come to the right place! We are continuously working on enhancing and improving our content – check back regularly and see what's new!	National	www.shescoding.org
she++	Non-Profit		Events	she++, a 501(c)3 nonprofit organization, works to empower underrepresented groups in technology by dismantling negative stereotypes surrounding technical careers. We aim to dispel the misconception that computer science is not a career for women and minorities by rebranding what it means to be a technologist.	National	www.sheplusplus.com
Tech Bridge Girls	Non-Profit	Chabot Space & Science Center	Education	Techbridge girls excites, educates, and equips girls from low-income communities by delivering high-quality STEM programming that empowers a girl to achieve economic mobility and better life chances.	CA	www.techbridgegirls.org
Tech Girls Rock	Non-Profit	Boys and Girls Clubs of America	Workshops	Following completion of the ten-week DIY STEM program, Tech Girls Rock events help girls further cultivate an interest in the subjects of STEM, and ultimately tech-related educational opportunities and careers. Through the support of CA Technologies, Tech Girls Rock will be hosted by select Boys & Girls Clubs across the country through unique workshops which include career exploration panels with technology professionals who will share their own experiences. Participants will engage in discussions on key IT trends and topics, and will participate in technology-focused challenges and projects, which will provide hands-on technology experience.	National	www.bgca.org/programs/education/tech-girls-rock

Program	Type	Organizer	Structure	Official Description	Location	Link
Tech Girlz	Non-Profit	--	Events	TechGirlz is a 501(c)3 organization that was founded in 2010 by Tracey Welson-Rossman, CMO of Chariot Solutions. TechGirlz is accomplishing its mission through the creation of free, fun, interactive "TechShopz" led by industry professionals, leaders and students. We share our free workshop curriculum with companies, organizations, schools and community groups so they can inspire girls around the world with technology.	PA	www.techgirlz.org
Tech Sassy Girlz	Non-Profit	Collegiate Pathways, Inc.	Education, Events, Summer Program	Tech Sassy Girlz (TSG) is the signature program of Collegiate Pathways, Inc., a 501(c)(3) nonprofit organization based in Orlando, FL. Our mission is to empower middle and high school girls to pursue science, technology, engineering and mathematics (STEM) fields through college preparation, career readiness, and mentoring.	Orlando, FL	www.techsassygirlz.org
Tech Savvy	Non-Profit	AAUW	Events	AAUW Tech Savvy is a daylong science, technology, engineering, and math (STEM) career conference designed to attract girls in sixth through ninth grades to these fields. AAUW Tech Savvy also includes an important parent program that encourages families to reinforce girls' interest in future education and careers in STEM. AAUW branches have taken the lead in organizing and holding these highly successful, one-day STEM conference for girls nationwide; find a conference site below or contact your local branch if you'd like to organize an event in your community.	National	www.aauw.org/what-we-do/stem-education/tech-savvy/
Tech-Girls	Non-Profit	Charlottesville Women in Tech, Mozilla	Events, Mentoring	Tech-Girls was founded in 2012 with a mission to empower girls to imagine and achieve their future dreams in our tech-savvy world. With the support of awesome volunteers and local organizations, Tech-Girls brings hands-on tech-related programming to girls throughout the region. In 2014, Charlottesville Women in Tech was formed to provide human connections and resources for local women in tech. Tech-Girls and Charlottesville Women in Tech have joined forces with the goal of supporting and helping women and girls begin their journey and stay in the technology pipeline. Tech-Girls offers programs across the K-12 spectrum. The focus through all the opportunities we offer girls in the community is to spark interest, build confidence, nurture an inclusive community and help girls develop their own tech identity.	VA	www.tech-girls.org

Program	Type	Organizer	Structure	Official Description	Location	Link
Technolochicas	Non-Profit	NCWIT, Televisa Foundation	Events, Mentoring	TECHNOLOchicas is a national initiative of the National Center for Women & Information Technology (NCWIT) and Televisa Foundation designed to raise awareness among young Latinas and their families about opportunities and careers in technology. TECHNOLOchicas uses the powerful stories of Latinas from diverse backgrounds, who are in technology fields, and recognize the power of innovation to change the world. These stories allow girls to see and relate to real-life role models.	National, AZ	www.technolochicas.org
Technovatation	Non-Profit	Iridescent Learning	Competition	Technovation offers girls around the world the opportunity to learn the necessary skills to become tech entrepreneurs and leaders. Girls ages 10 to 18 learn to identify a problem in their community and create a mobile app solution to address that problem, and then learn how to communicate these ideas and translate them into a fully launched business.	National	www.technovation challenge.org
WIT Girls	Non-Profit	--	Events	For over 25 years, Women in Technology (WIT) has worked to empower and educate women and girls about opportunities in science, technology, engineering, arts, and math (STEAM) by educating middle and high school girls, and young women in college, and by sharing the stories of successful professional women in STEAM.	Georgia	www.mywit.org
Artemis Project	University	Brown University	Summer Program	The Artemis Project is a free, intensive, five-week summer program for rising 9th grade students of underrepresented genders in STEM! Two undergraduate women, Laurie Kardos and Jesse Marmon, began the program in the summer of 1996 with the goal of enhancing the self-confidence and visibility of women in the computer science community through hands-on experience with programming. This year, to make Artemis more inclusive, we invited students of all underrespresented genders in STEM to apply (i.e. female, trans, and non-binary students). Four undergraduate women from Brown University run the program and strive to increase inclusivity in computer science.	Providence, RI	www.cs.brown.edu/ people/orgs/artemis/20 17/index.html

Program	Type	Organizer	Structure	Official Description	Location	Link
ChicTech	University	University of Illinois	Workshops	ChicTech Visits (pronounced "sheek-tek") are led by members of the Women in Computer Science student club. An all-volunteer ChicTech team will travel to Illinois high schools to deliver a presentation to explain and demystify the field of computer science. The ChicTech team will give a glimpse into life as a CS @ ILLINOIS student and explore the exciting and challenging career options open to graduates. The presentation also confronts the stereotypes of the male-dominated field and debunks myths, cites success stories, and shares personal experiences.	Illinois	www.cs.illinois.edu/engage/k-12-outreach#chictech-visits
Commonwealth Alliance for Information Technology Education	University	University of Massachusetts at Amherst	Advocacy and Access		Amherst, MA	www.caite.cs.umass.edu/index.html
CompuGirls	University	University of Arizona	Education, Summer Program	COMPUGIRLS is a culturally responsive technology program for adolescent (grades 8-12) girls from under-resourced school districts in Arizona, Colorado, New Jersey, and Wisconsin. Supported by grants from the National Science Foundation and based in the Center for Gender Equity in Science and Technology (CGEST), College of Liberal Arts and Sciences at Arizona State University, COMPUGIRLS provides fun summer, after-school and year-long programs where participants learn the latest technologies in digital media, game development, and virtual worlds.	Arizona, Colorado, New Jersey, Wisconsin	www.cgest.asu.edu/compugirls
Computer Science for Cyber Security	University	NYU	Summer Program	Computer Science for Cyber Security (CS4CS) is a FREE, three-week, full-day summer program providing an introduction for high school women on the fundamentals of cyber security and computer science at the NYU Tandon School of Engineering. No background or experience in cyber security or computer programming is needed in order to apply, only your interest and enthusiasm. The program is led by members of the Department of Computer Science and Engineering and the Offensive Security, Incident Response and Internet Security (OSIRIS) Laboratory.	NY	www.engineering.nyu.edu/k12stem/cs4cs/

Program	Type	Organizer	Structure	Official Description	Location	Link
Computer Science Roadshow	University	Carnegie Mellon University	Workshops	The School of Computer Science Outreach Roadshow, developed by Women@SCS, introduces children, teachers and parents to the many areas within computer science. This is a highly interactive presentation by undergrads and grads in the School of Computer Science at Carnegie Mellon who talk about why/how they began studying the area, their current experiences, what Computer Science means to them now, and their future hopes and expectations. The middle and high school presentations include a guessing game, a slide show of CS applications, algorithm style puzzles, a robot demo, and much more. The graduate level Roadshow (presented to undergrads) includes general information on going to graduate school and short research talks.	Pittsburgh Area	www.women.cs.cmu.edu/What/Outreach/
Engineeristas	University	University of New Hampshire	Summer Program	UNH Tech Camp is a set of summer programs for students entering grades 6 through 12 designed to increase STEM literacy. The programs engage young people in interactive, hands-on, problem solving activities in areas of science, technology, engineering and mathematics (STEM). UNH Tech Camp is offered by the College of Engineering and Physical Sciences at the University of New Hampshire and makes available the benefits of the UNH research campus to the community-at-large. Now in their 12th year, these programs are designed to immerse campers in the world of science, engineering and technology.	Durham, NH	www.ceps.unh.edu/techcamp
Expanding Your Horizons	University	UC Berkeley	Conference	Expanding Your Horizons conferences are designed to introduce 5th-8th grade girls to careers in science, technology, engineering and mathematics, (STEM).	Berkeley, CA	www.ocf.berkeley.edu/~eyh/index.html
FirstBytes	University	University of Texas at Austin	Summer Program	First Bytes Summer Camp is a one-week residential camp program for high school girls. It is designed to dispel myths about computer science and intrigue young women with the potential of computing and the excitement of problem solving.	Austin, TX	www.apps.cs.utexas.edu/camp/firstbytes

Program	Type	Organizer	Structure	Official Description	Location	Link
Girls Encoded	University	University of Michigan	Workshops	Girls Encoded is a program to develop the pipeline of women in computer science as well as to retain the women who have entered into the program. Run through the Computer Science and Engineering (CSE) department at the University of Michigan within the College of Engineering, the program has two focus areas: recruitment of women into the CSE department, and retention of women to graduation from the department.	Ann Arbor, Michigan	www.eecs.umich.edu/eecs/about/articles/2016/Girls-Encoded-ideas.html
Girls Teaching Girls to Code	University	Stanford	Education	Girls Teaching Girls to Code is a program where Stanford women teach and inspire Bay Area high school girls to explore Computer Science and Engineering. Students learn coding basics, build exciting projects, and develop strong relationships with mentors in the field.	San Francisco Bay Area, CA	www.girlsteachinggirlstocode.org
MAGIC	University	Purdue University Department of Computer Science	Mentoring	The Computer Science Department and the College of Science at Purdue University have endorsed a special collaboration between university computer science students and after-school technology clubs for high school-aged girls. The Mentors for Aspiring Girls in Computing (MAGIC) program attempts to increase interest in technology career paths among young women through the creation of safe and positive learning environments, the use of relevant CS activities for instruction, and near-peer mentoring to encourage future success.	Indiana	www.cs.purdue.edu/outreach/
Tech Savvy	University	Harvard University	Summer Program	Tech Savvy is a weeklong program during the summer focusing on computing, technology and engineering for girls entering the 7th or 8th grade. During this action-packed week, students visit a different university or technical company each day, where you design, develop, build and test current science and technology through hands-on activities.	Cambridge, MA	www.seas.harvard.edu/k-12-community-programs/k-12-programs/tech-savvy
TechDivaz	University	University of Pittsburgh	Workshops	TECH DIVAZ℠ Workshop is an all-girls computer science and programming workshop for girls rising to grade 6 to 9.	Pittsburgh Area	www.tli.cs.pitt.edu/techdivaz.html

Program	Type	Organizer	Structure	Official Description	Location	Link
TechGirlz Rev	University	UC Berkeley	Events	Welcome to TechGirls Rev. We are a community of individuals passionate about technology and education. Since our founding in 2013, TGR has grown into an extensive organization in the Bay Area. From hosting week-long summer programs to drop-in robotics sessions to Silicon Valley company field trips, TechGirls Rev offers a plethora of opportunities for pre-collegiate girls to learn, grow, and develop in a safe, supportive environment. Our team is always happy and excited to inspire and shape the futures of so many wonderful young ladies in STEM. We hope you find this site helpful and see you soon!	San Francisco Bay Area, CA	www.techgirlsrev.com
WeCode	University	Harvard	Events	WECode (Women Engineers Code) is the largest, student-run Women in Computer Science conference held at Harvard University each winter. We're dedicated to expanding the skills, network, and community of technical women worldwide, bringing together engineers over the course of two amazing days to share ideas and conversations on technology and innovation.	Cambridge, MA	www.wecodeharvard.com
WICS High School Day for Girls	University	University of Pennsylvania	Events	The University of Pennsylvania Women in Computer Science (WICS) student organization aims to foster a community for the women in tech at Penn - including Computer Science, Computer Engineering, Computational Biology, Digital Media Design and Networked and Social Systems Engineering. Our purpose is to support and promote women in CS by encouraging discussion and raising awareness regarding issues surrounding Women in Computer Science. Learn more. Each year, the CIS Department and WICS host a day for girls in high school who are interested in computer science. This event will be held on Friday, April 21, 2017. At this event, students will have the opportunity to meet computer scientists and engieers and learn what professionals in these fields do. Throughout the day the students will meet faculty and undergraduate women, have an admissions presentation, tour world-class labs, take a class, enjoy lunch with our school community and have fun! To learn more about this event, you can download previous year's information:	Philadelphia, PA	www.cis.upenn.edu/about-outreach/wics.php

Program	Type	Organizer	Structure	Official Description	Location	Link
Women in Computing	University	University of Rochester			Rochester, NY	www.csug.rochester.edu/URWIC/home.php
Women's Technology Program	University	MIT	Summer Program	The MIT Women's Technology Program (WTP) is a rigorous four-week summer academic and residential experience where female high school students explore engineering through hands-on classes, labs, and team-based projects in the summer after 11th grade .	Cambridge, MA	www.wtp.mit.edu
Young Women in Computing	University	New Mexico State University	Education, Events	Young Women in Computing (YWiC) offers fun and engaging activities for students. Our primary goal is to share the creativity of computing through hands-on tasks and project-based learning. We want all young women and men throughout our region to realize their potential for becoming a true creator of technology, and not just a user!	Las Cruces, New Mexico	www.cs.nmsu.edu/wp/index.php/outreach/outreach-programs/

APPENDIX D

As part of Study 3's experiments, parents engaged in an emotional elicitation task and then filled out a brief survey about their autonomy support (experiment 1), anxiety about their children's internet use (experiment 2), and likelihood to mediate their children's Internet use (both Experiments). For each experiment, the following appendix outlines each construct, the items measuring that construct, and the research that the measures were modelled off of. Where relevant, instructions are included in italics.

Manipulation Check:

Construct	Source	Items
Relatedness Support		Engaging together online can help bring us closer to our daughters. Reflect on a time from the past month when using technology with your child helped bring you closer together and spend five minutes writing about that time. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Relatedness Thwart		Devices can sometimes create a wedge between parents and children. Reflect on a time from the past month when technology made you feel disconnected from your daughter and spend five minutes writing about that time. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Control Condition		People have a lot of experiences engaging with the Internet with their children*. Reflect on something you did online in the past month and spend five minutes writing about it. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Relatedness (Manipulation Check)	La Guardia, Ryan, Couchman, & Deci (2000)	When I am with my child[10], I feel loved and cared about. When I am with my child I often feel a lot of distance in our relationship. (R) When I am with my child, I feel a lot of closeness and intimacy.

[10] For all items with the word child, the word was replaced with either daughter or son based on the child's gender identity to make the results personal

Experiment 1:

Construct	Source	Items
Relatedness Support		Engaging together online can help bring us closer to our daughters. Reflect on a time from the past month when using technology with your child helped bring you closer together and spend five minutes writing about that time. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Relatedness Thwart		Devices can sometimes create a wedge between parents and children. Reflect on a time from the past month when technology made you feel disconnected from your daughter and spend five minutes writing about that time. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Relatedness (Manipulation Check)	La Guardia, Ryan, Couchman, & Deci (2000)	When I am with my child[11], I feel loved and cared about. When I am with my child I often feel a lot of distance in our relationship. (R) When I am with my child, I feel a lot of closeness and intimacy.
Parent Autonomy Support	Deci, Schwartz, Sheinman, & Ryan (1981)	*In what follows are a series of vignettes. Each one describes an incident you might face as a parent and then lists four ways of responding to the situation. Please read each vignette and then consider each responses in turn. Think about each response option in terms of how appropriate you consider it to be as a means of dealing with the problem described in the vignette.* *For each response, pleas rate how appropriate you find it on a scale from 1 to 7, where 1 is highly inappropriate and 7 is very appropriate. Please rate each of the four options for each vignette. There are four vignettes with four options for each.* Your son Jim is an average student who has been working at grade level. You learn from his teacher that during the past two weeks he has appeared listless and he has not been completing assignments. You know that he has been spending a lot of time online lately. The most appropriate thing for you to do is: • Impress upon him the importance of finishing his assignments since he needs to learn this material for his own good. • Let him know that he doesn't have to finish all of his work now and see if you can help him work out the cause of the listlessness. • Prevent him from using the Internet until that day's assignments are done. • Let him see how he compares with the other children in terms of his assignments and encourage him to catch up with the others.

[11] For all items with the word child, the word was replaced with either daughter or son based on the child's gender identity to make the results personal

Parent Autonomy Support	Deci, Schwartz, Sheinman, & Ryan (1981)	Lately, Mr. and Mrs. Greene have noticed that their daughter Sarah has been spending a lot of time on the Internet teaching herself new things. At a parent conference last night, Mr. and Mrs. Greene were told that Sarah has made more progress than expected since the time of the last conference. All agree that they hope she continues to improve so that she does not have to repeat the grade (which the Greenes have been kind of expecting since the last report card). As a result of the conference, the Greenes decide to: • Increase her allowance and promise her a new computer if she continues to improve. • Tell her that she's now doing as well as many of the other children in her class. • Tell her about the report, letting her know that they're aware of her increased independence in school and at home. • Continue to emphasize that she has to keeping using the Internet to learn and to get better grades. Your child has a popular Youtube channel where they talks about their hobbies. However, you are concerned because your child just told you they failed their unit math test and will have to retake it the day after tomorrow. You decide that the best thing to do is: • Ask your child to talk about how they plan to handle the situation. • Tell your child they probably ought to decide to forego filming tomorrow's episode so they can catch up in math. • See if others are in the same predicament and suggest your child do as much preparation as the others. • Make your child skip tomorrow's episode to study; the Internet has been interfering too much with school work. You are concerned about how your child has been using Facebook – they are interacting with a lot of strangers and making a lot of crude jokes. You want your child to change their behavior. A useful approach might be to: • Encourage your child to talk about how they use Facebook and what it means for them. • Go over your child's profile with them; point out the inappropriate ways that they are using it. • Stress that your child should do better; they'll never get into college with online behaviors like these. • Turn off the Internet for 24 hours every time you see something inappropriate.
Active Mediation	Duerager & Livingstone (2012)	I intend to talk to my child about what they do online
Safety Guidelines		I will make recommendations for my child about how to use the Internet
Restrictive Mediation		I want to limit what my child can do online
		I intend to limit how much time my child can spend online
Co-Use		I want to use the Internet together with my child
Filtering		I will consider installing filters on my child's Internet use
Monitoring		In intend to monitor the websites my child visits online

Experiment 2:

Construct	Source	Items
Relatedness Support		Engaging together online can help bring us closer to our daughters. Reflect on a time from the past month when using technology with your child helped bring you closer together and spend five minutes writing about that time. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Relatedness Thwart		Devices can sometimes create a wedge between parents and children. Reflect on a time from the past month when technology made you feel disconnected from your daughter and spend five minutes writing about that time. *Please take the full five minutes to reflect on and write about this experience. After five minutes, the page will let you advance.*
Relatedness (Manipulation Check)	La Guardia, Ryan, Couchman, & Deci (2000)	When I am with my child[12], I feel loved and cared about. When I am with my child I often feel a lot of distance in our relationship. (R) When I am with my child, I feel a lot of closeness and intimacy.
Generalized Anxiety	Joiner, Brosnan, Duffield, Gavin, & Maras (2007)	When I am with my child*, I feel a lot of closeness and intimacy. I always feel anxious when my child is using the Internet. I go out of my way to make my child avoid using the Internet. It is easy for my child to use the Internet. It is important for my child to be able to use the Internet. My anxiety about my child Internet use bothers me.
	Madden, Cortesi, Gasser, Lenhart, & Duggan (2012)	I am more anxious about my child using the Internet than I should be How my child manages their reputation online The amount of information advertisers can learn about my child's online behavior My child's online activities might affect their future academic or employment opportunities
Concrete Fears	Sorbring (2014)	My child interacts online with people they do not know My child will see things online that I do not want them to see My child will become inactive because of Internet use My child will come into contact with pornography My child will come into contact with distressing material My child will come into contact with inaccurate information My child will come into contact with bullying My child will come into contact with pages which are hateful and/or mean to individuals or groups My child will be exposed to violent content My child will come into contact with dangerous individuals
Active Mediation	Duerager & Livingstone (2012)	I intend to talk to my child about what they do online
Safety Guidelines		I will make recommendations for my child about how to use the Internet
Restrictive Mediation		I want to limit what my child can do online I intend to limit how much time my child can spend online
Co-Use		I want to use the Internet together with my child
Filtering		I will consider installing filtes on my child's Internet use
Monitoring		In intend to monitor the websites my child visits online

[12] For all items with the word child, the word was replaced with either daughter or son based on the child's gender identity to make the results personal

APPENDIX E

As part of Study 3, parents were asked to reflect on a time that technology either brought them closer to or drove a wedge between themselves and their child. In what follows, sample responses to the manipulation check are offered to illustrate the ways that parents responded to the prompt.

Relatedness Support:

My daughter likes to play a game on the phone called Pokemon Go. This game has you walk around town hitting up "Pokestops" and Gyms for extras in the game. I like to run in the morning so I have been helping her out by taking the game out on a run with me where i can hit up the Pokestops and get her the stuff she needs to play the game. She loves it and will then sit and show me all of the things she has gotten and how excited she is for my help. She also wants me to go with her to different events and Raids to show me more about the game. Hell last weekend we went to the mall and walked around it for 2 hours while she hit Pokestops and caught various Pokemon. I really enjoy it while it is lasting.

Relatedness Thwart:

My daughter frequently is on her phone when we drive to school or the grocery store. This should be a time we can talk together but she chooses to spend her time watching videos and texting. Also, often times she will bring her phone with her to the dinner table. This is the one time that we should all be together as a family.

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