THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES AND RESILIENCE IN ADOLESCENCE

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DECLARATION

I, François Hugo Theron, declare that the thesis, ***The use of information and communication technologies and resilience in adolescence***, submitted by me for the Philosophiae Doctor (Child Psychology) degree at the University of the Free State, is my own independent work and has not previously been submitted by me at another university/faculty. I further cede copyright of this thesis in favour of the University of the Free State.

30 January 2015

François Hugo Theron   **Date**

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Grown-ups like numbers. When you tell them about a new friend, they never ask questions about what really matters. They never ask: "What does his voice sound like?" "What games does he like best?" "Does he collect butterflies?" They ask: "How old is he?" "How many brothers does he have?" "How much does he weigh?" "How much money does his father make?" Only then do they think they know him.

- Antoine de Saint-Exupéry, The Little Prince (1945)

Man is a knot into which relationships are tied.

- Antoine de Saint-Exupéry, Flight to Arras (1942)

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ABSTRACT

There has been an exponential uptake of information and communication technology (ICT) in the past decade. The majority of empirical research focuses on the possible adverse effects of this escalating ICT use on adolescent development. Few studies investigate any benefits of ICTs for adolescents. This study looks at the effect of frequency of ICT use on adolescent resilience, by examining its effect on social involvement, intrapersonal functioning and emotional regulation in adolescence. Gender and age-related differences are also studied.

A criterion cohort design was used to gather data in two waves on a stratified, random sample of 1000 adolescents (across diverse demographic assemblages) from ten Free State high schools. Mean ages ranged from 13.9 years for Wave 1 to 16.4 years for Wave 2. A biographical questionnaire was used to gather information about age, gender and frequency of ICT use. The *Behavioural and Emotional Rating Scale (BERS2)* (Epstein & Sharma, 1998), and the *Resiliency Scales for Children and Adolescents (RCSA)* (Prince-Embury, 2006) were used to obtain strengths and resilience data.

Participants were grouped into four groups based on their daily ICT use: a group with no use, two groups with moderate ICT use, and a group with

excessive ICT use. The relationship between different variables in both cohorts was statistically analysed to determine the effects of gender, and the number of hours of daily ICT use, on participants' social involvement, intrapersonal functioning, and emotional regulation.

Most participants in Wave 1 (56%) and Wave 2 (83%) used ICTs moderately, with a smaller number of adolescents reporting excessive daily use (Wave 1 = 23%; Wave 2 = 16%). No ICT usage decreased drastically (21% to 0.23%) from Wave 1 to 2. More girls than boys (24% compared to 16%) didn't use ICTs daily in Wave 1, whilst the proportion of boys and girls in all other ICT use groups of Wave 1 and 2 were remarkably similar.

In Wave 1, sense of relatedness scores and hours of ICT use per day differed significantly (F=7.465; p=0.000). Group differences were found between the non-users and both moderate ICT user groups, as well as between the more than 0 to 3 hours per day ICT use group and excessive ICT users. The moderate user group's sense of relatedness scores were the highest of all user groups, and the excessive user group's scores were the lowest. Younger adolescents with dissimilar frequencies of ICT use significantly differed in terms of their emotional reactivity (F=6.811; p=0.000). Specific differences were found between the group that used ICTs more than 0 to 3 hours per day (lowest emotional reactivity scores) and the excessive ICT use group (highest emotional reactivity scores), with high emotional reactivity indicative of low emotional regulation.

In Wave 1 and 2 there were significant differences between adolescent boys' and girls' intrapersonal strengths (Wave 1: F=5.847; p=0.016 and Wave 2: F=9.587; p=0.002), with females recording higher intrapersonal strength scores in Wave 1, and males in Wave 2.

Wave 2 females and males differed significantly (F=6.103; p=0.014) on interpersonal strength scores, with older adolescent boys reporting higher interpersonal strengths than older adolescent girls. Older adolescents with different daily ICT usage, differed significantly on sense of mastery scores (F=4.666; p=0.010), with specific differences between the two moderate ICT user groups (with the more than 3 hours to 6 hours group reporting the highest sense of mastery scores). The older cohort's girls reported significantly lower affective strength scores than the older boys.

The results from this, the first large quantitative study of its kind in South Africa, contribute to the body of empirical work on ICT use and adolescent resilience. The findings can inform adolescent caregivers about the significant effect between moderate ICT use and optimal adolescent resilience, as well as possible detrimental effects of excessive use.

OPSOMMING

Daar is 'n eksponensiële toename in informasie en kommunikasie tegnologie (IKT) gebruik oor die laaste dekade. Die meerderheid van empiriese navorsing fokus op die moontlike nadelige uitwerking van hierdie toename op adolessente ontwikkeling. Min studies ondersoek die moontlike positiewe effekte van IKT by adolessente. Hierdie studie kyk na die uitwerking van die frekwensie van IKT gebruik op adolessente veerkragtigheid, deur die effek op sosiale betrokkenheid, intrapersoonlike funksionering en emosionele regulering in adolessensie te bestudeer. Geslags- en ouderdomsverskille word ook bestudeer.

'n Kriterium kohort metodologie is gebruik om data in twee insamelingspunte op 'n gestratifiseerde, ewekansige steekproef van 1000 adolessente (vanuit diverse demografiese afkomste) van tien Vrystaatse skole in te vorder. Hulle gemiddelde ouderdomme strek van 13.9 jaar vir insamelingspunt 1 (W1) tot 16.4 jaar vir insamelingspunt 2 (W2). 'n Biografiese vraelys is gebruik om inligting oor ouderdom, geslag en frekwensie van IKT gebruik in te vorder. Die *Gedrags- en Emosionele Beoordelingskaal (Behavioral and Emotional Rating Scale – BERS2*) (Epstein & Sharma, 1998), en die *Veerkragtigheidskaal vir Kinders en Adolessente (Resiliency Scales for Children and Adolescents – RSCA*) (Prince-Embury, 2006) is gebruik vir data-invordering.

Studiedeelnemers is opgedeel in vier groepe, gebaseer op hulle daaglikse IKT gebruik: 'n groep met geen gebruik, twee groepe met matige gebruik, en 'n groep vir oormatige IKT gebruik. Die verhouding tussen verskillende veranderlikes in beide kohorte was statisties ontleed om die effekte van geslag, en die aantal ure daaglikse IKT gebruik, op studiedeelnemers se sosiale betrokkenheid, intrapersoonlike funksionering en emosionele regulering te bepaal.

Die meeste studiedeelnemers in W1 (56%) en W2 (83%) het IKT matig gebruik, met slegs 'n klein hoeveelheid adolessente wat oormatige gebruik gerapporteer het. Geen IKT gebruik het drasties afgeneem (21% tot 0.23%) van W1 tot W2. Meer meisies as seuns (24% teenoor 16%) in W1 het geen IKT per dag gebruik nie, terwyl die verhouding van seuns en dogters in alle ander IKT gebruiksgroepe van beide W1 en W2 merkwaardig eenders was.

In W1 het gevoel van verwantskap en ure IKT gebruik per dag statisties beduidend verskil (F=7.465; p=0.000). Groepsverskille is gevind tussen die geen gebruiksgroep en beide die matige gebruiksgroepe, sowel as tussen die meer as 0 ure tot 3 ure IKT gebruiksgroep en die oormatige IKT gebruikers. Die matige gebruikers se gevoel van verwantskap telling was die hoogste van al die gebruiksgroepe, en die oormatige gebruiksgroep se telling die laagste.

Jonger adolessente met verskillende IKT gebruiksfrekwensies verskil beduidend in terme van hul emosionele reaktiwiteit (F=6.811; p=0.000). Spesifieke verskille is gevind tussen die meer as 0 tot 3 ure IKT gebruiksgroep (laagste emosionele reaktiwiteit telling) en die oormatige gebruiksgroep (hoogste emosionele reaktiwiteit telling), met 'n hoë emosionele reaktiwiteit telling kenmerkend van lae emosionele regulering.

In die jonger en ouer kohorte was daar betekenisvolle verskille tussen die seuns en die dogters se intrapersoonlike sterkte tellings (W1: F=5.847; p=0.016 en W2: F=9.587; p=0.002), met die meisies wat die hoër intrapersoonlike sterkte telling aanteken in W1, en die seuns in W2.

W2 meisies en seuns verskil betekenisvol in terme van hulle interpersoonlike sterkte telling (F=6.103; p=0.014), met die ouer seuns wat hoër interpersoonlike sterkte rapporteer as die meisies. Ouer kohort adolessente met verskillende daaglikse IKT gebruik, verskil betekenisvol met betrekking tot gevoel van bemeestering tellings (F=4.666); p=0.010), met spesifieke verskille tussen die twee matige IKT gebruiksgroepe (met die hoogste gevoel van bemeestering telling te vinde by die meer as 3 tot 6 ure gebruiksgroep). Die ouer adolessente meisies rapporteer statisties beduidend laer affektiewe sterkte tellings as die ouer seuns.

Die resultate van hierdie, die eerste uitgebreide kwantitatiewe studie van sy soort in Suid-Afrika, lewer 'n waardevolle bydrae tot die bestaande volume empiriese werk oor IKT gebruik en adolessente veerkragtigheid. Die bevindinge kan versorgers van adolessente inlig oor die beduidende effek tussen matige IKT gebruik en optimale adolessente veerkragtigheid, asook oor die moontlike nadelige gevolge van oormatige gebruik.

Kernwoorde: Adolessensie, informasie en kommunikasie tegnologie (IKT), veerkragtigheid, sosiale betrokkenheid, intrapersoonlike funksionering, emosionele regulering, Suid-Afrika, geslag

CHAPTER 1

ORIENTATION AND PROBLEM STATEMENT

Introduction

This research report is presented in the form of three articles (following the stipulated academic requirements). This chapter serves as preamble to the three articles and will provide the reader with a holistic introduction to the study.

Orientation and problem statement

In 1964, Marshall McLuhan published his *opus magnus*, Understanding Media, a scholarly 'prophecy' (Nicholas Carr, 2010) that imagined a world where the "process of knowing will be collectively … extended to the whole of human society" (McLuhan, 1964, p.3). McLuhan's future was neither utopic nor dystopic; it was a future that acknowledged and celebrated the transformative power of new communication technologies, but also forewarned against that exact same power and the risk of being oblivious to it. McLuhan's envisaged tomorrow has become our present-day, and his cautionary prophetic words are now our daily reality.

It is the reality of a society saturated with information and communication technologies (ICTs) (Telecommunication Development Sector, 2014). ICTs are technology that people utilise to gain access to information, and include computers, mobile phones, radios, televisions, the internet and social media applications (e.g., Facebook, WhatsApp and Twitter) (Chatfield, 2012; Weber

& Kauffman, 2011). In 2014 (the year that the World Wide Web turned 25) (Berners-Lee, 2000) close to 80% of all human beings were already connected to the internet (Rosen, 2012), and worldwide ICT access has surpassed even the optimistic predictions made by the World Summit of the Information Society (WSIS) a decade ago (Doong & Ho, 2012). ICTs' presence is all pervasive in developed countries (100% penetration), and exponentially increasing in developing countries (China Internet Network Information Center (CNNIC), 2010). It is a phenomenon that is not just changing the societal landscape at large, but also affecting the most ordinary aspects of individuals' everyday lives (Turkle, 2011). For most people, engaging with ICTs are often the first and last action in their daily routine (Rosen, 2012), and in a recent study by the Pew Research Centre (2014), more than two thirds of participants reported themselves unable to comprehend not having a mobile phone, whilst almost 90% of the same respondents were willing to give up watching television.

The ubiquitous presence of ICTs is a fact of life for the present generation of adolescents (often referred to as 'digital natives' – a generation born into a world where digital technology has always existed) (Palfrey & Gasser, 2008), and worldwide, ICT use has become the preferred activity for the majority of them (Strasburger et al., 2013). Most adolescents have access to ICT and the internet and engage with ICTs in ever-increasing frequency and duration (Wallace, 2014). In fact, the average adolescent in developed countries spends his or her waking day interacting with screen technology (Sigman, 2012). Developing countries' adolescents are lagging in terms of ICT access

and use (Blignaut & Els, 2010), but improved mobile technology is driving an exponential uptake of ICTs amongst adolescents from the developing world (Telecommunication Development Sector, 2014). In South Africa, two thirds of adolescents access the internet via mobile technology every day (Chuma, 2014), with surprisingly little variation in frequency of ICT use across diverse demographic assemblages (Mbinjama, 2013).

Developmental realities (both physical and psychological) (Gilmore & Meersand, 2014) make children especially susceptible to the impact of this rapidly changing societal landscape that is driven by the rate of technological progress and the almost universal uptake of these technologies (Ahn, 2011; Bailin, Milanaik, & Adesman, 2014). The very real question thus begs: What are the effects of this ever-increasing ICT use on adolescents who are challenged with developmental demands, juxtaposed to dwindling communal support (Park, Clery, Curtice, Phillips, & Utting, 2012)?

Research on the effects of ICT use on adolescents and their development is substantive (Shapiro & Margolin, 2014), although the vast majority of published studies focuses on the possible negative consequences of ICT use for developing adolescents (e.g., Holtz & Appel, 2011; Hong et al., 2013; Kaess et al., 2014). Empirical studies have looked at the adverse effects of adolescent ICT use on developmental areas ranging from physical health (Hardy, Denney-Wilson, Thrift, Okely, & Baur, 2010), including sleep (Choi et al., 2009), relationships (Amichai-Hamburger & Hayat, 2011), and psycho-emotional well-being (Huang, 2010), to academic functioning (Weinstein,

Feder, Rosenberg, & Dannon, 2014), and eventual long-term outcomes for communities at large (Karlsen, Gual, & Anderson, 2013).

There is, however, a minority research discourse evolving from a small, but growing, volume of studies investigating possible positive effects of ICT use for adolescents. Ahiauzu and Odili (2012) argue eloquently in support of research that is more balanced in its studying of ICTs' effects on adolescent development – a "middle ground" approach, where technology and its use is neither detrimental nor beneficial, but where effects are associated with the amount of ICT use (Belanger, Akre, Berchtold, & Michaud, 2011).

The bio-ecological model of Bronfenbrenner (2005) provides a suitable theoretical framework to understand the important interplay between individual and environment. Johnson and Puplampu's (2008) addition of a techno subsystem to Bronfenbrenner's model acknowledges the growing importance of ICTs in the daily functioning of individuals.

The bio-ecological model encompasses a lifespan approach to development, and is theoretically applicable to childhood, adolescence and adulthood (Sigelman & Rider, 2014). The model highlights the importance of bi-directional effects between developing individuals and their surrounding environments (Bronfenbrenner & Morris, 2006). It consists of five interconnected systems of which the first, the *microsystem*, is contextually closest to the individual and encompasses interpersonal relationships and direct exchanges with the immediate surroundings. For example, an

adolescent's school, friends or family members, are seen as part of the microsystem. The second system, the *mesosystem*, defines reciprocity between different entities associated with the microsystem. A good relationship, for example, between an adolescent boy's father and his sport coach is part of the mesosystem because these two direct influences (that are considered to be part of the microsystem) will interact and affect the adolescent boy (the individual at the centre of Bronfenbrenner's model) positively. The third system, or the *exosystem*, does not directly impact on individuals, but is characterised by aspects of structures within the microsystem. A case in point would be parental job loss and its associated financial difficulties that would fundamentally affect an adolescent even though he or she is not directly involved. The fourth system, the *macrosystem*, is the outermost layer of the bio-ecological model, and integrates social beliefs or cultural ideologies that often shape an individual's environment. The ideologies that lead to the passing of specific laws is an example of the macrosystem (e.g., the racist nationalist ideologies that led to Apartheid laws and its profound impact on non-white adolescents pre-1994) (Clark & Worger, 2013). Lastly, the *chronosystem*, explains how time is an important component in the way that people, their environments and ultimately their interactions will change over time. For example, the specific way in which young children interact with their parents changes as they develop into adolescence (Gilmore & Meersand, 2014).
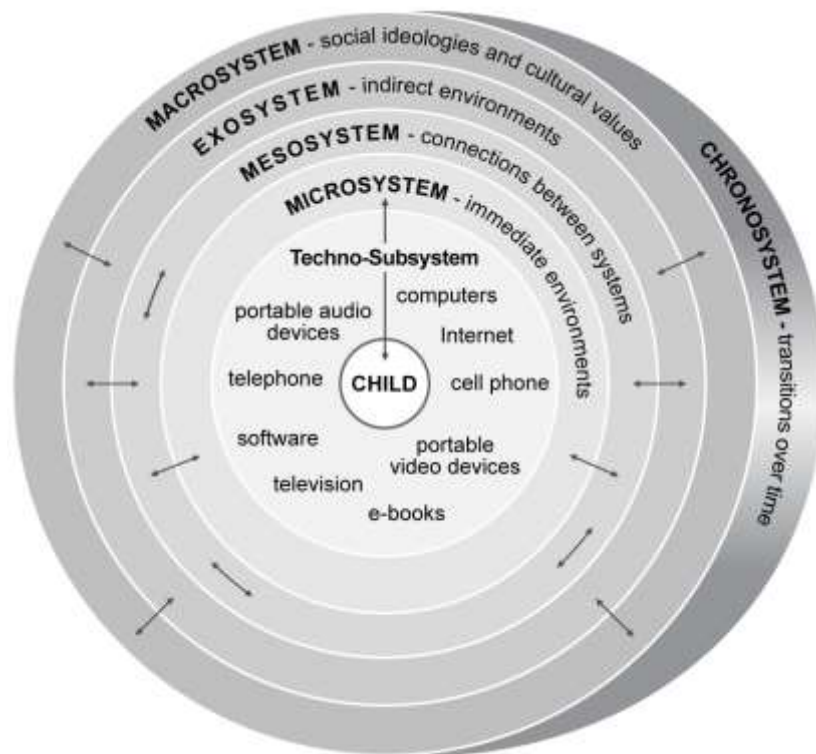
Figure 1. The ecological techno-subsystem (Johnson & Puplampu, 2008)

As can be seen in Figure 1, the techno-subsystem is an extension of the microsystem and explains the interaction between the adolescent and ICT (e.g., playing games on the computer), as well as interaction with the adolescent's microsystem mediated by ICTs (e.g., communicating to peers on social media platforms) (Johnson, 2010a). An example relating to the mesosystem would be parents' monitoring of school attendance or school marks by logging onto the school's website, or teacher and parents communicating via email about the adolescent's classroom behaviour. Socio-economic realities of parents often dictate the technological realities present in the home environment, i.e. mesosystem (e.g., if the parent is a computer programmer and generates enough income, the child might have an excellent

computer with a fast internet connection, or the latest and best smart phone). Macrosystem relevance for the techno-subsystem can be conceptualised in terms of the cultural value attached to ICT use (e.g., as an enhancer of education). The older an adolescent is, the more autonomy he or she is allowed, also as with regards to internet use (i.e., chronosystem). Excessive ICT use will affect all of the adolescent's interactional systems as defined by Bronfenbrenner's model (for example, excessive internet online gaming will lead to less time to invest in reciprocal interaction between an individual and his or her peers and family members, adversely influencing the microsystem) (Johnson, 2010b).

Bronfenbrenner's (2005) model thus explains how the complex interactions between personal attributes and environmental circumstances, mediated by internal mechanisms of the adolescent himself or herself, will dictate how well adolescents manage and adapt to their environment (Luthar, Cicchetti, & Becker, 2000). Researchers have embraced this focus on people's abilities to effectively adjust to adversity (Cohen, Pooley, Ferguson, & Harms, 2011), and this has led to a fundamental paradigm shift in empirical studies over the last 20 years (Prince-Embury & Saklofske, 2013).

In developmental psychology especially, this paradigm shift has embraced the concept of resilience (Luthar & Zelazo, 2003), and it has become indispensable in order to understand children and adolescents' strengths and personal resiliency, and how it relates to optimal development (Brownlee et al., 2013). Rutter and Taylor (2003, p.264) define resilience as "the ability to

demonstrate successful development and adaptation within contexts of risk". The effectiveness with which adolescents negotiate their environment and its inherent risks (including the possible adverse effects of ICT use) is dependent on what Prince-Embury and Saklofske (2013) refer to as personal resiliency. Three core developmental attributes associated with personal resiliency have been identified and studied (Prince-Embury, 2006), namely sense of relatedness, sense of mastery, and emotional reactivity. Sense of relatedness is associated with an adolescent's social and relational resiliency, and consists of four theoretically linked constructs, namely *tolerance* (of differences with others), that other people can be *trusted*, and that they will be able to provide *comfort* and *support* when needed. Sense of mastery is linked to the adolescent's intrapersonal resiliency, and consists of the conceptually related constructs of *optimism* (of one's own competence), *adaptability* (in being able to productively incorporate feedback and adjust accordingly), and *self-efficacy* (in one's problem-solving ability). Emotional reactivity relates to the adolescent's ability to regulate his or her emotions, via the three interconnected constructs of *sensitivity* (i.e., both the adolescent's threshold for emotional reaction and the intensity with which he or she reacts), *impairment* (i.e., how much the emotional reaction affected the adolescent's functioning), and *recovery* (i.e., how long it takes the adolescent to return to normal emotional levels) (Prince-Embury & Saklofske, 2013).

How well adolescents manage the daily demands of their environments does not only depend on their above-described personal resiliency constructs, but also on specific psychological strengths they might have, that continue to

evolve throughout adolescence (Brownlee et al., 2013). These strengths can be internal personal strengths of the individual, or external environmentally associated strengths. The Behavioral and Emotional Rating Scale (BERS-2) (Epstein & Sharma, 1998) is an instrument that utilises a strength-based approach for the assessment of adolescent behaviour and emotional strengths, and includes interpersonal strengths, family involvement, school functioning, intrapersonal strengths, and affective strengths (Epstein, 2000).

Prince-Embury and Saklofske (2013) thus argues that if resilience is defined as a combination of interactions between personal attributes and environmental realities, mediated by internal mechanisms, then adolescent resilience studies, must include the personal attributes or strengths, as well as the personal resiliency factors of adolescents, specifically as it pertains to three core developmental systems in adolescence, namely social involvement (i.e., include sense of relatedness, school functioning, family involvement, and interpersonal strengths), intrapersonal functioning (i.e., include sense of mastery and intrapersonal strengths), and emotional regulation (i.e., include emotional reactivity and affective strengths).

Peer-reviewed publications expansively discuss the possible detrimental effects of ICT use on these three core adolescent developmental systems (Bailin et al., 2014; Lam, 2014). Juxtaposed to this dominant discourse of possible negative consequences, is the necessity for a more balanced academic discussion relating to ICT use and its sequelae, including possible positive effects (Ahiauzu & Odili, 2012). Another lacuna in the published

literature is related to methodological issues, with too many studies deploying cross-sectional research designs, and too few studies employing large, representative samples (Shek & Yu, 2012). An exception to the dominant deficit-only research publications, that also addresses both the representative sampling and the research design issues, is Yu and Shek's (2013) three-year longitudinal study on adolescent ICT use in Hong Kong.

Adolescence brings major life changes, related to biology, psycho-social status, and larger environmental contexts (e.g., moving from primary school to secondary school) (Gilmore & Meersand, 2014). In terms of biology, adolescent boys and girls differ both behaviourally and neurologically. Hines (2011) argues that the mere existence of gender differences in adolescents' behaviour suggests underlying neurological gender differences, because all behaviour depends on the nervous system. The evolving psycho-social status of adolescents is comprehensive and far-reaching, whilst also equivocal – they are migrating away from the dependent and controlled environment of childhood, but are not yet afforded the autonomy of adulthood (Pettit, Laird, Dodge, Bates, & Criss, 2001). Societal norms towards adolescent girls and boys are often different, with gender-biased parenting practices (Varner & Mandara, 2013). Young adolescent girls are often afforded less autonomy than their male counterparts, while expectations of responsibility for them are higher than for the boys (Varner & Mandara, 2013). These gender differences, and their significance for successful environmental adjustment, and ultimately for adolescent resilience development, is well documented (Oberle, Schonert-Reichl, & Thomson, 2010; Werner, 2013).

Research has shown a decrease in gender-specific differences in adolescent ICT use (Drabowicz, 2014), emulating a larger societal shift in gender identities and roles (Williams, Consalvo, Caplan, & Yee, 2009). The differences that do remain point to female ICT use often linked to information seeking and communication (Chen & Tzeng, 2010), while male ICT use focuses primarily on entertainment (Lai & Gwung, 2013). Both the adolescent girls and the adolescent boys spend less time with ICTs as they grow older (Yu & Shek, 2013), while the younger adolescent males are more likely to use ICTs excessively, possibly because females report stricter monitoring by their parents than males (Rosen, Cheever, & Carrier, 2008).

Bronfenbrenner's bio-ecological model recognises, by the inclusion of the chronosystem, the specific influence that time has on the ever-evolving relationship between individual and environment, and that people will react differently to environmental influences at different stages of their lives (Crockett & Silbereisen, 2000). A child of six years, for example, will react differently to social exclusion from a specific peer-group than an adolescent of 16 years.

Current integrated theories from the fields of Neuroscience and Developmental Psychology acknowledge that brain maturation processes provide developing adolescents with an ever-changing set of skills (Christakou et al., 2013). Normal neurological maturation in adolescence include structural and functional changes in regions involved in decision

making, cognitive control, executive attention, and emotional processing (Lin et al., 2012). These changes provide adolescents with ever-greater emotional and behavioural control (Hare et al., 2008), and influence deeply how well they will manage their daily lives at different periods during adolescence (Silvers et al., 2012). The different effects of ICT use on the same group of adolescents at different times during adolescence are not well studied (Yu & Shek, 2013), and were therefore important to include for consideration in this study.

There is a lack of South African research that examines adolescent ICT use in general (Savahl, September, Odendaal, & Moos, 2008), and no studies that investigate ICTs' possible effects on adolescent resilience, gender or age. The available South African research has small data-sets (e.g.,, Bosch, 2008; Chuma, 2014; Louw & Winter, 2011), employs qualitative methodologies (e.g.,, Mbinjama, 2013; Odendaal, Malcolm, Savahl, & September, 2006), focuses on aspects other than the developmental effects of ICT use (e.g.,, Gudmundsdottir, 2010; Mbinjama, 2013; Oyedemi, 2015; Van der Merwe, 2013), or utilises cross-sectional or survey research designs in the gathering of data (Mbinjama, 2013; Oyedemi, 2015), making any interpretation of age-related variables over time problematic (Shipman, 2014). Lastly, Tudge and his colleagues eloquently argue in support of empirical studies being grounded in sound theory (Tudge, Mokrova, Hatfield, & Karnik, 2009). Unfortunately, many of the South African studies lack a clear theoretical foundation.

This article strives to address the methodological issues raised and fill the crucial gap in empirical research on resilience and frequency of ICT use, especially as it pertains to the South African context. The guiding research question of the study is: "to what extent does the frequency of ICT use effect differences in resilience of adolescent girls and boys over a period of two years?"

Focus of the research

The overarching aim of this study is to investigate the significance of differences between groups that report different levels of ICT use with respect to their resilience, specifically adolescent social involvement, intrapersonal functioning, and emotional regulation, and to identify any gender or age differences with regards to ICT use and its effect on resilience.

The specific goals of this study are:

- To investigate the effect of the number of hours of ICT use on adolescent resilience-associated dimensions of social involvement (i.e., sense of relatedness, school functioning, family involvement, and interpersonal strengths).

- To investigate the effect of the number of hours of ICT use on the adolescent resilience-associated dimensions of intrapersonal functioning (i.e., sense of mastery and intrapersonal strengths).

- To investigate the effect of the number of hours of ICT use on the adolescent resilience-associated dimensions of emotional regulation (i.e., emotional reactivity and affective strengths).

- To determine whether there are any differences between adolescent boys and girls with regards to their ICT use, social involvement, intrapersonal functioning, and emotional regulation.

- To determine whether there are any differences between the younger adolescent cohort and the older adolescent cohort as pertaining to ICT use, social involvement, intrapersonal functioning, and emotional regulation.

Methodology

Research design

The research paradigm followed throughout the study is an empirical positivistic paradigm. The study will employ a criterion group design.

Participants and data gathering

Accumulated data from the Adolescent Risk and Resilience Project was used in this study. The Adolescent Risk and Resilience Project (managed by a team of researchers, including the author of this thesis, from the University of the Free State's Department of Psychology) was a research project that studied risk and resilience in an adolescent group over a time-period of three years. The data was gathered in two separate waves during 2010 and during 2012 from the same ten schools in the Free State Province, South Africa.

Standardised, back-translated psychometric tests in booklet format (available in all three official languages of the province) were supplied during school hours to the participants for completion. The psychometric tests were

completed as a group, under the supervision of registered psychologists and field workers, at the participants' respective schools.

Measuring instruments

The following measuring instruments were used:

Biographical questionnaire. Closed-ended questions provided participants' age and gender information, whilst the amount of ICT usage emerged from the average amount of hours per day spent on ICT use as self-reported by the adolescents.

Behavioral and Emotional Rating Scale (BERS2) (Epstein, 2000). The BERS2 scale evaluates interpersonal, school functioning, family involvement, intrapersonal, and affective strengths. These items have been shown to have high internal consistency in American (Epstein & Sharma, 1998) and South African studies (De Villiers, 2009).

Resiliency Scales for Children and Adolescents (RCSA) (Prince-Embury, 2006). The RCSA evaluate a participant's personal resilience by measuring three resilience-subscales, namely Sense of Relatedness, Sense of Mastery, and Emotional Reactivity. Previous South African research has been done in which RCSA was used (De Villiers, 2009).

Ethical considerations

Permission to conduct this study was obtained from the Research Committee of the Faculty of Humanities, University of the Free State, as well as from the principals of participating schools and the provincial Department of Education. Participation was voluntary and all information was obtained anonymously to ensure confidentiality. The informed assent and consent of adolescents and their parents were obtained prior to inclusion in the project. Participants were debriefed by a field-worker post-administration of the questionnaires to make sure that no adolescent was emotionally upset. If necessary and indicated, referrals for individual professional counselling were made. Pamphlets with information on coping strategies and support resources were provided to each participant.

Concept clarification

In order to facilitate a better understanding of this study, key concepts and terms will be clarified:

- ***Information and Communication Technology (ICT) / Information and Communication Technologies (ICTs).***

Technologies that provide access to information through telecommunications (Chatfield, 2012).

- ***Adolescent***

A human in the life stage after middle childhood and before early adulthood (i.e., between puberty and 19 years of age) (Louw & Louw, 2007).

- ***Resilience***

The ability to adjust successfully in the face of adversity (Prince-Embury & Saklofske, 2013).

- ***Risk***

A measurable entity that predicts negative or adverse outcomes for a certain group of individuals (Wright & Masten, 2013).

- ***Emotional reactivity***

An intrinsic part of resilience. High emotional reactivity is associated with sensitivity, slow recovery from an emotional reaction, and impairment caused by emotional arousal (Prince-Embury & Saklofske, 2013).

- *Sense of mastery*

An intrinsic part of resilience. Optimism about oneself and one's environment; a self-believe in one's problem-solving skills, adaptive capabilities, or help-seeking skills (Prince-Embury & Saklofske, 2013).

- *Sense of relatedness*

An intrinsic part of resilience. Social support, tolerance of differences, and comfort with others (Prince-Embury & Saklofske, 2013).

- *School functioning*

Educational abilities and competence in school tasks, and classroom conduct (Epstein, 2000).

- *Family involvement*

The level of participation and quality of relationships with one's family (Epstein, 2000).

- *Interpersonal strength*

The skill of emotional and behavioural control in social situations (Epstein, 2000).

- ***Intrapersonal strength***

One's perception of one's abilities, successes and competence (Epstein, 2000).

- ***Affective strength***

The ability to accept feelings from others and reciprocate (Epstein, 2000).

Each of these terms or key concepts will be thoroughly discussed and theoretically grounded in subsequent chapters' literature review.

Delineation of the study

This thesis consists of an introductory chapter, followed by the three articles as stipulated by the PhD requirements. The concluding chapter recapitulates the general findings for the purpose of integration of results across all three articles.

Chapter 1: Orientation and Problem Statement

This chapter orientates the reader to the rationale of this thesis, providing general background information, as well as a complete discussion of the relevant literature, arguing the necessity for this study, especially within a South African context. The research goals and methodology are provided to

the reader, together with key terms and concept definitions. Lastly, the focus of each of the chapters is given.

Chapter 2:   Research article 1:   The use of Information and Communication Technologies and Social Involvement in Adolescence

Planned article submission to the *Journal of Psychology in Africa*.

The pervasive and ever-increasing uptake of ICTs into the daily lives of most adolescents from both the developed and developing world, necessitates that researchers pay attention to its effect on developing adolescents. Resilience factors are utilised by adolescents to negotiate the rapidly changing landscape of adolescence. Half a century of resilience research underlines the importance of relationships in adolescent development, and thus social involvement. This chapter studies this relationship of ICTs on social involvement in adolescent girls and boys, to see the possible effects thereof, and how it might differ from early adolescence to later adolescence. It does so by providing both literature and empirical findings.

Chapter 3:   Research article 2:   The use of Information and Communication Technologies and Intrapersonal Functioning in Adolescence

Planned article submission to the *International Journal of Cyber Behavior, Psychology and Learning*.

A large volume of resilience research has studied adolescents' sense of competence or mastery and how it is connected to their successful adaptation to stressful and ever-changing environmental contexts. Adolescence is a time of increased self-awareness in general, but specifically as it pertains to a sense of mastery of their environment, including relationships. ICT effects important adolescent developmental requirements like self-efficacy, self-esteem, optimism and adaptability, and thus affecting, in particular, intrapersonal functioning. The exponential increase of ICT use amongst adolescents worldwide and its possible effect on the resilience dimensions relating to intrapersonal functioning is the focus of this chapter. Applicable literature and results are presented. The most pertinent conclusions and relevant recommendations are also presented.

Chapter 4: Research article 3: The use of Information and Communication Technologies and Emotional Regulation in Adolescence

Planned article submission to *Developmental Psychology*.

Both resilience studies and research from the field of developmental psychopathology have recognised the importance of emotional regulation as an important factor directing interaction patterns between adolescents and their environment, and thus adversely affecting or ameliorating emotional and behavioural issues in the developing adolescent. Literature highlighting the importance of examining the possible effect that ever-increasing ICT usage might have on the emotional reactivity and affective strengths (as

representative and measurable constructs of emotional regulation) of adolescents, is discussed. Results in this regard are presented and possible important findings crystallising from the results are discussed and recommendations made.

Chapter 5: Conclusion

In this chapter the results across the three articles are assimilated, interpreted, and integrated within the framework of Bronfenbrenner's Ecological Model to present a coherent set of conclusions for the research project. It is explained how the knowledge emerging from the set of conclusions is an important addition to the body of knowledge pertaining to ICT use and its influence and effect on adolescent resilience and thus development. The particular importance of the study's outcome results and conclusions for the South African context and how it can be of practical benefit to local adolescents and their caregivers are also stated. The limitations of the study are provided and discussed, echoing a long tradition of rigorous scientific practice (Harris, 2013; Popper, 2002), that promotes prudence in interpreting research findings and also serves to make recommendations for future research (Haig, 2014). Lastly, the chapter concludes with a personal reflection on the research process by the author.

CHAPTER 2: ARTICLE 1

THE USE OF INFORMATION AND COMMUNICATION

TECHNOLOGIES AND SOCIAL INVOLVEMENT IN

ADOLESCENCE

Abstract

Adolescent information and communication technology (ICT) use has exponentially increased over recent years. This study investigates the effect of the frequency of ICT use on adolescent social involvement, by examining its effect on the resilience-associated dimensions of sense of relatedness, school functioning, family involvement, and interpersonal strengths. Gender and age-related differences are also noted. A criterion group design was used to gather data in two waves (2 years apart) on a stratified, random sample of 1000 adolescents (across diverse demographic assemblages) from the same ten high schools in Free State Province, South Africa. Their mean ages were 13.9 years (Wave 1 group) and 16.4 years (Wave 2 group). A biographical questionnaire was used to gather information about age, gender and frequency of ICT use. The three interconnected subscales of the Behavioural and Emotional Rating Scale (BERS2) associated with core relational strengths, and the Sense of Relatedness subscale of the Resiliency Scales for Children and Adolescents (RCSA) were used to obtain data about their social functioning. The results reflected that 23% of the younger group and 16% of the older group reported excessive ICT use (more than six hours per day), with the majority displaying moderate ICT usage (less than 6 hours per day). Excessive ICT use in the younger group negatively effected their sense of relatedness. Significant gender differences were found, with older boys reporting better interpersonal strengths than older girls. The amount of ICT use did not affect the older group's sense of relatedness as much as that of their younger counterparts. The results indicate a significant effect for ICT

use on adolescents' perceived sense of relatedness. The self-report of information is a limitation of this study – objective ICT measuring questionnaires or electronic tracking of ICT use are recommended for follow-up studies. Qualitative studies can further elucidate the influence of ICT use on adolescent resilience. Results highlight beneficial effects for moderate ICT use, thus contributing to a more balanced debate regarding the effects of ICTs on adolescent development, and how caregivers manage adolescent ICT use.

Introduction

ICT use has become the dominant pastime for children and adolescents globally (International Telecommunication Union, 2013). Children from most countries spend almost a third of their waking hours engaging with ICT (Calvert & Wartella, 2014). This fundamental shift in their interaction with the world (Buckingham, 2013) raises diverse health concerns (Turkle, 2011).

International data indicates almost 100% internet penetration among adolescents in industrialised countries (Telecommunication Development Sector, 2014). Average adolescents in the UK, Canada and the USA spend more than 50% of their waking time using ICT (Sigman, 2012). Developing countries are lagging slightly (Blignaut & Els, 2010) but improved mobile technology is driving a doubling of adolescent users every 5 years (Telecommunication Development Sector, 2014). More than half of all adolescents use a social media site at least daily, with almost a quarter accessing sites 10 times or more per day (O'Keeffe & Clarke-Pearson, 2011).

Possible consequences of ICT use are well-documented (Strasburger et al., 2013). Concerns range from the impact on physical health (Christakis & Zimmerman, 2006; Hardy, Denney-Wilson, Thrift, Okely, & Baur, 2010) or psycho-emotional well-being (Huang, 2010), to the possible effects on psychosocial functioning (Amichai-Hamburger & Hayat, 2011; Valkenburg & Peter, 2009), and eventual long-term outcomes for societies at large (Karlsen, Gual, & Anderson, 2013).

Resilience-related empirical work focuses on how to lessen the negative consequences of ICT use and even encourage positive outcomes (Friedman & Chase-Landsdale, 2003). Potential positive effects for children and adolescents have only recently been considered (Chesley & Johnson, 2014). This article responds to the necessity for studies focusing on such possible positive outcomes (Grieve, Indian, Witteveen, Tolan, & Marrington, 2013; Valkenburg & Peter, 2011) by investigating the impact of hours of ICT use on the resilience-associated dimension relating to social involvement and interpersonal strengths of adolescents.

The fortigenic approach considers strengths and resources of adolescents that might facilitate effective development within often suboptimal circumstances (Cohen, Pooley, Ferguson, & Harms, 2011). The interaction of these personal and contextual factors are best described by the complex entities of risk and resilience (Ahern & Norris, 2011). Resilience is defined as "a product of complex interactions of personal attributes and environmental circumstances, mediated by internal mechanisms" (Prince-Embury & Saklofske, 2013, p.3), that becomes "a dynamic process encompassing *positive adaptation* within the context of significant adversity" (Luthar, Cicchetti, & Becker, 2000, p.543). This is especially relevant in adolescent development (Dahl, 2004) because of particular priming (and vulnerability) for individual-environment interaction effects (Theron & Theron, 2010).

Reviews of fifty years of resilience research (e.g., Prince-Embury & Saklofske, 2013), supported by numerous reviews of protective factors for resilience (e.g., Masten & Obradovic, 2006), highlight the importance of relationships for humans (Rutter, 2012; Sapienza & Masten, 2011). Social relationships are especially significant in adolescent development (Blakemore, 2012), and social relatedness is vitally important for adolescents (Padilla, Fraser, Black, & Bean, 2014) who interpret social support to be specific in nature and context (Anderson, Christenson, Sinclair, & Lehr, 2004). This, in turn, shape expectations for future support that are internalised (Lakey & Orehek, 2011) and that impact on the psychological well-being of individuals (Lynch, 2012). Successful, developmentally appropriate assimilation of coping skills is therefore an internally and environmentally driven process, of which interpersonal skills leading to a sense of relatedness and social support are paramount (Barber & Schluterman, 2008; Van den Berg et al., 2013).

Bronfenbrenner's (2005) bio-ecological model provides a suitable theoretical perspective for understanding the systemic impact of social interaction on adolescents. The model consists of five interrelated systems (the microsystem, mesosystem, exosystem, macrosystem, and chronosystem) (Figure 1), each affecting the next in a causal sequential manner (Bronfenbrenner & Morris, 2006).
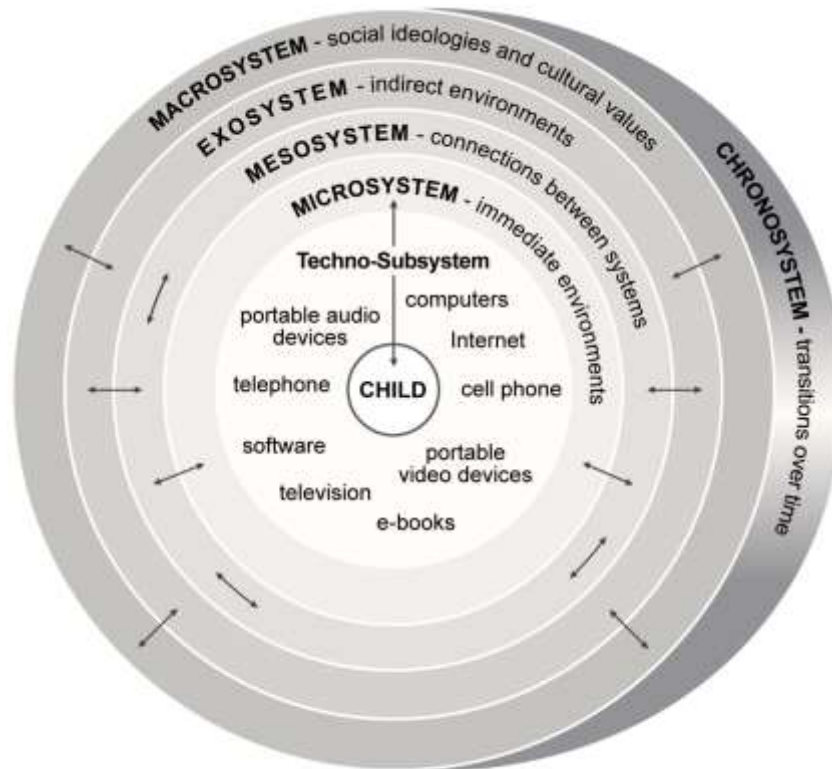
Figure 1. Bronfenbrenner's (2005) bio-ecological model with Johnson and Puplampu's techno-subsystem dimension incorporated (2008, p.23)

The microsystem consists of immediate interpersonal interactions between the adolescent and his environment and/or other individuals (e.g., family, peers, school, and church) (Flook & Fuligni, 2008; Leonard, 2011). Microsystems interact with each other within the broader mesosystem (e.g., a good relationship between an adolescent's parents and his or her school can positively affect the adolescent and his or her attitude towards academic work) (Bronfenbrenner & Morris, 2006), whilst the exosystem impacts on the

adolescent without direct reciprocation (e.g., the financial implications of parental job loss and the effects that it might have on the adolescent's daily life) (Visser, 2007). The macrosystem defines the social and cultural context of the adolescent (e.g., laws that define the age at which an adolescent may legaly drive a car or consume alcohol) (Zimring, 2014), and also includes the value attached to ICT (Lanigan, 2009). The chronosystem incorporates change in individuals and environments over time (e.g., the change in how children and parents interact and relate to each other as children develop) (Pinquart & Silbereisen, 2004).

One of the non-human constructs that adolescents are therefore confronted with is ICT (Johnson, 2010a). Johnson and Puplampu (2008) describe it as a specific kind of techno-subsystem within Bronfenbrenner's microsystem. Adolescents spend an ever-increasing amount of time engaging with said techno-subsystem (Kaess et al., 2014) and this impacts on all the other systems (Johnson, 2010b). Bronfenbrenner's model, therefore, gives a theoretical framework within which the impact of adolescent ICT use within a specific context can be studied (Blignaut & Els, 2010).

The impact of ICT use on the adolescent can be explained by three hypotheses. The displacement hypothesis (Valkenburg & Peter, 2007) stipulates that excessive ICT use replaces other developmentally important activities (Endestad, Heim, Kaare, Torgersen, & Brandtzæg, 2011) (e.g., the time an adolescent spends engaging in online gaming with strangers, displaces the time he spends with established friends, potentially reducing the

quality of these existing friendships). The augmentation or stimulation hypothesis (Valkenburg & Peter, 2007) argues that utilising one medium can increase the use of other mediums (Huang, 2010) (e.g., ICT use can enhance "face-to-face" interactions among friends (Allen, Ryan, Gray, McInerney, & Waters, 2014). The threshold effect theory (Endestad et al., 2011) proposes a specific limit in the number of hours that the adolescent can engage with ICT before negative effects occur (Belanger, Akre, Berchtold, & Michaud, 2011). The amount of hours that define this threshold is still unclear and interpretations range from two or more hours (Belanger et al., 2011) to six or more hours per day (Hawi, 2012; Weinstein, Feder, Rosenberg, & Dannon, 2014).

Research has shown ICT overuse to impact negatively on adolescents' physical health (Bailin, Milanaik, & Adesman, 2014), diet (Jackson, von Eye, Fitzgerald, Witt, & Zhao, 2011), and sleeping patterns (Choi et al., 2009). There are also correlations between overuse and mood disorders and anxiety disorders (Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000), academic functional decline (Skoric, Teo, & Neo, 2009), externalising behaviour problems (Holtz & Appel, 2011), and suboptimal social/peer interaction (Valkenburg & Peter, 2009). Research has indicated dopamine reward pathways in the brain (associated with an increased sense of pleasure that can lead to addiction behaviour) to be actively involved in most digital technologies associated with ICT use (Han et al., 2011). Adolescents with disrupted family environments, who struggle with learning problems, social

isolation, low self-esteem, and impulsivity are more vulnerable to negative effects of ICT overuse (Ma, Li, & Pow, 2011).

Very few studies have examined the role ICT use plays in normal developmental pathways of adolescents and the benefits it holds for the enhancement of protective factors and resiliency dimensions in their lives (Huang, 2010). ICT use can reinforce established relationships, increase a sense of well-being (Huang, 2010; Kraut et al., 2002), and positively augment learning (Chen & Tzeng, 2010).

Almost two thirds of South African adolescents regularly access the internet (Oyedemi, 2015; Van der Merwe, 2013), mostly via mobile technology (Louw & Winter, 2011). Most South African studies find ICT use among adolescents pervasive (across all demographic realities) (Mbinjama, 2013). A few local studies refer in general terms to the time adolescents spent on ICTs (e.g., Bosch, 2008; Oyedemi, 2015), but quantitative data specifying hours of usage remain critically unreported.

The impact of increasing ICT engagement on relationships is usually empirically reported as being either all harmful or all beneficial for relationships (Suoranta, 2003). Ahiauzu and Odili (2012) argue for a more balanced "middle ground" approach, focusing on the quantity of ICT use and its determination of positive or negative outcomes. Such an approach echoes the theoretical notions of the threshold effect hypothesis.

Some researchers highlight how ICT use tend to isolate adolescents (Schiffrin, Edelman, Falkenstern, & Stewart, 2010), deteriorate in-person interaction (Misra, Cheng, Genevie, & Yuan, 2014), and cause a more permeable geographical sense of belonging (Crisp, 2010; Palfrey & Gasser, 2008). Adults don't engage with ICT to the same extent as adolescents, leading to an absence of parental guidance and a non-sharing of entertainment (O'Keeffe & Clarke-Pearson, 2011).

Judi, Ashaari, Zin, and Yusof (2013) emphasise the empowering ability of ICT technologies. Adolescents' drive towards autonomy is enhanced by owning a cell phone (Blair & Fletcher, 2011) or having access to (unregulated) information via the internet (Campbell, 2006). Initial face-to-face social anxieties are often negated by ICT communication (Bonetti, Campbell, & Gilmore, 2010) and it provides substantial social support for adolescents in need (Valkenburg & Peter, 2011). Even relationships that started solely via ICT communication often lead to face-to-face contact (Schiffrin et al., 2010).

Gross and colleagues (2002) view adolescents' online communication as an extension of their off-line relationships, and see ICTs as just another communication tool. In that sense, the outcomes of ICT use are related to variables associated with the individual rather than the medium of communication (Lai, Lin, Chen, Gwung, & Li, 2013). Quantity of ICT use has also proven to be an important predictor of relational impact, with higher usage leading to increased negative effects (Belanger et al., 2011; Tonioni et al., 2012).

South African research

Local research investigating the nature of the interplay between teenagers and ICT is scarce (Savahl, September, Odendaal, & Moos, 2008). Published South African research often stems from smaller studies with limited data sets and qualitative methodologies (e.g., Bosch, 2008; Chuma, 2014; Louw & Winter, 2011) or focus on areas other than the impact of ICT usage on adolescent functioning (e.g, Gudmundsdottir, 2010; Mbinjama, 2013; Oyedemi, 2015; Van der Merwe, 2013). This article strives to fill the crucial gap in empirical research in this field, especially pertaining to the South African context.

Gender differences

Gender differences in ICT usage reported more than a decade ago (Banerjee, Kang, Bagchi-Sen, & Rao, 2005; Volman, Van Eck, Heemskerk, & Kuiper, 2005) have become less distinct (Jackson et al., 2008), but still exist (Drabowicz, 2014). Girls often use ICT to seek information or communicate, and overuse causes internalised behaviour problems (Chen & Tzeng, 2010). Male use is more focused on entertainment, with overuse leading to both internalised and externalised behaviour problems (Drabowicz, 2014; Lai & Gwung, 2013). Boys generally spend more time engaging with ICT than girls (Harris, Straker, & Pollock, 2013) and also benefit more from online communication – 33% of boys prefer to self-disclose via ICTs rather than face-to-face (Schouten, Valkenburg, & Peter, 2007), perhaps precisely

because they find in-person self-disclosure so difficult (McNelles & Connolly, 1999). ICT mediated communication can therefore enhance adolescent boys' sense of connectedness and well-being (Schouten et al., 2007).

Research question

This study addresses several research gaps by investigating the difference between different levels of ICT use and adolescent perception of social involvement within a large, representative South African sample. The research question guiding the study is: "How do adolescent girls and boys, who report different levels of ICT use, differ with regards to their social involvement?"

The null hypothesis (H_0) states that there is no difference in adolescent sense of relatedness, school functioning, family involvement, and interpersonal strengths and demographic variables between adolescents, notwithstanding the number of hours they engage with ICT, and that there are no significant gender differences.

Research methods

Participants and procedures

Data from a research project (investigating risk and resilience in a group of adolescents over a period of three years) was used in this study. This Adolescent Risk and Resilience Project was conducted by a team of researchers from the Department of Psychology at Free State University in South Africa.

The empirical information for this criterion design study was gathered in two waves in 2010 (first year in high school) and 2012 (third year in high school) on a stratified, random sample of adolescents (across diverse socio-economic, and rural/urban assemblages) from the same ten schools in Free State Province, South Africa. The mean age for the 2010 cohort [Wave 1] ($n = 817$; 337 girls and 480 boys) is 13.9 years, and 16.4 years for the 2012 cohort [Wave 2] ($n = 994$; 418 girls and 578 boys). Due to incomplete datasets (i.e., datasets with more than one missing value per questionnaire) 113 participants were excluded from Wave 1 and 126 participants from Wave 2.

In both waves standardised (back translated) psychometric tests were distributed in all three official languages of the province (i.e., Afrikaans, English and Sesotho) in booklet format during school hours to designated groups of adolescents for completion. Participants completed the psychometric tests as a group at their respective schools under the

supervision of registered psychologists and fieldworkers.

Measuring instruments

The following measuring instruments were used:

Biographical questionnaire. Close-ended questions were used to gather information about the age and gender of the participants, whilst open-ended questions were employed to ask participants to provide time spent on ICT use. Frequency of ICT use data was collected by means of one question asking participants to report their average hours of ICT use per day.

Behavioral and Emotional Rating Scale (BERS2). This 57-item scale evaluate the interpersonal, intrapersonal and affective strengths, as well as the family involvement and school functioning of eleven to eighteen year old adolescents. The first 52 self-reported behavioural and emotional strength items of the BERS2 were used. These items have been shown across several studies to have high internal consistency (alpha coefficients ranging from 0.66 to 0.77) in South African (De Villiers, 2009) and American samples (Epstein & Sharma, 1998). This study incorporated the three interconnected subscales (i.e., interpersonal strengths, family involvement and school functioning) of the BERS2 that are associated with core relational strengths (Epstein, 2000). The higher the scores on the subscales, the better the core strength-based competencies of the adolescents (Epstein & Sharma, 1998). Together these specific three strengths build interpersonal resilience and thus accomplish

more positive social interaction and productive group involvement (Masten & Obradovic, 2006, Prince-Embury & Saklofske, 2013).

Resiliency Scales for Children and Adolescents (RCSA). These scales (including the subscales for sense of relatedness, sense of mastery, and emotional reactivity) measure participants' resilience. The 64-item test has shown good alpha coefficients in previous research (0.89 to 0.91) (Prince-Embury & Saklofske, 2013), including South African contexts (0.90 to 0.93) (De Villiers, 2009). For this article, the 24-item *Sense of Relatedness* subscale was used. For this subscale, the higher the sense of relatedness score, the greater the adolescent's implied social and relational resilience.

Ethical considerations

Ethical approval for the study was obtained from the Research Committee of Faculty of Humanities (Free State University). Permission for the study was obtained from the provincial Department of Education, as well as the principals of the target schools. The adolescents gave assent, and their parents gave informed consent prior to inclusion in the project. All information was obtained anonymously to ensure confidentiality, and field workers debriefed participants post-administration of questionnaires to address any possible emotional corollary or disquietude associated with the process and, if indicated, individual referrals for professional counselling were made. After completion of the psychometric tests, all participants received a brochure that

included effective emotional and behavioural coping strategies, as well as the contact information of possible support and referral sources.

Data analysis

The frequency distribution of the self-reported number of hours of ICT use was compiled. Participants were grouped into four categories based on their frequency of ICT use, namely: 0 hours ICT use; more than 0 to 3 hours ICT use; more than 3 to 6 hours ICT use; more than 6 hours ICT use. Before the data was analysed to determine significance of differences in the strengths and resilience of participants with different levels of ICT use, the data was tested for assumptions of multivariate normality, multi-collinearity, and evidence of non-linear relationships. The Kolmogorov-Smirnov and Shapiro-Wilks tests confirmed a normal distribution of data. No evidence was found of significant multi-collinearity and non-linear relationships. Due to the confirmation of the normal distribution of data, the research proceeded and the relationship between the different variables was analysed using a two-way multivariate analysis of variance for both Wave 1 and Wave 2 to determine the effects of gender, as well as the number of hours of ICT use per day on the students' sense of relatedness, family involvement, school functioning and interpersonal strengths. Wilk's lambda multivariate statistics were used to determine which of the groups differed significantly (Anderson, 2003).

Results

From Table 1, it is evident that there is a drastic decrease in the number of older adolescents that indicated no ICT use during the day, with 146 participants in the 2010 cohort, but only 2 in the 2012 group.

Table 1

Daily ICT use among adolescents (Monday – Sunday)

ICT use Hours per day	WAVE 1						WAVE 2					
	Total group		Girls		Boys		Total group		Girls		Boys	
	N	%	N	%	N	%	N	%	N	%	N	%
0 hours	146	20,74%	99	24,03%	47	16,10%	2	0,23%	1	0,20%	1	0,27%
More than 0 hour to 1 hours	91	12,93%	51	12,38%	40	13,70%	146	16,82%	79	15,83%	67	18,16%
More than 1 hours to 2 hours	94	13,35%	53	12,86%	41	14,04%	144	16,59%	85	17,03%	59	15,99%
More than 2 hours to 3 hours	85	12,07%	47	11,41%	38	13,01%	153	17,63%	92	18,44%	61	16,53%
More than 3 hours to 6 hours	124	17,61%	65	15,78%	59	20,21%	285	32,83%	161	32,26%	124	33,60%
More than 6 hours to 9 hours	76	10,80%	49	11,89%	27	9,25%	73	8,41%	40	8,02%	33	8,94%
More than 9 hours to 12 hours	40	5,68%	27	6,55%	13	4,45%	35	4,03%	20	4,01%	15	4,07%
More than 12 hours	48	6,82%	21	5,10%	27	9,25%	30	3,46%	21	4,21%	9	2,44%

The majority of adolescents in both Wave 1 and Wave 2 utilised ICT moderately (i.e., between 0 hours up to 6 hours per day), with a smaller group in both cohorts admitting to excessive daily ICT usage (i.e., more than 6 hours per day). The adolescents were divided into 4 groups based on frequency of

ICT use per day, namely: Group 1 (0 hours of ICT use per day), Group 2 (more than 0 hours to 3 hours of ICT use per day), Group 3 (more than 3 hours to 6 hours of ICT use per day), and Group 4 (more than 6 hours of ICT use per day) (See Table 2). This was done to further simplify data and elucidate results, with group 2 and 3 being defined as moderate users of ICT and group 4 as excessive ICT users.

Table 2
Four combined groups of ICT use

Different groups of ICT use	ICT use Hours per day	WAVE 1						WAVE 2					
		Total group		Girls		Boys		Total group		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%	N	%
Group 1	0 hours	146	20,74%	99	24,03%	47	16,10%	2	0,23%	1	0,20%	1	0,27%
Group 2	More than 0 to 3 hours	270	38,35%	151	36,65%	119	40,75%	443	51,04%	256	51,30%	187	50,68%
Group 3	More than 3 to 6 hours	124	17,61%	65	15,78%	59	20,21%	285	32,83%	161	32,26%	124	33,60%
Group 4	More than 6 hours	164	23,30%	97	23,54%	67	22,95%	138	15,90%	81	16,23%	57	15,45%

In the younger cohort (Wave 1) the percentage of girls not using ICT is significantly more than the percentage of boys with no ICT use, whilst the gender differences in ICT use in all three other groups of Wave 1 are negligible. The proportion of girls and boys in the different groups of ICT use in the older cohort (Wave 2) are remarkably similar. The group of excessive ICT users decreased from just over 23% of the total amount of participants in Wave 1 to less than 16% in Wave 2, whilst the percentage of moderate users increased from almost 56% in the 2010 cohort to nearly 84% in the 2012

cohort. The small number of non-users in Wave 2 (only 2), did not allow for the use of a MANOVA because the number of participants in this group was fewer than the number of variables (i.e., 7 variables) included in the analysis (Anderson, 2003).

Table 3

Descriptive statistics for the strength and resilience scales of the different groups

ICT use Hours per day		WAVE 1						WAVE 2					
		Total group		Girls		Boys		Total group		Girls		Boys	
		Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev
Group 1	Sense of relatedness	65,64	15,73	65,95	15,15	65	17,03						
0 hours	Interpersonal strengths	33,93	7,19	33,65	7,3	34,52	7						
	Family involvement	22,34	5,22	22,13	5,3	22,8	5,06						
	School functioning	21,46	4,71	21,59	4,64	21,18	4,91						
Group 2	Sense of relatedness	71,78	13,73	72,21	13,24	71,24	14,37	63,37	14,75	63,52	15,27	63,18	14,03
More than 0 to 3 hours	Interpersonal strengths	34,75	6,34	35,32	5,95	34,04	6,75	24,31	5,78	23,92	5,73	24,86	5,82
	Family involvement	23,87	4,61	24,27	4,39	23,37	4,84	15,84	3,91	15,4	4,02	15,96	3,75
	School functioning	21,37	4,33	21,99	3,94	20,61	4,68	15,15	3,73	14,06	3,72	15,41	3,73
More than 3 to 6 hours	Interpersonal strengths	34,18	7,78	33,65	7,37	34,77	8,24	24,84	5,25	24,33	4,89	25,04	5,67
	Family involvement	23,12	5,42	22,85	5,18	23,4	5,7	15,71	3,53	16	3,57	15,33	3,45
	School functioning	20,55	4,62	20,06	4,61	21,09	4,63	15,68	3,44	15,43	3,17	16,01	3,74
More than 6 hours	Interpersonal strengths	32,78	7,61	33,7	6,54	31,41	8,86	24,8	6,59	23,67	5,35	26,02	5,66
	Family involvement	22,55	5,43	22,89	5,11	22,05	5,87	15,5	3,76	15,16	3,72	16,04	3,81
	School functioning	20,55	4,56	21,43	3,7	19,26	5,37	15,58	3,83	15,38	4,13	15,92	3,33

Note. There were only 2 respondents in Wave 2 cohort who indicated 0 hours of ICT use per day. This was deemed too few respondents for further statistical analysis of that usage group's results.

As can be seen in Table 3, there is little difference in the mean sense of relatedness scores, interpersonal strength scores, family involvement scores, and school functioning scores for the four groups of Wave 1 and Wave 2 respectively. The mean sense of relatedness scores, interpersonal strength scores, family involvement scores, and school functioning scores of adolescent boys and girls are very similar. The mean interpersonal strength scores, family involvement scores, and school functioning scores of Wave 2 are significantly lower than that of Wave 1 for all ICT usage groups (i.e., Group 2, 3 and 4), although the mean sense of relatedness score for Wave 2 is significantly lower than that of Wave 1 only for Groups 2 and 3 (moderate ICT usage groups).

Table 4

Significance of differences between groups of ICT use and gender

Effect	Wave	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
ICT hours per day	Wave 1	0.941	3.459	12.000	1775.591	**0.000****	0.020
	Wave 2	0.988	1.025	8.000	1350.000	0.415	0.006
Gender	Wave 1	0.991	1.587	4.000	671.000	0.176	0.009
	Wave 2	0.985	2.621	4.000	675.000	**0.034***	0.015
ICT hours per day x Gender	Wave 1	0.975	1.398	12.000	1775.591	0.159	0.008
	Wave 2	0.987	1.077	8.000	1350.000	0.377	0.006

* 5% $p \leq .05$. ** 1% $p \leq .01$

There was a significant difference (F=3.459; p=0.000) (on the combined dependent variable, i.e., sense of relatedness, family involvement, school functioning and interpersonal strengths) between individuals who spend different numbers of hours per day on ICT. No statistically significant differences between the male and female groups were found. In order to determine which ICT groups differed significantly from one another Wilke's lambda statistics were calculated.

With Wave 2 (see Table 4) there is a significant difference between males and females (F=2.621; p=0.034) on the combined dependent variable (i.e., sense of relatedness, family involvement, school functioning and interpersonal strengths). There was no significant difference on said variable between individuals who spend different numbers of hours per day on ICT, and there was also no significant interaction effect between number of hours per day on ICT and gender. To determine on which variable of sense of relatedness, family involvement, school functioning and interpersonal strengths adolescent males and adolescent females differed, further analysis of between-subjects effects was conducted.

Table 5

Wilk's lambda statistics indicating specific group differences in sense of relatedness (Wave 1)

	ICT hours per day		Mean Difference	Std Error	Sig.
Sense of Relatedness	0 hours	more than 0 to 3 hours	-6.9607	1.49786	**0.000****
		more than 3 to 6 hours	-5.8539	1.78508	**0.006****
		more than 6 hours	-2.7378	1.65728	0.350
	more than 0 to 3 hours	0 hours	6.9607	1.49786	**0.000****
		more than 3 to 6 hours	1.1068	1.57816	0.897
		more than 6 hours	4.2229	1.43202	**0.017***
	more than 3 to 6 hours	0 hours	5.8539	1.78508	**0.006****
		more than 0 to 3 hours	-1.1068	1.57816	0.897
		more than 6 hours	3.1161	1.73020	0.274
	more than 6 hours	0 hours	2.7378	1.65728	0.350
		more than 0 to 3 hours	-4.2229	1.43202	**0.017***
		more than 3 to 6 hours	-3.1161	1.73020	0.274

* 5% $p \leq .05$. ** 1% $p \leq .01$

As can be seen in Table 5 above, there was a significant difference in sense of relatedness (in Wave 1) between individuals who spend 0 hours per day on

ICT and those who spend more than 0 hours to 3 hours per day on ICT, as well as between individuals who spend 0 hours per day on ICT and those who spend more than 3 hours to 6 hours per day on ICT. There was, however, no significant difference in sense of relatedness between individuals who spend 0 hours per day on ICT, and individuals who spend more than 6 hours per day on ICT. Finally, there was a significant difference in sense of relatedness between individuals who spend more than 0 hours to 3 hours per day on ICT, and individuals who spend more than 6 hours per day on ICT. Adolescents who spend 0 hours per day on ICT, and adolescents who spend more than 6 hours per day on ICT, reported the lowest sense of relatedness, whilst adolescents who spend more than 0 hours up to 6 hours per day scored highest on sense of relatedness.

Table 6

Between subjects effects

Source	Dependent Variable	Wave	df	Mean Square	F	Sig.	Partial Eta Squared
ICT hours per day	school functioning	Wave 1	3	40.355	2.020	0.110	0.009
		Wave 2	2	7.647	0.591	0.554	0.002
	family involvement	Wave 1	3	84.328	3.274	0.021	0.014
		Wave 2	2	4.569	0.336	0.715	0.001
	Interpersonal strengths	Wave 1	3	149.634	2.994	0.030	0.013
		Wave 2	2	6.113	0.201	0.818	0.001
	Sense of relatedness	Wave 1	3	1524.986	7.465	0.000**	0.032
		Wave 2	2	438.911	2.427	0.089	0.007
Gender	school functioning	Wave 1	1	72.252	3.617	0.058	0.005
		Wave 2	1	36.329	2.805	0.094	0.004
	family involvement	Wave 1	1	2.959	0.115	0.735	0.000
		Wave 2	1	0.187	0.014	0.907	0.000
	Interpersonal strengths	Wave 1	1	22.808	0.456	0.500	0.001
		Wave 2	1	186.052	6.103	0.014*	0.009
	Sense of relatedness	Wave 1	1	111.975	0.548	0.459	0.001
		Wave 2	1	207.564	1.148	0.284	0.002

* 5% $p \le .05$. ** 1% $p \le .01$

Due to the fact that comparisons were made between the ICT groups for each

of the dependent variables separately (school functioning, family involvement,

interpersonal strengths, and sense of relatedness), an adjustment was carried

out for multiple comparisons for both Wave 1 and Wave 2. This means that the significance value needed for statistical significance was adjusted from 0.05 to 0.0125 (0.05/4). Thus, the significance value had to be smaller than 0.0125, rather than 0.05, in order for a result to reach statistical significance (Bland & Altman, 1995). No statistically meaningful difference was found between groups based on their school functioning, family involvement or interpersonal strengths (see Table 6). In Wave 2 (see Table 6) females and males differed only in terms of interpersonal strengths (F=6.103; p=0.014), with adolescent boys reporting higher interpersonal strengths than their female counterparts (see Table 7).

Table 7

Gender differences in interpersonal strengths (Wave 2)

	Gender			
	Male		Female	
	Mean	Standard Deviation	Mean	Standard Deviation
Interpersonal strengths	25.24	5.82	23.79	5.39

Discussion

Only 20% of the Wave 1 participants indicated no ICT use and this percentage drastically decreased in the older cohort (Wave 2) – perhaps due

to parenting effects, with younger adolescents' ICT use often being closely monitored and controlled by their parents, whilst older adolescents are afforded more autonomy (Rosen, Cheever, & Carrier, 2008). The majority of participants fell into the moderate usage groups (Groups 2 and 3) (Wave 1 = 56% and Wave 2= 84%), while the number of participants who reported excessive ICT use (6 or more hours per day) declined significantly with age (Wave 1 = 23.3% and Wave 2 = 15.9%).

The percentage of excessive users in the younger group (23.3.%) is significantly higher than most international prevalence rates, while the percentage of excessive users in Wave 2 (15.9%) is higher than that reported for European countries and the USA (around 5-10%) (Park, Kim, & Cho, 2007), but on par with the 18% prevalence rate of the UK, as well as that of Taiwan and South Korea (15-20%) (Wallace, 2014; Weinstein et al., 2014).

In both the moderate and the excessive user groups, the change in frequency rates with age might be related to neurological maturation of emotional and behavioural control systems in the adolescent brain over time (Casey, Jones, & Hare, 2008), making older adolescents both less vulnerable to excessive ICT use (and thus more prone to moderate ICT use), and more robust to absorb the possible adverse neurological effect of excessive use than their younger counterparts (Brand, Young, & Laier, 2014). It is important to note that current research in the neuroscience of excessive adolescent ICT use points towards a possible bi-directionality between excessive use and regulatory brain-mechanisms (Hong et al., 2013).

Almost a quarter of all the Wave 1 girls reported no ICT use, compared to 16% of the boys. The gender differences in the moderate and excessive ICT use groups in Wave 1, as well as the proportional differences between girls and boys in all usage groups in Wave 2, are insignificant.

Some studies indicate higher overall ICT use among adolescent boys than adolescent girls (Harris et al., 2013), but other studies highlight that gender differences have become less distinct (Cotton, Anderson & Tufekci, 2009; Jackson et al., 2008). The higher percentage of younger girls not using ICTs daily can relate to gender-specific differential parenting biases (Mandara, Varner & Richman, 2010), with parents closely monitoring early adolescent girls (Pettit, Laird, Dodge, Bates, & Criss, 2001) and affording them less autonomy than young adolescent boys (Varner & Mandara, 2013).

The participants of both waves of the current study reported higher levels of sense of relatedness across different levels of ICT use and gender groups than the normative American group reported by Prince-Embury (2006). Only normative scores were available for the strength subscales of the American sample (Epstein, 2000), making comparison with the current sample impossible. In Wave 1 there were significant differences in sense of relatedness among different ICT use groups, but no significant gender differences. Moderate users reported the most optimal sense of relatedness scores. Non-users presented with lower scores and excessive users with the lowest sense of relatedness scores. This correlates well with the premise of

the augmentation/stimulation hypothesis that ICT use can enhance established relationships (Valkenburg & Peter, 2007), an idea further supported by other published studies that highlight how moderate ICT mediated communication enhances the quality of existing friendships, increases social support, and leads to overall higher sense of relatedness (Allen et al., 2014). The heavy user group's low sense of relatedness is supported by previous studies (e.g., Bonetti et al., 2010) that found adolescents who self-reported being lonely and feeling isolated, to engaged significantly more in ICT-mediated communication. High ICT use did not, however, help to alleviate feelings of disconnectedness (Ko et al., 2014). The effect could also be bi-directional in nature, i.e. the more time adolescents spent with ICTs, the less they engage in face-to-face relationships and other important interpersonal activities, leading to gradual isolation and feelings of loneliness (Endestad et al., 2011). This would be in accordance with the displacement theory (Valkenburg & Peter, 2007).

It is important to note that non-users felt less connected to others than moderate users. ICT use is pervasive in our society (Smith, 2014) and numerous research studies highlight the importance of ICT mediated communication for today's adolescents (Telecommunication Development Sector, 2014). Adolescents, who do not engage with ICT, can easily become isolated from their peers, and feel unaccepted and even disconnected from others (Palfrey & Gasser, 2008).

In Wave 2 the different ICT use groups did not differ significantly in terms of the four resilience variables (i.e., sense of relatedness, school functioning, family involvement, and interpersonal strength). Significant gender differences were, however, found in all usage groups of Wave 2, with boys reporting higher levels of interpersonal strengths. Although adolescent girls use ICTs for communication more often than adolescent boys (Chen & Tzeng, 2010), research findings have indicated that adolescent boys benefit more from online communication with existing friends than girls (Schouten et al., 2007), probably because they find face-to-face self-disclosure and communication too intimate (McNelles & Connolly, 1999). ICT mediated communication inadvertently increases their sense of support from peers and friends and enhances their feelings of connectedness and social involvement (Schouten et al., 2007). Empirical literature asserts that older adolescent girls report significantly more subjectively experienced stress than younger girls and adolescent boys in general (Schraml, Perski, Grossi, & Simonsson-Sarnecki, 2011). The negative effect of high stress on the way humans engage with others is well-researched (Lewandowski, Mattingly, & Pedreiro, 2014). It follows that the heightened stress experienced by adolescent girls will negatively affect their interpersonal strength scores (Jordan, 2013). Another possible explanation is that older adolescent girls are more susceptible to depression and anxiety disorders that might mediate feelings of isolation, even whilst catalysing increased online communication behaviour (Cyranowski, Frank, Young, & Shear, 2000).

In the younger group, ICT use has a significant effect on sense of relatedness, but this result is not repeated in the older group (Wave 2). Two possible explanations could be that ICT mediated communication (especially via ownership of a mobile phone) is more of a novelty for younger adolescents (Blair & Fletcher, 2011; Moreno et al., 2012), and that younger adolescents often have less freedom of movement than their older counterparts (Chuma, 2014) making ICT mediated communication important for connecting with peers outside of school time (Przybylski, Murayama, DeHaan, & Gladwell, 2013). For older adolescents the ICT mediated communication is additional to established in-person friendships (Judi et al., 2013).

The above results as discussed clearly reveal the null hypothesis to be partially rejected for both data waves. H_0 is rejected with regards to frequency of ICT use and sense of relatedness for the younger group, and for the interpersonal strengths of boys and girls in the older group.

Conclusion

This study focused on the global exponential increase in daily ICT use, and the specific effect of this phenomenon on developing adolescents' perception of social connectedness. It was argued from previously published work that the relational aspect of adolescence is developmentally important. A disproportionate volume of empirical work highlights the negative impact of ICT use on adolescents' sense of social connectedness. From the subject domain that pertains to resilience and its developmental precursors and

sequelae, the real question that arises is what the possible positive or resilience-enhancing effects (if any) of ICT use in adolescence might be. The effect of ICT use on social connectedness for adolescents was theoretically grounded in Bronfenbrenner's (2005) bio-ecological model, incorporating Johnson and Puplampu's (2008) techno-subsystem. It was postulated (based on published research) that the amount of ICT use will affect (differently for boys and girls) adolescents' sense of relatedness, school functioning, family involvement and interpersonal strengths, with excessive ICT use (more than 6 hours per day) affecting these social involvement variables negatively. Two possible theoretical explanations (the augmentation/stimulation hypothesis and the displacement hypothesis) were applied to the study's data to elucidate the ICT usage effect on the social connectedness variables.

23.3% of the younger adolescents and 15.9% of the older adolescents reported excessive ICT use (more than six hours per day). Less than 21% of Wave 1 participants did not use any ICT, whilst the majority (in both cohorts) used ICTs moderately (if measured in hours per day usage). In the younger group, moderate daily ICT use (more than 0 hours to six hours per day) effected most optimally their measured sense of relatedness. This echoes the notion put forward by the augmentation/stimulation hypothesis, that moderate ICT users most probably are enhancing already established relationships – the nett-effect of which is to increase the adolescent's sense of being socially involved (Endestad et al., 2011). Wave 1 excessive ICT users experienced a significant negative effect on their reported sense of relatedness. This can be understood in terms of the displacement hypothesis, that asserts that

excessive ICT use (e.g., spending more than 6 hours per day playing online games or visiting blogs) 'displaces' or replaces other developmentally important activities for an adolescent, like spending time with existing friends. This could potentially reduce the qualitative experience of these friendships, eventually leading to a lower sense of relatedness (Valkenburg & Peter, 2007).

The fact that the boys in the older adolescent group reported better interpersonal strengths than the girls, highlights a phenomenon discussed in other published studies, where (although adolescent girls use ICT for communication more often that boys) (Chen & Tzeng, 2010) boys benefit more from online communication because they find face-to-face communication so challenging (McNelles & Connolly, 1999; Schouten et al., 2007).

The effect of ICT use on sense of relatedness in the younger group (significant) compared to the older group (non-significant), underlines possible developmental realities associated with differential parenting for younger and older children – that younger adolescents have less freedom than older adolescents and therefore rely more on ICTs to establish a sense of independence and to connect with peers (Rosen et al., 2008).

This study's results indicate that ICT use has a significant effect on adolescents' perceived social involvement with others, and therefore underline the importance of the inclusion of Johnson and Puplampu's (2008) techno-subsystem's within Bronfenbrenner's (2005) microsystem. It also

proves that ICT use can enhance resilience, specifically with regards to an adolescents' social involvement. Lastly, excessive use (and no use) of ICTs negatively affects adolescent relational realities and their perception thereof.

Limitations and recommendations

Research concerns associated with self-report methodology (as was used to gather data in this study) are well documented with both under-reporting and over-reporting being problematic (van den Einden, Spijkerman, Vermulst, van Rooij, & Engels, 2010). Electronic tracking of hours of ICT use (e.g., as in Underwood, Rosen, More, Ehrenreich, & Gentsch, 2012), as well as two or more data information sources (that can be assimilated to give a more complete picture of ICT use), for example parental, teacher, and adolescent self-report, are highly recommended for future research.

Future follow-up studies can further elucidate the results of this study by employing a mixed method design (e.g., as with Magee and colleagues' (2014) study). Such a design can, in particular, provide answers as to the possible reasons for excessive ICT use, the effects of said ICT use, and the experienced benefits and disadvantages thereof (Ostlund, Kidd, Wengstrom, & Rowa-Dewar, 2011).

Another limitation is the necessary time delay between the data gathering of wave one and wave two, that creates possible scenarios where the interpreted results are aged almost immediately at publication because of the

exponential rate of change in technology and its usage. This can be addressed by focusing on more specific ICT usage platforms (e.g., Instagram or WhatsApp) that provides continues real-time data.

Value of current study

The results of this study add to the existing international body of empirical work associated with ICT use and its effects on adolescents' interpersonal strengths, school functioning, family involvement and sense of relatedness.

The large sample size, and the specific rigorous research methodology (including the criterion group design's two separate waves of data gathering) used for this study, provide substantive results. This study also fundamentally expands the current knowledge on this topic within a South African context.

The results elucidate that moderate ICT use optimally affects adolescent sense of relatedness, and this result can contribute to a more balanced debate (nationally and internationally) as to the positive and negative effects of adolescent ICT usage.

References

Ahern, N.R., & Norris, A.E. (2011). Examining factors that increase and decrease stress in adolescent community college students. *Journal of Pediatric Nursing, 26*(6), 530-540.

Ahiauzu, L. U., & Odili, S. O. (2012). The Influence of information and communication technologies (ICTS) on parents/adolescents relationship. *Mediterranean Journal of Social Sciences, 3*(13), 127-136. doi:10.5901/mjss.2012.v3n13p127

Allen, K. A., Ryan, T., Gray, D. L., McInerney, D. M., & Waters, L. (2014). Social media use and social connectedness in adolescents: The positives and the potential pitfalls. *The Australian Educational and Developmental Psychologist, 31*(1), 18-31. doi:10.1017/edp.2014.2.

Amichai-Hamburger, Y., & Hayat, Z. (2011). The impact of the internet on the social lives of users: A representative sample from 13 countries. *Computers in Human Behavior, 27*(1), 585-589.

Anderson, A. R., Christenson, S. L., Sinclair, M. F., & Lehr, C. A. (2004). Check & Connect: The importance of relationships for promoting engagement with school. *Journal of School Psychology, 42*(2), 95-113.

Anderson, T.W. (2003). *An introduction to multivariate statistical analysis.* New York, NY: Wiley.

Bailin, A., Milanaik, R., & Adesman, A. (2014). Health implications of new age technologies for adolescents: A review of the research. *Current Opinion in Pediatrics*, *26*(5), 605-619. doi: 10.1097/MOP.0000000000000140

Banerjee, S., Kang, H., Bagchi-Sen, S., & Rao, H.R. (2005). Gender divide in the use of the internet applications. *International Journal of E-Business Research, 1*(2), 24-39.

Barber, B. K., & Schluterman, J. M. (2008). Connectedness in the lives of children and adolescents: A call for greater conceptual clarity. *Journal of Adolescent Health, 43*(3), 209-216.

Belanger, R.E., Akre, C., Berchtold, A., & Michaud, P.A. (2011). A u-shaped association between intensity of internet use and adolescent health. *Pediatrics, 127*(2), e330-e335.

Blair, B. L., & Fletcher, A. C. (2011). "The only 13-year-old on Planet Earth without a cell phone": Meanings of cell phones in early adolescents' everyday lives. *Journal of Adolescent Research*, *26*(2), 155-177.

Blakemore, S. J. (2012). Development of the social brain in adolescence. *Journal of the Royal Society of Medicine*, *105*(3), 111-116.

Bland, J.M., & Altman, D.G. (1995). Multiple significance tests: The Bonferroni method. *British Medical Journal, 310*(6973), 170.

Blignaut, S., & Els, C. (2010). Towards a research framework for ICT use in developing contexts. *Journal of Systemics, Cybernetics & Informatics, 8*(1), 25-33.

Bonetti, L., Campbell, M.A., & Gilmore, L. (2010). The relationship of loneliness and social anxiety with children's and adolescents' online communication. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 279-285.

Bosch, T.E. (2008). WOTS ur ASLR? Adolescent girls' use of cellphones in Cape Town. *Commonwealth Youth and Development, 6*(2), 52-69.

Brand, M., Young, K. S., & Laier, C. (2014). Prefrontal control and Internet addiction: A theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience*, *8*, 375-388. doi:10.3389/fnhum.2014.00375

Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives of human development*. Thousand Oaks, CA: Sage.

Bronfenbrenner, U., & Morris, P. A. (2006). The bio-ecological model of human development. In W. Damon & R. M. Lerner (Eds. in Chief.). & R. M. Lerner (Vol. Ed.), *Handbook of child psychology: Vol: 1. Theoretical models of human development* (6th ed) (pp. 793-828). Hoboken, NJ: Wiley.

Buckingham, D. (2013). *After the death of childhood*. Cambridge, United Kingdom: John Wiley & Sons.

Calvert, S. L., & Wartella, E. A. (2014). Children and electronic media. In E.T. Gershoff, R.S. Mistry, & D.A. Crosby (Eds.), *Societal contexts of child development: Pathways of influence and implications for practice and policy* (pp. 175-187). New York, NY: Oxford University Press.

Campbell, R. (2006). Teenage girls and cellular phones: Discourses of independence, safety and 'rebellion'. *Journal of Youth Studies, 9*(2), 195-212.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*(1), 111-126.

Chen, S.Y., & Tzeng, J.Y. (2010). College female and male heavy internet users' profiles of practices and their academic grades and psychosocial adjustment. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 257-262.

Chesley, N., & Johnson, B. E. (2014). Information and communication technology use and social connectedness over the life course. *Sociology Compass, 8*(6), 589-602.

Choi, K., Son, H., Park, M., Han, J., Kim, K., Lee, B., & Gwak, H. (2009). Internet overuse and excessive daytime sleepiness in adolescents. *Psychiatry and Clinical Neurosciences*, *63*(4), 455-462. doi: 10.1111/j.1440-1819. 2009.01925.x

Crisp, B. R. (2010). Belonging, connectedness and social exclusion. *Journal of Social Inclusion*, *1*(2), 123-132.

Christakis, D.A., & Zimmerman, F.J. (2006). *Media as public health issue. Archives of Pediatric and Adolescent Medicine, 160*, 445-446.

Chuma, W. (2014). The social meanings of mobile phones among South Africa's 'digital natives': a case study. *Media, Culture & Society, 36*(3), 398-408. doi: 10.1177/0163443713517842

Cohen, L., Pooley, J.A., Ferguson, C., & Harms, C. (2011). Psychologists' understanding of resilience: Implications for the discipline of psychology and psychology practice. *The Australian Community Psychologist, 23*(2), 7-22.

Cotton, S., Anderson, W., & Tufekci, Z. (2009). Old wine in a new technology, or a different type of digital divide? *New Media & Society, 11*(7), 1163-1186.

Cyranowski, J.M., Frank, E., Young, E., & Shear, M.K. (2000). Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Archives of General Psychiatry*, *57*(1), 21-27.

Dahl, R.E. (2004). Adolescent brain development: A period of vulnerabilities and opportunities. Keynote address. *Annals of the New York Academy of Sciences, 1021*, 1-22. doi:10.1196/annals.1308.001

De Villiers, M. (2009). *Die ontwikkeling en evaluering van 'n intervensieprogram om kinders se stresweerstandigheid te bevorder. [The development and evaluation of an intervention programme to promote child resiliency]*. (Unpublished doctoral dissertation). University of the Free State, Bloemfontein, South Africa.

Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: A comparitive study of 39 countries. *Computers and Education, 74*, 98-111.

Endestad, T., Heim, J., Kaare, B., Torgersen, L., & Brandtzæg, P.B. (2011). Media user types among young children and social displacement. *Nordicom Review, 32(1),* 17-30.

Epstein, M.H. (2000). The behavioral and emotional rating scale: A strength-based approach to assessment. *Diagnostique, 25*(3). doi: 10.1177/ 073724770002500304

Epstein, M.H., & Sharma, J. (1998). *Behavioral and emotional rating scale: A strength-based approach to assessment.* Austin, Texas: Pro-Ed.

Flook, L., & Fuligni, A.J. (2008). Family and school spillover in adolescents' daily lives. *Child Development, 79*(3), 776-787. doi: 10.1111/j.1467-8624.2008.01157.x

Friedman, R., & Chase-Landsdale, P.L. (2003). Chronic adversities. In M. Rutter & E. Taylor (Eds.), *Child and adolscent psychiatry (4th Ed.)* (pp. 261-276). Malden, Massachusetts: Blackwell Science.

Gross, E.F., Juvonen, J., & Gable, S.L. (2002). Internet use and well being in adolescence. *Journal of Social Issues, 58*(1), 75-98.

Grieve, R., Indian, M., Witteveen, K., Anne Tolan, G., & Marrington, J. (2013). Face-to-face or Facebook: Can social connectedness be derived online?. *Computers in Human Behavior, 29*(3), 604-609.

Gudmundsdottir, G.B. (2010). From digital divide to digital equity: Learner's ICT competence in four primary schools in Cape Town, South Africa. *International Journal of Education and Development using Information and Communication Technology, 6*(2), 84-105.

Han, D.H., Bolo, N., Daniels, M.A., Arenella, L., Lyoo, I.K., & Renshaw, P.F. (2011). Brain activity and desire for internet video game play. *Comprehensive Psychiatry, 52*, 88-95.

Hardy, L. L., Denney-Wilson, E., Thrift, A. P., Okely, A. D., & Baur, L. A. (2010). Screen time and metabolic risk factors among adolescents. *Archives of Pediatrics and Adolescent Medicine, 164*(7), 643-649.

Harris, C., Straker, L., & Pollock, C. (2013). The influence of age, gender and other information technology use on young people's computer use at school and home. *Work: A Journal of Prevention, Assessment and Rehabilitation, 44*(Supplement 1), S61-S71.

Holtz, P., & Appel, M. (2011). Internet use and video gaming predict problem behavior in early adolescence. *Journal of Adolescence, 34*, 49-58.

Hong, S. B., Zalesky, A., Cocchi, L., Fornito, A., Choi, E. J., Kim, H. H., ... & Yi, S. H. (2013). Decreased functional brain connectivity in adolescents with internet addiction. *PloS One*, *8*(2), e57831.

Huang, C. (2010). Internet use and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 241-249.

International Telecomunication Union. (2013). *World telecommunication/ICT indicators database 2013 (17th edition).*

Jackson, L.A., von Eye, A., Fitzgerald, H.E., Witt, E.A., & Zhao, Y. (2011). Internet use, videogame playing and cell phone use as predictors of children's body mass index (BMI), body weight, academic performance, and social and overall self-esteem. *Computers in Human Behavior, 27*, 599-604.

Jackson, L.A., Zhao, Y., Kolenic, A., Fitzgerald, H.E., Harold, R., & von Eye, A. (2008). Race, gender and information technology use: The new digital divide. *Cyberpsychology and Behavior, 11*(4), 437-442.

Johnson, G. M. (2010a). Internet use and child development: The techno-microsystem. *Australian Journal of Educational & Developmental Psychology, 10*, 32-43.

Johnson, G. M. (2010b). Internet use and child development: Validation of the ecological techno-subsystem. *Educational Technology & Society, 13*(1), 176-185.

Johnson, G.M., & Puplampu, P. (2008). A conceptual framework for understanding the effect of the internet on child development: The ecological techno-subsystem. *Canadian Journal of Learning and Technology, 34*(1), 19-28.

Jordan, J. V. (2013). Relational resilience in girls. In S. Goldstein & R.B. Brooks (Eds.), *Handbook of resilience in children* (pp. 73-86). New York, NY: Springer. doi: 10.1007/978-1-4614-3661-4

Judi, H. M., Ashaari, N., Zin, N. A. M., & Yusof, Z. M. (2013). Framework of ICT Impact on Adolescent. *Procedia Technology, 11*, 1034-1040.

Kaess, M., Durkee, T., Brunner, R., Carli, V., Parzer, P., Wasserman, C., …Wasserman, D. (2014). Pathological internet use among European adolescents: psychopathology and self-destructive behaviours. *European Child and Adolescent Psychiatry, 23*(1), 1093-1102. doi:10.1007/s00787-014-0562-7

Karlsen, J. E., Gual, A., & Anderson, P. (2013). Foresighting addiction and lifestyles in Europe 2030+. *European Journal of Futures Research, 1*(1), 1-10.

Ko, C. H., Liu, T. L., Wang, P. W., Chen, C. S., Yen, C. F., & Yen, J. Y. (2014). The exacerbation of depression, hostility, and social anxiety in the course of internet addiction among adolescents: a prospective study. *Comprehensive Psychiatry, 55,* 1377-1384.

Kraut, R., Kiesler, S., Boneva, B., Cummings, J., Helgeson, V., & Crawford, A. (2002). Internet paradox revisited. *Journal of Social Issues, 58*(1), 49-74.

Lai, C-H., & Gwung, H-L. (2013). The effect of gender and internet usage on physical and cyber interpersonal relationships. *Computers and Education, 69*, 303-309.

Lai, C. H., Lin, C. Y., Chen, C. H., Gwung, H. L., & Li, C. H. (2013). Can internet usage positively or negatively affect interpersonal relationship?. In *Advances in Intelligent Systems and Applications-Volume 1* (pp. 373-382). Berlin: Springer

Lakey, B., & Orehek, E. (2011). Relational regulation theory: a new approach to explain the link between perceived social support and mental health. *Psychological Review, 118*(3), 482.

Lanigan, J.D. (2009). A sociotechnological model for family research and intervention: How information and communication technologies affect family life. *Journal of Marriage & Family Review, 45*, 587-609. doi: 10.1080/ 01494920903224194

Leonard, J. (2011). Using Bronfenbrenner's ecological theory to understand community partnerships: A historical case study of one urban high school. *Urban Education, 46*(5), 987-1010. doi: 10.1177/0042085911400337

Lewandowski, G. W., Mattingly, B. A., & Pedreiro, A. (2014). Under pressure: the effects of stress on positive and negative relationship behaviors. *The Journal of Social Psychology, 154*(5), 463-473.

Louw, A.E., & Winter, M. (2011). The use and trends of information and communication technology (ICT) during middle childhood. *Journal of Child*

and Adolescent Mental Health, 23(1), 29-42. doi: 10.2989/ 17280583.2011.594247

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543-562.

Lynch, J.G. (2012). *Perceived stress and the buffering hypothesis of perceived social support on Facebook*. (Unpublished doctoral dissertation). Antioch University, Los Angeles, CA.

Ma, H.K., Li, S.C., & Pow, J.W.C. (2011). The relation of internet use to prosocial and antisocial behavior in Chinese adolescents. *Cyberpsychology, Behavior, and Social Networking, 14*(3), 123-130.

Magee, R. M., Agosto, D. E., Forte, A., & Dickard, M. (2014). Examining teens' non-use of technologies. *Technology*, *15*, 289.

Mandara, J., Varner, F., & Richman, S. (2010). Do African American mothers really "love" their sons and "raise" their daughters? *Journal of Family Psychology*, *24*, 41–50. doi:10.1037/a0018072

Masten, A.S. & Obradovic, J. (2006). Competence and resilience in development. *Annals of the New York Academy of Science, 1094*, 13-27.

Mbinjama, A. (2013). Language and cultural ideologies on the internet: Social media use of adolescents in semi-rural South Africa. *Journal of Intercultural Disciplines, 11*, 58.

McNelles, L.R., & Connolly, J.A. (1999). Intimacy between adolescent friends: Age and gender differences in intimate affect and intimate behaviors. *Journal of Research on Adolescence, 9*, 143-159.

Misra, S., Cheng, L., Genevie, J., & Yuan, M. (2014). The iPhone effect: The quality of in-person social interactions in the presence of mobile devices. *Environment and Behavior*, 1-24. doi:10.1177/0013916514539755.

Moreno, M. A., Jelenchick, L., Koff, R., Eikoff, J., Diermyer, C., & Christakis, D. A. (2012). Internet use and multitasking among older adolescents: An experience sampling approach. *Computers in Human Behavior*, *28*(4), 1097-1102.

O'Keeffe, G. S., & Clarke-Pearson, K. (2011). The impact of social media on children, adolescents, and families. *Pediatrics, 127*(4), 800-804.

Ostlund, U., Kidd, L., Wengstrom, Y., & Rowa-Dewar, N. (2011). Combining qualitative and quantitative research within mixed method research designs: a methodological review. *International Journal of Nursing Studies*, *48*(3), 369-383.

Oyedemi, T. (2015). Participation, citizenship and internet use among South African youths. *Telematics and Informatics, 32*(1), 11-22. http://dx.doi.org/ 10.1016/j.tele.2014.08.002

Padilla-Walker, L. M., Fraser, A. M., Black, B. B., & Bean, R. A. (2014). Associations between friendship, sympathy, and prosocial behavior toward friends. *Journal of Research on Adolescence.* doi: 10.1111/jora.12108

Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives.* New York, NY: Basic Books

Park, S.K., Kim, J.Y., & Cho, C.B. (2007). Prevalence of internet addiction and correlations with family factors among South Korean adolescents. *Adolescence, 43*(172), 895-909.

Pettit, G. S., Laird, R. D., Dodge, K. A., Bates, J. E., & Criss, M. M. (2001). Antecedents and behavior- problem outcomes of parental monitoring and psychological control in early adolescence. *Child Development, 72*, 583–598. doi:10.1111/1467- 8624.00298

Pinquart, M., & Silbereisen, R.K. (2004). Human development in times of social change: Theoretical considerations and research needs. *International Journal of Behavioral Development, 28*(4), 289-298. doi: 10.1080/ 01650250344000406

Prince-Embury, S. (2006). *Resiliency scales for children & adolescents. A profile of personal strengths.* San Antonio, TX: Harcourt Assessment.

Prince-Embury, S., & Saklofske, D.H. (Eds.). (2013). *Resilience in children, adolescents, and adults: Translating research into practice.* New York, NY: Springer.

Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. *Computers in Human Behavior*, *29*(4), 1841-1848.

Rosen, L. D., Cheever, N. A., & Carrier, L. M. (2008). The association of parenting style and child age with parental limit setting and adolescent MySpace behavior. *Journal of Applied Developmental Psychology*, *29*(6), 459-471.

Rutter, M. (2012). Resilience as a dynamic concept. *Development and psychopathology, 24*(02), 335-344.

Sapienza, J. K., & Masten, A. S. (2011). Understanding and promoting resilience in children and youth. *Current Opinion in Psychiatry, 24*(4), 267-273.

Savahl, S., September, R., Odendaal, W., & Moos, A. (2008). Information and communication technology: A descriptive study of children's communication patterns. *South African Journal of Psychology, 38*, 515-525.

Schiffrin, H., Edelman, A., Falkenstern, M., & Stewart, C. (2010). The associations among computer-mediated communication, relationships, and well-being. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 299-306.

Schouten, A.P., Valkenburg, P.M., & Peter, J. (2007). Precursors and underlying processes of adolescents' online self-disclosure: Developing and testing and "internet-attribute-perception" model. *Media Psychology, 10*, 292-314.

Schraml, K., Perski, A., Grossi, G., & Simonsson-Sarnecki, M. (2011). Stress symptoms among adolescents: The role of subjective psychosocial conditions, lifestyle, and self-esteem. *Journal of adolescence*, *34*(5), 987-996.

Shapira, N.A., Goldsmith, T.D., Keck, P.E., Khosla, U.M., & McElroy, S.L. (2000). Psychiatric features of individuals with problematic internet use. *Journal of Affective Disorders, 57*(1-3), 267-272.

Sigman, A. (2012). Time for view on screen time. *Archive of Disease in Childhood, 97*(11), 935-942.

Skoric, M.M., Teo, L.L.C., & Neo, R.L. (2009). Children and video games: Addiction, engagement, and scholastic achievement. *Cyberpsychology and Behavior*, 12(5), 567-572.

Smith, D. (2014, November 30). *For the first time ever, Americans spend more time using mobile devices than TV* [Online article, published in Business Insider]. Retrieved from http://www.businessinsider.com/chart-of-the-day-americans-spend-more-time-using-mobile-devices-than-tv-2014-11

Strasburger, V. C., Hogan, M. J., Mulligan, D. A., Ameenuddin, N., Christakis, D. A., Cross, C., & Swanson, W. S. L. (2013). *Children, adolescents, and the media*. Pediatrics, 132(5), 958-961.

Suoranta, J. (2003). The world divided in two: Digital divide, information and communication technologies, and the 'Youth Question'. *Journal for Critical Education Policy Studies, 1*(2), 1-31.

Telecommunication Development Sector (ITU-D), Secretariat of Telecommunication Development Bureau (BDT), United Nations UN). (2014). *The world in 2014: ICT facts and figures.* Retrieved from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf

Theron, L.C., & Theron, A.M.C. (2010). A critical review of studies of South African youth resilience, 1990-2008. *South African Journal of Science, 106*(7-8), 1-8.

Tonioni, F., D'Alessandris, L., Lai, C., Martinelli, D., Corvino, S., Vasale, M., ... & Bria, P. (2012). Internet addiction: hours spent online, behaviors and psychological symptoms. *General Hospital Psychiatry*, *34*(1), 80-87.

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other*. New York, NY: Basic Books.

Underwood, M. K., Rosen, L. H., More, D., Ehrenreich, S. E., & Gentsch, J. K. (2012). The BlackBerry project: capturing the content of adolescents' text messaging. *Developmental Psychology*, *48*(2), 295.

Valkenburg, P. M., & Peter, J. (2007). Online communication and adolescent well-being: Testing the stimulation versus the displacement hypothesis. *Journal of Computer‐Mediated Communication, 12*(4), 1169-1182.

Valkenburg, P.M., & Peter, J. (2009). Social consequences of the internet for adolescents: A decade of research. *Current Directions in Psychological Science, 18*(1), 1-5.

Valkenburg, P. M., & Peter, J. (2011). Online communication among adolescents: An integrated model of its attraction, opportunities, and risks. *Journal of Adolescent Health, 48*(2), 121-127.

Van den Berg, H.S., George, A.A., Du Plessis, E.D., Botha, A., Basson, N., De Villiers, M., & Makola, S. (2013). The Pivotal Role of Social Support in the

Well-Being of Adolescents. In M.P. Wissing (Ed.), *Well-Being Research in South Africa* (pp. 315-339). Amsterdam, Netherlands: Springer.

Van Den Eijnden, R.J., Spijkerman, R., Vermulst, A.A., van Rooij, T.J., & Engels, R.C. (2010). Compulsive internet use among adolescents: bidirectional parent–child relationships. *Journal of Abnormal Child Psychology*, *38*(1), 77-89.

Van der Merwe, P. (2013). South Africa's adolescents in a wired world. *International Journal of Criminology and Sociology, 2*, 348-361.

Varner, F., & Mandara, J. (2013). Differential parenting of african american adolescents as an explanation for gender disparities in achievement. *Journal of Research on Adolescence, 24*(4), 667-680.

Visser, M. (2007). *Contextualising community psychology in South Africa*. Pretoria, South Africa: Van Schaik

Volman, M., Van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education, 45*(1), 35-55.

Wallace, P. (2014). Internet addiction disorder and youth. *EMBO Reports*, *15*(1), 12-16. doi: 10.1002/embr.201238222

Weinstein, A., Feder, L. C., Rosenberg, K. P., & Dannon, P. (2014). Internet Addiction Disorder: Overview and Controversies. *Behavioral Addictions*, 99-117. http://dx.doi.org/10.1016/B978-0-12-407724-9.00005-7

Zimring, F.E. (2014). *The changing legal world of adolescence*. New Orleans, LA: Quid Pro Books.

CHAPTER 3: ARTICLE 2

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THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES AND INTRAPERSONAL FUNCTIONING IN ADOLESCENCE

Abstract

The recent exponential growth in adolescent information and communication technology (ICT) use was the catalyst for this investigation into the effect of frequency of ICT use on adolescent intrapersonal functioning. The study examines the effect of ICT usage on the resilience-associated dimensions of sense of mastery and intrapersonal strengths. Gender and age-related differences are also examined. Data was gathered from adolescents in two waves (2 years apart). The stratified, random sample of 1000 adolescents (from diverse demographic assemblages) was selected from ten high schools in Free State Province, South Africa. The mean ages of participants were 13.9 years (Wave 1 group) and 16.4 years (Wave 2 group). Information about age, gender and frequency of ICT use was gathered by means of a biographical questionnaire. The intrapersonal subscale of the Behavioural and Emotional Rating Scale (BERS2) and the Sense of Mastery subscale of the Resiliency Scales for Children and Adolescents (RCSA) were used to gather intrapersonal functioning data. 23% of the younger group, and 16% of Wave 2 adolescents, reported ICT use in excess of six hours per day, but the majority displayed moderate ICT usage of between 0 and 6 hours per day. The younger girls and the older boys achieved significantly higher intrapersonal strengths scores than their opposite age related gender. The amount of ICT use had a significant effect on sense of mastery for older adolescents, with a statistically significant difference between individuals who spend more than 0 hours to 3 hours per day on ICT, and individuals who spend more than 3 hours per day to 6 hours per day on ICT, with the latter

group reporting the highest sense of mastery scores. The results indicate that, although ICT use has an insignificant effect on adolescents' perceived intrapersonal functioning, it does significantly affect older adolescents' sense of mastery. Gender differences in change in intrapersonal strength over time are also significant. A limitation of this study is the self-report of information. Objective ICT measuring instruments or electronic tracking of ICT use is recommended for future research. Results elucidate the effect of ICT use on older adolescents' sense of mastery, and highlight gender specific developmental concerns with regards to girls' intrapersonal functioning from early to late adolescence.

Introduction

Throughout history humans have been concerned about possible dire effects of new technologies, especially on the developing youth (Johnson, 2006). Socrates, for example, warned against taking up writing (because it would erode the memory) (Mills, 2014). Today's debate about the impact of ICT use on development (e.g., Sigman, 2012) can easily be discarded as unfounded Socratian echoes (Wallace, 2014). Information and communication technologies (ICTs) are technologies that provide access to information through telecommunications (Chatfield, 2012), and include television, radio, computers, mobile phones, the internet, and social media applications (like Facebook, Twitter, WhatsApp and Instagram) (Weber & Kauffman 2011). ICT is currently the preferred activity for the majority of adolescents globally (Øverby, Klepp, & Bere, 2013; Strasburger et al., 2013) and on average, adolescents spend a third of their time interacting with screen technology (Calvert & Wartella, 2014).

Almost 100% of adolescents in industrialised countries have ICT access (Telecommunication Development Sector, 2014). In the UK, the USA and Canada teenagers spend more than 50% of their waking time engaging with ICT (Sigman, 2012). Developing countries are lagging slightly, but the improvement of mobile technology (Van der Merwe, 2013) is driving exponential growth in ICT use in these countries (Telecommunication Development Sector, 2014). Almost 70% of South African adolescents regularly access the internet (Oyedemi, 2015; Van der Merwe, 2013). Adolescent ICT use (according to several South African

studies, e.g., Bosch (2008) and Chuma (2014), is pervasive across socio-economic and geographical realities (Mbinjama, 2013). This rapidly changing social landscape presents a critical shift in how adolescents engage with the world (Buckingham, 2013; Greenfield & Yan, 2006) and challenges them with growing developmental demands at a time when society provides them with dwindling support (Park, Clery, Curtice, Phillips, & Utting, 2012).

The effects of ICT use on the adolescent can be explained by the theoretical framework of Bronfenbrenner's (2005) bio-ecological model, and the added ecological techno-subsystem dimension as proposed by Johnson and Puplampu (2008) (See Figure 1).
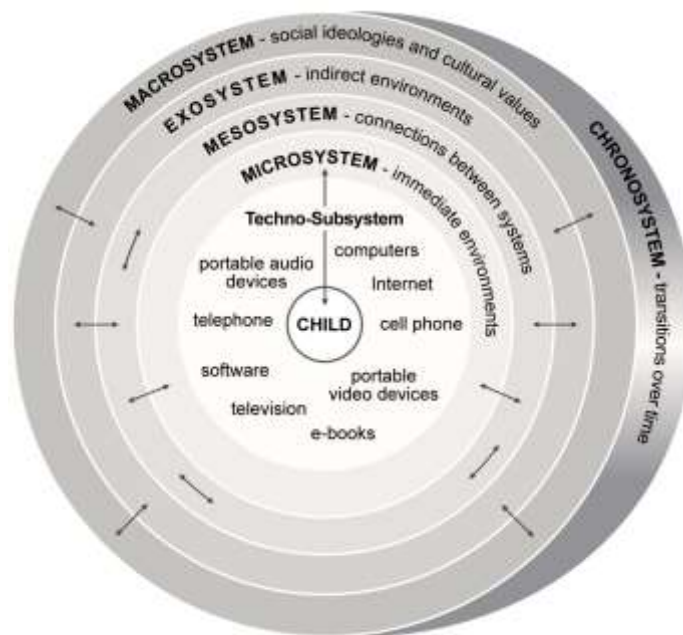
Figure 1. Bronfenbrenner's (2005) bio-ecological model with Johnson and Puplampu's techno-subsystem dimension incorporated

Bronfenbrenner's (2005) model situates the adolescent centre within multiple relationships influenced by five hierarchical spheres of the surrounding environment (Darling, 2007) with bi-directional influences within and between spheres. The *microsystem* refers to immediate connections (e.g., peers, family, and school) and the *mesosystem* to interactions between immediate environments (e.g., the relationship between parents and the child's school can positively impact on attitude of the child towards schoolwork). The *exosystem* non-directly impacts on the adolescent (e.g., the financial remuneration of the parent affects the socio-economic reality of the child's daily life), whilst the *macrosystem* relates to social-cultural influences (e.g., being raised in a specific cultural or religious context, with specific gender-bias towards girls, will affect the assimilation of female gender roles for girls in that society) (Raday, 2003). Changes over time in systems and individuals, are explained by the *chronosystem* (e.g., the relationship between children and parents change as children mature) (Johnson, 2010a). Johnson and Puplampu (2008) added the techno-subsystem as a dimension of the microsystem to explain adolescent interaction with ICT. This techno-subsystem highlights the importance of ICTs as agent of influence on adolescent development, but does not propose by what mechanism such influence would work (Johnson, 2010b).

An ever-growing volume of research concerns itself with the real effects (as postulated in Bronfenbrenner's bio-ecological model) of ICT use on adolescent development and functioning (Judi, Ashaari, Zin, & Yusof, 2013; O'Keeffe & Clarke-Pearson, 2011), but increasingly straggles behind the exponential growth

in adolescent ICT use (Kaess et al., 2014). Studies often focus on possible dire consequences of ICT use, such as physical health issues (Hardy, Denney-Wilson, Thrift, Okely, & Baur, 2010), mental health issues (Page, Cooper, Griew, & Jago, 2010), interpersonal and relational effects (Amichai-Hamburger & Hayat, 2011), and academic problems (Weinstein, Feder, Rosenberg, & Dannon, 2014). ICT mediated activation of the dopamine pathways in the brain (associated with an increased sense of pleasure linked to addictive behaviour (Hong et al., 2013) play an important role in ICT overuse (Cash, Rae, Steel, & Winkler, 2012; Han et al., 2011). An expanding volume of work highlight potential positive outcomes of adolescent ICT use (Chesley & Johnson, 2014), including development of a sense of mastery and intrapersonal strengths (Huang, 2010; Shank & Cotton, 2014).

The focus on the effect of ICT use on adolescents' sense of mastery and intrapersonal strengths is best understood in terms of its importance against the larger theoretical and empirical backdrop of resilience and adolescent development. Rutter and Taylor (2003, p.264) define resilience as "the ability to demonstrate successful development and adaptation within contexts of risk", whilst, according to Zheng and colleagues (2009), self-efficacy is the belief that one can optimally handle life's challenges. Successful adolescent development is characterised by the establishment of personal identity (Arnett, 2014; Erikson, 1968) and exploration of the self in relation to others (Louw & Louw, 2007) by utilising ever-increasing complex cognitive abilities (Keating, 2012; Piaget, 1964). The prototypical self-knowledge developed in early childhood direct later

internalised schemas of human interaction in middle childhood, and eventually form the complex appraisal system used to interpret environmental and relational cues in adolescence (Friedman & Chase-Lansdale, 2003).

Sense of mastery, perception of self-efficacy, optimism and adaptability are important for developing resilience (Prince-Embury & Saklofske, 2013). Early research emphasise the importance of curiosity as catalyst for environmental exploration (White, 1959) – an interaction that is intrinsically rewarding, teaches the child the joys of active agency in cause and effect dynamics, and most importantly is the source of problem solving skills (Sroufe, 1996). White (1959) and subsequent researchers (Masten, Burt, & Coatsworth, 2006) suggest that a sense of mastery, self-efficacy, and competence is derived from and 'grows' in relation to this interaction with the environment. Adolescents' self-efficacy beliefs also impact on their academic motivation and success (Bandura, 1993) and a sense of mastery can prevent or ameliorate emotional and behavioural problems through better adaptation to stressful contexts (Brownlee et al., 2013). A sense of mastery grows as adolescents begin to control and influence greater parts of their lives, which in turn (in optimal contexts) improves self-esteem (Erol & Orth, 2011).

ICT use can effectuate adolescents' sense of mastery and intrapersonal strengths (Brown, 2014; Shank & Cotten, 2014). It enhances their desire for identity exploration and experimentation (Amichai-Hamburger & Hayat, 2011), enables them to gain greater autonomy (Duran, Kelly, & Rotaru, 2011), as well

as access to information and ICT skills (including problem-solving skills) (Binkley et al., 2012). In the process intrapersonal skills are strengthened and a sense of mastery over the environment is established (Shank & Cotten, 2014). ICT use offers adolescents opportunities to develop empowering self-efficacy beliefs when adult limit-setting is present (Brown, 2014). Strong self-efficacy motivates perseverance, enhancing learning and ultimately leading to achievement, especially in academic settings (Lsuzczynska, Guterrez-Dona, & Schwarzer, 2005). The flexibility and modifiability of ICT (Chen & McGrath, 2003) encourage positive self-efficacy in adolescents by empowering them to pursue a variety of goals in multiple settings (Zheng et al., 2009). Peer-to-peer relationships are important for teenagers and the solidifying of face-to-face friendships via ICT creates feelings of satisfaction and connectedness in adolescent girls (Schofield-Clark, 2005) and thereby strengthens self-efficacy beliefs (Brown, 2014). Self-esteem rests on two pillars: belief that one can control one's environment and acceptance from others (Valkenburg & Peter, 2011). ICT use provides adolescents with both. They experience a sense of mastery via ICT use (Jackson, von Eye, & Fitzgerald, 2010; Valkenburg, Peter, & Schouten, 2006). The more often ICT communication is used, the more (mostly positive) feedback is generated, that in turn leads to higher self-esteem (Valkenburg & Peter, 2009). Conversely, adolescents who receive negative feedback experience diminished self-esteem (Shapiro & Margolin, 2014).   Research indicates a positive relationship between ICT use and sense of mastery, self-esteem and self-efficacy (Shank & Cotton, 2014; Valkenburg & Peter, 2011) but these studies do not include excessive ICT use (Kaes et al., 2014; Moreno, Jelenchick, &

Christakis, 2013). Results from studies on adolescent ICT overuse clearly indicate excessive use to negatively influence these same factors (Ghassemzadeh, Shahraray, & Moradi, 2008; Yu & Shek, 2013).

The effect of ICT use on adolescents' intrapersonal strengths and sense of mastery is often reported as either being all harmful or all beneficial (Suoranta, 2003). All of the above-mentioned positive effects of ICT usage can also be supplanted by pernicious consequences, depending on factors separate from or associated with ICT use (Weinstein et al., 2014). Ahiauzu and Odili (2012) plead for a more balanced "middle ground" approach that does not view technology as inherently good or bad (Suler, 2005), but that links the effects on adolescent development to the amount of ICT use (Belanger, Akre, Berchtold, & Michaud, 2011).

The nature of the effect of ICT use on the adolescent can be explained by three hypotheses. The augmentation or stimulation hypothesis (Valkenburg & Peter, 2007) reasons that the use of one medium enhances engagement with other mediums (Huang, 2010) (e.g., ICT mediated communication enhances eye-to-eye communication in established relationships (Allen, Ryan, Gray, McInerney, & Walker, 2014). The displacement hypothesis (Valkenburg & Peter, 2007) argues that excessive ICT usage prevents engagement in other developmentally important activities (Endestad, Heim, Kaare, Torgersen, & Brandtzæg, 2011). The threshold effect theory (Endestad et al., 2011) stipulates a critical time-limit for ICT use, after which negative effects occur (Belanger et al., 2011). There is

currently no consensus as to the number of hours that would define said critical time-threshold (Belanger et al., 2011) and definitions of excessive use range from two hours per day (Meerkerk, Van den Eijnden, Vermulst, & Garretsen, 2009) to six or more hours per day (Hawi, 2012; Tonioni et al., 2012).

More than six hours of ICT use per day profoundly affects adolescents' resilience (Li et al., 2010), specifically their intrapersonal strengths and sense of mastery. Overuse negatively affects self-esteem (Wallace, 2014), with moderate users displaying higher self-esteem than excessive users (Ghassemzadeh et al., 2008). Weinstein and colleagues (2014) also found that adolescents with low self-esteem and self-efficacy experience a greater need for control, often leading to excessive ICT use. Problematic ICT use is also related to low problem solving skills (Yu & Shek, 2013). Moderate ICT use is associated with emotionally warm parenting and healthy parent-adolescent communication, whilst parental rejection or overprotection is associated with excessive use (Yao, He, Ko, & Pang, 2014). Over time, parents of excessive ICT using adolescents often 'give up', thus exacerbating the problem (Van den Eijnden, Spijkerman, Vermulst, van Rooij, & Engels, 2010). Research also shows that stricter rule-setting without bettering the parent-adolescent relationship does not decrease excessive ICT use (Van den Eijnden et al., 2010). Younger adolescents are more significantly affected by excessive ICT use than older adolescents (Koo & Kwon, 2014). Older excessive users perceive and experience themselves and their lives as more negative than moderate users (Yan, Li, & Sui, 2014). Excessive ICT use might decrease over time because of (i) a decrease in the novelty factor, (ii) psycho-physiological

maturing, leading to better self-control and increased self-efficacy, and (iii) more social and academic distractions (Yu & Shek, 2013). The amount of ICT use and its relationship with intrapersonal variables is most probably bi-directional in nature (Koo & Kwon, 2014; Wallace, 2014).

A paucity exists in South African research on ICT use and its effect on adolescent development in general (Savahl et al., 2008), and on intrapersonal strengths and sense of mastery specifically. Published studies have small data-sets and/or qualitative and cross-sectional methodologies (e.g., Bosch, 2008; Chuma, 2014; Louw & Winter, 2011; Odendaal, Malcolm, Savahl, 2006), or focus on aspects other than the developmental effect of ICT (e.g., Gudmundsdottir, 2010; Mbinjama, 2013; Van der Merwe, 2013).

Gender differences in ICT usage have decreased in the last ten years, but still exist (Banerjee, Kang, Bagchi-Sen, & Rao, 2005; Drabowicz, 2014). Adolescent girls use ICTs mainly for information seeking and communication (Chen & Tzeng, 2010), whilst adolescent boys use it mainly for entertainment (Lai & Gwung, 2013). Boys are more vulnerable to excessive ICT use than girls, with girls probably being better supervised within family contexts (Yu & Shek, 2013). Adolescent boys spend more time engaging with ICTs than girls (Harris, Straker, & Pollock, 2013) and benefit more from ICT communication than their female counterparts because they find face-to-face self-disclosure more uncomfortable (McNelles & Connolly, 1999), and, therefore, find ICT mediated communication easier to negotiate (Schouten et al., 2007).

Purpose of the study

This study addresses various research gaps by examining the interplay between the ICT usage of a large South African sample and the resilience-associated dimensions of sense of mastery and intrapersonal strengths. Most international studies of the effect of ICT use on adolescents have small datasets and employ qualitative methodology (with the noteworthy exception of Yu and Shek's 2013 article). There is a complete absence of studies that examine the effect of amount of ICT use on resilience in adolescence, and specifically on sense of mastery and intrapersonal strengths within a South African context. The research question directing this study, is therefore: "How do adolescent males and females, with different levels of self-reported ICT use differ with regards to their intrapersonal functioning?"

The null hypothesis states that there is no difference in adolescent sense of mastery and intrapersonal strengths between adolescents, notwithstanding the amount of hours they engage with ICT, nor between male and female participants, nor between different age groups.

Research methods

Participants and procedures

Data was collected over a three year period by a team of researchers from the Department of Psychology at Free State University in South Africa. The research project employed a criterion group design for the data gathering. The information was gathered in two waves (Wave 1 being in the adolescents' first year of high school in 2010; and Wave 2 being in their third year of high school in 2012) utilising a stratified, random sample of 1000 adolescents. The adolescents represented the full range of diversity as with regards to socio-economic and rural/urban realities, and they came from the same ten schools in Free State Province, South Africa. The mean age for the Wave 1 cohort [2010] ($n = 817$; 337 girls and 480 boys) is 13.9 years, and 16.4 years for the Wave 2 cohort [2012] ($n = 994$; 418 girls and 578 boys). The difference in total subjects between the Wave 1 and Wave 2 cohorts, as well as the slightly older than expected average age of the Wave 2 cohorts, is best explained by the inclusion of learners that failed in the two years of data gathering, and ended up being included in the Wave 2 cohort (even though they were not originally part of the 2010 cohort).

Standardised (back translated) psychometric tests (in all three official languages of the province and in booklet format) were given during school hours to groups of adolescents for completion. Participants completed the tests as a group at their school under the supervision of registered psychologists and fieldworkers.

Measuring instruments

The following measuring instruments were used:

Biographical questionnaire. Close-ended questions were utilised to get information about the age and gender of the participants. Frequency of ICT use (i.e., average hours per day spent on ICTs) was derived from participant-reported data.

Behavioral and Emotional Rating Scale (BERS2) (Epstein, 2000). The Adolescent Risk and Resilience Project used the first 52 self-reported behavioural and emotional strength items of the BERS2 (with five demographic questions omitted in favour of the locally more relevant Biographical Questionnaire, designed by the research team.) This BERS2 scale evaluates the interpersonal, intrapersonal and affective strengths, as well as the family involvement and school functioning of eleven to eighteen year old adolescents. The items of the BERS2 scale have been shown (across several studies) to have acceptable internal consistency with alpha coefficients ranging from 0.66 in South African samples (De Villiers, 2009) to 0.77 in American studies (Epstein & Sharma, 1998). This study incorporated only the intrapersonal subscale of the BERS2 that focuses on those core strengths of a child that are associated with his or her sense of their own accomplishments and competence (e.g.,, "enthusiastic about life" and "is self-confident") (Epstein, 2000). The higher the score on the intrapersonal subscale, the better the core intrapersonal competencies of the adolescents

(Epstein & Sharma, 1998). These specific strengths build intrapersonal resilience and thus create a more positive sense-of-self (Masten & Obradovic, 2006).

Resiliency Scales for Children and Adolescents (RCSA) (Prince-Embury, 2006). The RCSA measure Sense of Relatedness, Sense of Mastery, and Emotional Reactivity – three constructs that are seen as essential in the development of personal resilience. They were used to measure participants' resilience. The 64-item test has shown good alpha coefficients in previous research (0.89 to 0.91) (Prince-Embury & Saklofske, 2013), including South African contexts (0.90 to 0.93) (De Villiers, 2009). The Sense of Mastery subscale (a 20-item questionnaire) investigates the conceptually related constructs of *optimism* (of one's autonomous competence), *self-efficacy* (in one's problem-solving ability) and *adaptability* (in being able to productively incorporate feedback and adjust accordingly). The higher the sense of mastery score, the greater the adolescent's implied intrapersonal resilience.

Ethical considerations

Ethical approval for the study was obtained from the Research Committee of the Faculty of Humanities (Free State University). Permission for the study was obtained from the principals of the target schools, as well as from the provincial Department of Education. The adolescents' parents gave informed consent, whilst they themselves gave written assent, prior to inclusion in the project. Information was attained anonymously to ensure confidentiality, and field workers debriefed participants post-administration of questionnaires to

address any possible emotional corollary or disquietude associated with the process, and, if indicated, individual referrals for professional counselling were made. Adjacent to this, all participants also received a brochure that included information about effective emotional and behavioural coping strategies at completion of the research questionnaires, as well as possible support and referral sources' contact information.

Data analysis

The distribution of frequency of ICT use (self-reported by the adolescents in number of hours of use per day) was used to group ICT users into four groups, namely those that reported no ICT use per day (Group 1), those that reported moderate ICT use per day (Group 2 – more than 0 to 3 hours; Group 3 – more than 3 to 6 hours), and finally those that reported excessive ICT use per day (Group 4 – more than 6 hours). The data was first tested for assumptions of multivariate normality, multi-collinearity, and evidence of non-linear relationships, and then used to determine significance of differences in the resilience and strength scores of adolescents with different levels of ICT use. The Kolmogorov-Smirnov and Shapiro-Wilks tests confirmed a normal distribution of data, and no evidence of significant multi-collinearity and non-linear relationships was found. Next, the relationship between the different study variables was statistically assessed by means of a two-way multivariate analysis of variance for both the younger adolescents (Wave1) and the older adolescents (Wave 2) to establish the effects of gender, as well as frequency of daily ICT use, on the participants' sense of mastery and intrapersonal

strengths. Wilk's lambda multivariate statistics were used to consider which of the groups differed significantly (Anderson, 2003).

Results

Participants were divided into four groups based on the number of hours of ICT usage they self-reported (Group 1: 0 hours per day, Group 2: more than 0 hours to 3 hours per day, Group 3: more than 3 to 6 hours per day, and Group 4: more than 6 hours per day). This was done to simplify data and to elucidate results, with Groups 2 and 3 defined as moderate ICT users, and Group 4 encompassing excessive ICT use.

Table 1
Four combined groups of ICT use

Different groups of ICT use	ICT use Hours per day	WAVE 1						WAVE 2					
		Total group		Girls		Boys		Total group		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%	N	%
Group 1	0 hours	146	20,74%	99	24,03%	47	16,10%	2	0,23%	1	0,20%	1	0,27%
Group 2	More than 0 to 3 hours	270	38,35%	151	36,65%	119	40,75%	443	51,04%	256	51,30%	187	50,68%
Group 3	More than 3 to 6 hours	124	17,61%	65	15,78%	59	20,21%	285	32,83%	161	32,26%	124	33,60%
Group 4	More than 6 hours	164	23,30%	97	23,54%	67	22,95%	138	15,90%	81	16,23%	57	15,45%

It can clearly be seen in Table 1 that there is a decline in the number of participants that did not utilise any ICTs, from almost 21% (of the total number of adolescents) in Wave 1 to less than half a percentage (of the total number

of adolescents) in Wave 2. The majority of adolescents in both cohorts indicate themselves to be moderate ICT users, while the number of participants that use ICTs for more than 6 hours a day (i.e., excessive users) decreased from almost 23% of the total number of adolescents in the younger cohort (Wave1) to 15.9% of the older cohort (Wave 2). A Manova could not be done to compare group 1's Wave 1 and 2 data, as the required number of variables (i.e., 4 variables in this study) is more than the number of participants (i.e., 2 adolescents) (Anderson, 2003).

Table 2

Descriptive statistics for the strength and resilience scales of the different groups

ICT use Hours per day		WAVE 1						WAVE 2					
		Total group		Girls		Boys		Total group		Girls		Boys	
		Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev
Group 1	Intrapersonal strengths	26,64	5,39	26,96	5,34	25,95	5,47						
0 hours	Sense of mastery	54,34	13,59	53,99	13,43	55,09	14,05						
Group 2	Intrapersonal strengths	27,66	4,7	28,09	4,47	27,1	4,94	16,09	3,73	15,76	3,67	16,54	3,79
More than 0 to 3 hours	Sense of mastery	56,16	12,02	56,28	11,45	56,01	12,76	50,7	10,72	50,24	11,44	51,34	9,64
Group 3	Intrapersonal strengths	26,99	5,78	27,39	4,85	26,56	6,67	16,27	3,8	15,97	3,49	16,66	4,14
More than 3 to 6 hours	Sense of mastery	54,73	12,26	52,14	12,51	57,58	11,42	53,22	10,71	52,81	11,11	53,76	10,19
Group 4	Intrapersonal strengths	27,04	5,03	27,54	4,18	26,3	6,05	16,7	3,98	16,15	3,95	17,56	3,9
More than 6 hours	Sense of mastery	53,51	11,43	52,15	10,88	55,46	12	52,86	9,52	52,14	9,66	53,88	9,31

Note. There were only 2 respondents in Wave 2 cohort who indicated 0 hours of ICT use per day. This was deemed too few respondents for further statistical analysis of that usage group's results.

As can be seen in Table 2, there is little variation in the mean intrapersonal strengths (scores range from 26 to 28 for Wave 1, and 16 to 17 for Wave 2) and sense of mastery scores (range from 53 to 57 for Wave 1, and 50-54 for Wave 2) in each of the cohort's four ICT usage groups. The mean intrapersonal strength and sense of mastery scores are similar for boys and girls in Wave 1 and in Wave 2 respectively. The mean intrapersonal strength scores of Wave 1 is significantly higher for Groups 2, 3 and 4 than that of Wave 2.

Table 3

Effect of Gender and number of hours on ICT per day on sense of mastery and intrapersonal strengths (multivariate test scores)

Effect	Wave	Value	F	Hypothesis df	Sig.	Partial Eta Squared
ICT hours per day	Wave 1	0.990	1.144	6.000	0.335	0.005
	Wave 2	0.978	4.577	4.000	**0.001****	0.011
Gender	Wave 1	0.975	8.625	2.000	**0.000****	0.025
	Wave 2	0.982	7.415	2.000	**0.001****	0.018
ICT hours per day x Gender	Wave 1	0.990	1.097	6.000	0.362	0.005
	Wave 2	0.997	0.519	4.000	0.722	0.001

** 1% $p \leq .01$.

In Wave 1 (see Table 3) there was a significant difference between males and females (F=8.625; p=0.000) on the combined dependent variable (i.e., sense of mastery and intrapersonal strengths). However, there was no significant

difference in sense of mastery and intrapersonal strength scores between adolescents who spend different numbers of hours per day on ICT, and there was also no significant interaction effect between gender and amount of hours spend per day on ICT. To determine exactly which of the dependent variables differed between adolescent boys and girls, further analysis of between-subjects effects was conducted.

With Wave 2 (see Table 3) there was a significant difference between males and females (F=7.415; p=0.001) on the combined dependent variable (i.e., sense of mastery and intrapersonal strengths). There was also a significant difference on said combined sense of mastery and intrapersonal strengths variable between adolescents who spend different numbers of hours per day on ICT (F=4.577; p=0.001). There was, however, no statistical significant interaction effect between gender and the amount of hours per day on ICT. In order to see exactly which groups differed significantly in terms of their sense of mastery and intrapersonal strengths, further analysis of between-subjects effects was conducted.

Table 4

Between-subjects effects

Source	Dependent Variable	Wave	df	Mean Square	F	Sig.	Partial Eta Squared
ICT hours per day	Intrapersonal strengths	Wave 1	3	40.521	1.552	0.200	0.007
		Wave 2	2	25.632	1.808	0.165	0.004
	Sense of mastery	Wave 1	3	219.906	1.470	0.221	0.006
		Wave 2	2	481.039	4.666	**0.010***	0.011
Gender	Intrapersonal strengths	Wave 1	1	152.683	5.847	**0.016***	0.009
		Wave 2	1	135.926	9.587	**0.002****	0.012
	Sense of mastery	Wave 1	1	716.017	4.787	0.029	0.007
		Wave 2	1	104.748	1.016	0.314	0.001

* 5% $p \leq .05$. ** 1% $p \leq .01$

There was, with Wave 1, only a significant difference between males and females in intrapersonal strengths (F=5.847; p=0.016) (See Table 4), and as can be seen in Table 6, females had higher intrapersonal strengths than males. As can be seen in Table 4, adolescents in Wave 2 who spend different numbers of hours per day on ICTs differed in terms of their sense of mastery only (F=4.666; p=0.010). As can be seen in Table 5, there was a statistically significant difference in sense of mastery scores between individuals who spend more than 0 hours to 3 hours per day on ICT, and individuals who spend more than 3 hours per day to 6 hours per day on ICT, with the latter group reporting the highest sense of mastery scores.

Table 5

Wilk's lambda statistics indicating specific group differences in sense of mastery (Wave 2)

	ICT hours per day		Mean Difference	Std Error	Sig.
Sense of mastery	more than 0 to 3 hours	more than 3 to 6 hours	-2.2588	.79460	**.013***
		more than 6 hours	-2.0770	1.03019	.109
	more than 3 to 6 hours	more than 0 to 3 hours	2.2588	.79460	**.013***
		more than 6 hours	.1819	1.09247	.985
	more than 6 hours	more than 0 to 3 hours	2.0770	1.03019	.109
		more than 3 to 6 hours	-.1819	1.09247	.985

* 5% $p \leq .05$.

Males and females in the older cohort differed significantly only in terms of intrapersonal strengths (F=9.587; p=0.002), with males having higher intrapersonal strength scores than females (see Table 6).

Table 6

Gender differences in intrapersonal strengths

	Gender			
	Male		Female	
	Mean	Standard Deviation	Mean	Standard Deviation
Intrapersonal strengths (Wave 1)	26.14	5.94	27.35	4.86
Intrapersonal strengths (Wave 2)	16.97	4.10	15.85	3.68

Discussion

A dramatic decrease can be seen in the number of adolescents who reported no ICT use from Wave 1 to Wave 2 (from 20% to less than 0.5%). Moderate ICT use was indicated by the majority of participants in both the younger group (56%) and the older group (84%). In this study the increase in the number of moderate users from Wave 1 to Wave 2 reflected in the decrease of the number of excessive users from Wave 1 (23.3.%) to Wave 2 (15.9%).

The older cohort's percentage of moderate users echo the prevalence rates for moderate ICT use in a recent, large multi-centre European study (Kaes et al., 2014). The decline in excessive use over time, and the upward trend in

moderate use percentages, support current neuroscientific research associated with normal neurological maturation effects noted from early to late adolescence (Casey, Jones, & Hare, 2008; Ernst & Korelitz, 2009) . Said maturation provides developing adolescents with increasing behavioural and emotional control (Ernst, Pine, & Hardin, 2006;   Hare et al., 2008), making older adolescents less susceptible to possible addiction-effects of ICT use than younger adolescents (Crews, He, & Hodge, 2007; Zhou, Zhu, Li, & Wang, 2014). A bi-directionality in the relationship between excessive use and neurological regulatory mechanisms is currently debated in international publications (Brand, Young, & Laier, 2014; Hong et al., 2013).

The percentage of Wave 1 excessive users is much higher than reported American and European prevalence rates (ranging between 5% and 10% (Park, Kim, & Cho, 2007), and slightly higher than the prevalence rates of between 15-20% reported for South Korea and Taiwan (Weinstein et al., 2014). Whilst the Wave 2 excessive ICT use percentage is on par with the South Korean and Taiwanese studies, it is also higher than American and European prevalence rates. A notable exception is a three year longitudinal study of Hong Kong adolescents done by Yu and Shek (2013) that found a prevalence rate of 26.7% of excessive use – higher than both Wave 1 and Wave 2 Group 4 percentages in this study. Empirical work has highlighted the detrimental results of excessive ICT usage on an adolescent's sense of mastery (Moreno et al., 2013).   The

threshold effect theory defines a critical amount of ICT use after which negative effects will start to occur (Belanger et al., 2011; Endestad et al., 2011).

There is a significant difference between the number of younger girls (24%) and younger boys (16%) who do not engage with ICTs. All the other usage groups of Wave 1, as well as Groups 1 to 4 of Wave 2, show remarkably little gender differences in ICT use. The lack of gender differences in the different ICT use groups of both waves (except for Wave 1's non user group), challenges studies that found a higher overall ICT use frequency for adolescent boys than for adolescent girls (Harris et al., 2013), and echoes the dominant zeitgeist in relevant research with regards to gender differences (i.e., that it has become less distinct) (Banerjee et al., 2005; Cotton, Anderson, & Tufekci, 2009). The higher percentage of female non-users in Wave 1 might indicate a societal gender bias in parenting practices, where younger adolescent girls report being monitored more closely and receiving less autonomy than younger adolescent boys (Varner & Mandara, 2013)

The adolescents in both waves of this study reported higher levels of sense of mastery across the different gender groups and levels of ICT use than the normative sample of Prince-Embury (2006). The normative scores for the strength subscales of Epstein's (2000) American sample makes any comparative assessment with the current study's strength scores difficult.

A marked decline in intrapersonal strengths is noticeable between Wave 1 and Wave 2, irrespective of level of ICT use. This result supports empirical publications that found an increase in perceived expectations and overall experienced stress amongst developing adolescents, with a resultant decrease in self-esteem as they mature (Schraml, Perski, Grossi, & Simonsson-Sarnecki, 2011).

In both waves, significant gender differences in intrapersonal strengths were found, with girls reporting higher levels of intrapersonal strengths in Wave 1 and boys reporting higher levels in Wave 2. Numerous studies reveal that girls primarily use ICT for communication and information in early adolescence (in contrast to boys, who primarily use it for entertainment) (Drabowicz, 2014; Lai & Gwung, 2013). This ICT mediated communication leads to an increased sense of connectedness (Schofield-Clark, 2005; Valkenburg & Peter, 2009), that eventually (following empirical work done by Valkenburg and colleagues, 2006) translates into strong self-efficacy beliefs (Brown, 2014) for these girls. This study's results echo the above-mentioned research with respect to the adolescent girls in the younger group measuring better on intrapersonal strengths than the adolescent boys of the same cohort. The results were, however, reversed for the older group, with the boys reporting higher intrapersonal strengths. Bronfenbrenner's (2005) bio-ecological model conceptually explain the various influences that an individual will experience from different spheres of his or her existence over time (Johnson 2010b). Moksnes,

Moljord, Espnes, and Byrne (2010) found that adolescent girls displayed significant stress in all domains, and that boys conversely scored "significantly higher on self-esteem". The decrease in intrapersonal strengths for adolescent girls over time (and the comparative higher intrapersonal strength scores for adolescent boys in the older cohort) seen in this study, might be indicative of bio-psychological changes associated with maturing, as well as societal expectations (with both being causes of stress for the adolescent) (Schraml et al., 2011; Varner & Mandara, 2013).

In the older cohort, frequency of ICT use had a significant effect on sense of mastery, with significant differences found between Group 2 and Group 3. The research case is strong in support of the positive impact of ICT use for adolescents' sense of mastery (Shank & Cotton, 2014; Valkenburg & Peter, 2011). Several studies have indisputably shown that ICT provides adolescents with powerful opportunities to develop self-efficacy (e.g., Brown, 2014), and that the more time they spend using ICT, the greater the positive effect on self-esteem (Shank & Cotton, 2014; Valkenburg et al., 2006). This result supports the theoretical notion put forth by the Augmentation/Stimulation Hypothesis – an idea countered by other research that discusses the negative effect on sense of mastery and self-esteem associated with excessive ICT use (Moreno et al., 2013). Another factor to consider (keeping Brown's (2014) article in mind), is the possible mediating effect that parental limit-setting in the younger adolescent group might have in terms of ICT effects on self-efficacy and a sense of mastery.

Even though limit-setting is important to curb or prevent excessive ICT use, parental encouragement of children's ICT activities in manners that are not constraining can actually enhance an adolescent's sense of autonomy and control, which is at the heart of strong self-efficacy (Brown, 2014).

Lastly, this discussion shows the null hypothesis to be partially rejected in both the Wave 1 and Wave 2 results. The null hypothesis is rejected with regards to the difference in intrapersonal strengths of both the younger and the older adolescent boys and girls, as well as for the number of hours of ICT use and sense of mastery for the older adolescents.

Conclusion

The possible developmental impact of the worldwide pervasive proliferation of adolescent ICT use, specifically in terms of its effect on the adolescent's sense of mastery and intrapersonal strengths, was the research-focus of this study. The developmental importance of perceiving oneself to be able to assert control over, be curious in, adapt to, and manage one's environment (defined as sense of mastery and intrapersonal strengths) stem from past empirical work, especially in the field of adolescent resilience. The majority of said research studied the detrimental sequelae of ICT use on adolescent sense of mastery and intrapersonal strengths, with a minority of research focussing on possible positive, resilience-enhancing effects. The interplay (whether positive or negative in effect)

between adolescents and ICTs was theoretically explained with Bronfenbrenner's (2005) bio-ecological model (integrating Johnson and Puplampu's (2008) techno-subsystem). It was posited (following on other published research in this field) that adolescents' sense of mastery and their intrapersonal strengths will be gender-uniquely affected by the amount of ICT use, with excessive use (more than six hours per day) having the most adverse effect on said constructs. Three theoretical hypotheses (i.e., the threshold effect hypothesis, the augmentation/stimulation hypothesis, and the displacement hypothesis) were superimposed on the study's empirical data, in order to better understand possible ICT use effects on the adolescents' sense of mastery and intrapersonal strengths.

A minority of young adolescents (Wave 1) reported never using ICTs, while almost every participant (excepting 2) of the older cohort used ICT daily. Just under a quarter of Wave 1 adolescents self-reported excessive ICT usage (i.e., six or more hours per day). This figure decreased to less than 16% in the older adolescent group. It is also important to note that the majority of young adolescents in the study reported moderate ICT use.

The younger girls measured better than the younger boys on intrapersonal strengths, echoing other empirical work that highlights how young adolescent girls utilise ICT for information seeking and communication purposes, thus enhancing the establishment of strong self-efficacy beliefs (Jose, Ryan, & Pryor,

2012). (Young adolescent boys primarily, but not exclusively, use ICTs for entertainment purposes (Drabowicz, 2014).) This result supports the premise inherent to the augmentation/stimulation hypothesis. The study's findings also showed that, in Wave 2, sense of mastery was significantly affected by frequency of ICT use, with the moderate usage group (enganging more than 3 to 6 hours per day with ICTs) recording the highest sense of mastery scores. The older adolescent boys' intrapersonal strenghts (although lower than the intrapersonal strengths of the younger boys) measure significantly higher than that of the older girls. Possible explanations for this change over time in perceived intrapersonal strengths for both boys and girls, is the impact of bio-psychological maturing, susceptibility to depression and anxiety (especially in girls), heightened experience of stress (Moksnes et al., 2010; Schraml et al., 2011), and a gender specificity in societal expectations – one example being a difference in the amount of autonomy and responsibility that boys and girls are given by their parents (Varner & Mandara, 2013; Yu & Shek, 2013). Girls are typically given more responsibility, but less autonomy – an occurrence that negatively affect their sense of mastery and self-efficacy (Schraml et al., 2011; Varner & Mandara, 2013).

Even though excessive ICT use seemed to have limited adverse effects on the older adolescents' sense of mastery in this study, results still support the important notion that moderate use (more than 3 to 6 hours per day for this article) enhance adolescents' sense of mastery.

The results of this study highlight the changes experienced by boys and girls in perceived intrapersonal strengths from early to late adolescence. It reinforces the notion that moderate ICT use is developmentally beneficial for today's adolescents, especially as it pertains to the development of an optimal sense of mastery.

Limitations and recommendations

Several researchers have highlighted the issues associated with self-report generated data (e.g., Shaffer, Peller, Laplante, Nelson, & Labrie, 2010), and especially in the field of adolescent ICT use the quandary of over- and under-reporting is a methodological hurdle to be negotiated (Moreno et al., 2012). The information provided by the adolescents themselves is, therefore, a limitation of this study, and several important recommendations can be made in this regard for future studies of this nature: making use of real-time electronic tracking of ICT use (Underwood, Rosen, More, Ehrenreich, & Gentsch, 2012), employing multiple sources for information (e.g., the adolescent, some of his peers, his parents or other family members, and even teachers) to corroborate data and the results derived from it, and utilising objective measuring instruments (see Laconi, Rodgers, & Chabrol's (2014) review article pertaining to existing scales and their psychometric properties).

The present study's methodology (utilising cohort-data measured in two separate waves) renders powerful information that was used quantitatively to investigate the effect of number of hours of ICT on adolescent sense of mastery and intrapersonal strengths, but it only provides an indication of whether there are differences between variables – to further investigate the specific nature of these differences, a mixed method design follow-up study is proposed (e.g., Magee, Agosto, Forte, & Dickard, 2014). More substantial information about, for instance, the specific meaning that adolescents attach to the ICTs they use (e.g., mobile phones as a provider of autonomy) (Bosch, 2008), or what mobile applications ('apps') they use and what they are used for (e.g., Wikipedia's mobile application as a tool to search for information for school projects) (Purcell et al., 2012) can be incorporated into follow-up studies. Said inclusion of more detailed information can highlight subtle differences between variables that the present study cannot do.

Longitudinal research methodology requires data gathering over time, but because of the rapid metamorphosis of technology and its use, the data and the results flowing from it might be at risk of losing relevance quickly. One possible way to attend to this problem is by focusing on specific social media platforms (e.g., Mxit or BBM) from which sustained and real-time data could be collected.

Value of current study

The results from this study add to an already existing volume of international peer-reviewed publications focusing on ICT use and its effects on adolescent development, specifically the resilience-associated dimensions of sense of mastery and intrapersonal strengths.

This research project utilised a large sample size, with a rigorous research design (including a criterion group design and two separate waves of data gathering). This is the first large quantitative study of adolescent ICT use and resilience factors for South Africa, and provides invaluable local data on hours of ICT use and the prevalence of moderate and excessive users.

Study results inform adolescent care-givers of the importance of encouraging self-esteem and associated intrapersonal strengths in young adolescent boys, as well as optimising environmental factors for older adolescent girls to sustain early adolescent intrapersonal strengths. The overall significance of moderate ICT use and its possible enhancement of adolescents' sense of mastery in today's ICT driven world, is important and informative to the international debate in this field.

References

Ahiauzu, L. U., & Odili, S. O. (2012). The influence of information and communication technologies (ICTS) on parents/adolescents relationship. *Mediterranean Journal of Social Sciences, 3*(13), 127-136. doi:10.5901/ mjss.2012.v3n13p127

Allen, K. A., Ryan, T., Gray, D. L., McInerney, D. M., & Waters, L. (2014). Social media use and social connectedness in adolescents: The positives and the potential pitfalls. *The Australian Educational and Developmental Psychologist*, 1-14.

Amichai-Hamburger, Y., & Hayat, Z. (2011). The impact of the Internet on the social lives of users: A representative sample from 13 countries. *Computers in Human Behavior, 27*(1), 585-589.

Anderson, T.W. (2003). *An introduction to multivariate statistical analysis.* New York, NY: Wiley.

Arnett, J. J. (2014). Chapter 4: Identity development from adolescence to emerging adulthood: What we know and (especially) don't know. In K.C. McLean & M. Syed (Eds.), *The Oxford Handbook of Identity Development* (pp. 53-64). Oxford, UK: Oxford University Press.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148.

Banerjee, S., Kang, H., Bagchi-Sen, S., & Rao, H.R. (2005). Gender divide in the use of the internet applications. *International Journal of E-Business Research, 1*(2), 24-39.

Belanger, R.E., Akre, C., Berchtold, A., & Michaud, P.A. (2011). A u-shaped association between intensity of internet use and adolescent health. *Pediatrics, 127*(2), e330-e335.

Bosch, T.E. (2008). WOTS ur ASLR? Adolescent girls' use of cellphones in Cape Town. *Commonwealth Youth and Development, 6*(2), 52-69.

Brand, M., Young, K. S., & Laier, C. (2014). Prefrontal control and Internet addiction: A theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience*, *8*, 375-388. doi:10.3389/fnhum.2014.00375

Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives of human development*. Thousand Oaks, CA: Sage.

Brown, T.M. (2014). "I just want to work hard": Self-efficacy and the social contexts in adolescents' ICT use. *Youth and Society, 46*(6), 853-874. doi:10.1177/0044118X12455026

Brownlee, K., Rawana, J., Franks, J., Harper, J., Bajwa, J., O'Brien, E., & Clarkson, A. (2013). A systematic review of strengths and resilience outcome literature relevant to children and adolescents. *Child and Adolescent Social Work Journal, 30(*5), 435-459. doi: 10.1007/s10560-013-0301-9

Buckingham, D. (2013). *After the death of childhood*. Cambridge, United Kingdom: John Wiley & Sons.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*(1), 111-126.

Cash, H., Rae, C. D., Steel, A. H., & Winkler, A. (2012). Internet addiction: A brief summary of research and practice. *Current Psychiatry Reviews*, *8*(4), 292-298. doi: 10.2174/157340012803520513

Chatfield, T. (2012). *How to thrive in the digital age*. London, UK: Macmillan.

Chen, P., & McGrath, D. (2003). Knowledge construction and knowledge representation in high school students' design of hypermedia documents. *Journal of Educational Multimedia and Hypermedia, 12*(1), 33-61.

Chen, S.Y., & Tzeng, J.Y. (2010). College female and male heavy internet users' profiles of practices and their academic grades and psychosocial adjustment. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 257-262.

Chesley, N., & Johnson, B. E. (2014). Information and communication technology use and social connectedness over the life course. *Sociology Compass, 8*(6), 589-602.

Chuma, W. (2014). The social meanings of mobile phones among South Africa's 'digital natives': a case study. *Media, Culture & Society, 36*(3), 398-408. doi: 10.1177/0163443713517842.

Cotton, S., Anderson, W., & Tufekci, Z. (2009). Old wine in a new technology, or a different type of digital divide? *New Media & Society, 11*(7), 1163-1186.

Crews, F., He, J., & Hodge, C. (2007). Adolescent cortical development: a critical period of vulnerability for addiction. *Pharmacology Biochemistry and Behavior*, *86*(2), 189-199.

Darling, N. (2007). Ecological systems theory: The person in the center of the circles. *Research in Human Development, 4*, 203-217.

De Villiers, M. (2009). *Die ontwikkeling en evaluering van 'n intervensieprogram om kinders se stresweerstandigheid te bevorder*. *[The development and evaluation of an intervention programme to promote child resiliency]*. (Unpublished doctoral dissertation). University of the Free State, Bloemfontein, South Africa.

Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: A comparitive study of 39 countries. *Computers and Education, 74*, 98-111.

Duran, R. L., Kelly, L., & Rotaru, T. (2011). Mobile phones in romantic relationships and the dialectic of autonomy versus connection. *Communication Quarterly, 59*(1), 19-36.

Endestad, T., Heim, J., Kaare, B., Torgersen, L., & Brandtzæg, P.B. (2011). Media user types among young children and social displacement. *Nordicom Review, 32(1),* 17-30.

Epstein, M. H. (2000). The behavioral and emotional rating scale: A strength-based approach to assessment. *Assessment for Effective Intervention, 25*(3), 249-256. doi: 10.1177/073724770002500304

Epstein, M.H., & Sharma, J. (1998). *Behavioral and emotional rating scale: A strength-based approach to assessment.* Austin, Texas: Pro-Ed.

Erikson, E.H. (1968). *Identity, youth and crisis.* New York, NY: W. W. Norton.

Ernst, M., & Korelitz, K.E. (2009). Cerebral maturation in adolescence: behavioral vulnerability. *Encephale, 35*, S182-189. doi:10.1016/S0013-7006(09)73469-4

Ernst, M., Pine, D. S., & Hardin, M. (2006). Triadic model of the neurobiology of motivated behavior in adolescence. *Psychological Medicine*, *36*(03), 299-312.

Erol, R.Y., & Orth, U. (2011). Self-esteem development from age 14 to 30 years: A longitudinal study. *Journal of Personality and Social Psychology, 101*(3), 607-619. doi: 10.1037/a0024299

Friedman, R.J., & Chase-Lansdale, P. (2003). Chapter 15: Chronic adversities. In M. Rutter & E. Taylor (Eds.), *Child and adolescent psychiatry (4th Ed.)* (pp. 261-276). Malden, MA: Blackwell Science.

Ghassemzadeh, L., Shahraray, M., & Moradi, A. (2008). Prevalence of Internet addiction and comparison of Internet addicts and non-addicts in Iranian high schools. *CyberPsychology & Behavior*, *11*(6), 731-733.

Greenfield, P., & Yan, Z. (2006). Children, adolescents, and the internet: A new field of inquiry in developmental psychology. *Developmental Psychology, 42*, 391-394.

Gudmundsdottir, G.B. (2010). From digital divide to digital equity: Learner's ICT competence in four primary schools in Cape Town, South Africa. *International Journal of Education and Development Using Information and Communication Technology, 6*(2), 84-105.

Hardy, L. L., Denney-Wilson, E., Thrift, A. P., Okely, A. D., & Baur, L. A. (2010). Screen time and metabolic risk factors among adolescents. *Archives of Pediatrics and Adolescent Medicine, 164*(7), 643-649.

Hare, T. A., Tottenham, N., Galvan, A., Voss, H. U., Glover, G. H., & Casey, B. J. (2008). Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-nogo task. *Biological Psychiatry*, *63*(10), 927-934.

Harris, C., Straker, L., & Pollock, C. (2013). The influence of age, gender and other information technology use on young people's computer use at school and home. *Work: A Journal of Prevention, Assessment and Rehabilitation, 44*(Supplement 1), S61-S71.

Hawi, N.S. (2012). Internet addiction among adolescent in Lebanon. *Computers in Human Behavior, 28*, 1044-1053. doi: 10.1016/j.chb. 2012.01.007

Hong, S. B., Zalesky, A., Cocchi, L., Fornito, A., Choi, E. J., Kim, H. H., ... & Yi, S. H. (2013). Decreased functional brain connectivity in adolescents with internet addiction. *PloS One*, *8*(2), e57831. doi:10.1371/journal.pone. 0057831

Huang, C. (2010). Internet use and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 241-249.

Jackson, L.A., von Eye, A., Fitzgerald, H.E. (2010). Self-concept, self-esteem, gender, race and information technology use. *Computers in Human Behaviour, 26*, 323-328.

Johnson, G.M. (2006). Internet use and cognitive development: A theoretical framework. *E-Learning, 4*, 565-573.

Johnson, G. M. (2010a). Internet use and child development: The techno-microsystem. *Australian Journal of Educational & Developmental Psychology, 10*, 32-43.

Johnson, G. M. (2010b). Internet use and child development: Validation of the ecological techno-subsystem. *Educational Technology & Society, 13*(1), 176-185.

Johnson, G.M., & Puplampu, P. (2008). A conceptual framework for understanding the effect of the internet on child development: The ecological techno-subsystem. *Canadian Journal of Learning and Technology, 34*, 19-28.

Jose, P. E., Ryan, N., & Pryor, J. (2012). Does social connectedness promote a greater sense of well-being in adolescence over time? *Journal of Research on Adolescence, 22*(2), 235-251.

Judi, H. M., Ashaari, N., Zin, N. A. M., & Yusof, Z. M. (2013). Framework of ICT impact on adolescent. *Procedia Technology, 11*, 1034-1040.

Kaess, M., Durkee, T., Brunner, R., Carli, V., Parzer, P., Wasserman, C., …Wasserman, D. (2014). Pathological internet use among European adolescents: Psychopathology and self-destructive behaviours. *European Child and Adolescent Psychiatry, 23*(1), 1093-1102. doi:10.1007/s00787-014-0562-7

Keating, D. P. (2012). Cognitive and brain development in adolescence. *Enfance, 3*, 267-279. http://dx.doi.org/10.4074/S0013754512003035

Koo, H. J., & Kwon, J. H. (2014). Risk and protective factors of internet addiction: A meta-analysis of empirical studies in Korea. *Yonsei Medical Journal, 55*(6), 1691-1711.

Laconi, S., Rodgers, R. F., & Chabrol, H. (2014). The measurement of internet addiction: A critical review of existing scales and their psychometric properties. *Computers in Human Behavior, 41*, 190-202.

Lai, C-H., & Gwung, H-L. (2013). The effect of gender and internet usage on physical and cyber interpersonal relationships. *Computers and Education, 69*, 303-309.

Li, X., Shi, M., Wang, Z., Shi, K., Yang, R., & Yang, C. (2010, August). Resilience as a predictor of internet addiction: The mediation effects of perceived class climate and alienation. In *Web Society (SWS), 2010 IEEE 2nd Symposium on* (pp. 66-70). IEEE. doi: 10.1109/SWS.2010.5607478

Louw, A.E., & Winter, M. (2011). The use and trends of information and communication technology (ICT) during middle childhood. *Journal of Child and Adolescent Mental Health, 23*(1), 29-42. doi: 10.2989/ 17280583.2011.594247

Louw, D., & Louw, A. (2007). *Child and adolescent development.* Bloemfontein, South Africa: Psychology Publications.

Luszczynska, A., Gutierrez-Dona, B., & Schwarzer, R. (2005). General self-efficacy in various domains of human functioning: Evidence from five countries. *International Journal of Psychology, 40*(2), 80-89.

Magee, R. M., Agosto, D. E., Forte, A., & Dickard, M. (2014). Examining teens' non-use of technologies. *Technology*, *15*, 289-292.

Masten, A.S., Burt, K.B., & Coatsworth, J.D. (2006). Competence and psychopathology in development. In D. Cicchetti & D. Cohen (Eds.), *Handbook of developmental psychopathology* (2nd Ed., Vol. 3) (pp. 696-738). New York, NY: Wiley.

Masten, A.S., & Obradovic, J. (2006). Competence and resilience in development. *Annals of the New York Academy of Science, 1094*, 13-27.

Mbinjama, A. (2013). Language and cultural ideologies on the internet: Social media use of adolescents in semi-rural South Africa. *Journal of Intercultural Disciplines, 11*, 58.

McNelles, L.R., & Connolly, J.A. (1999). Intimacy between adolescent friends: Age and gender differences in intimate affect and intimate behaviors. *Journal of Research on Adolescence, 9*, 143-159.

Meerkerk, G.J., Van den Eijnden, R.J., Vermulst, A.A., & Garretsen, H.F. (2009). The compulsive internet use scale (CIUS): some psychometric properties. *CyberPsychology & Behavior, 12*(1), 1-6.

Mills, K.L. (2014). Effects of internet use on the adolescent brain: Despite popular claims, experimental evidence remains scarce. *Trends in Cognitive Sciences, 18*(8), 385-387.

Moksnes, U. K., Moljord, I. E., Espnes, G. A., & Byrne, D. G. (2010). The association between stress and emotional states in adolescents: The role of gender and self-esteem. *Personality and Individual Differences, 49*(5), 430-435.

Moreno, M.A., Jelenchick, L.A., & Christakis, D.A. (2013). Problematic internet use among older adolescents: A conceptual framework. *Computers in Human Behavior, 29*, 1879-1887.

Moreno, M. A., Jelenchick, L., Koff, R., Eikoff, J., Diermyer, C., & Christakis, D. A. (2012). Internet use and multitasking among older adolescents: An experience sampling approach. *Computers in Human Behavior, 28*(4), 1097-1102.

Odendaal, W., Malcolm, C., Savahl, S., & September, R. (2006). Adolescents, their parents, and information and communication technologies: Exploring adolescents' perceptions on how these technologies present in parent-adolescent relationships. *Indo-Pacific Journal of Phenomenology, 6*(1),1-8.

O'Keeffe, G. S., & Clarke-Pearson, K. (2011). The impact of social media on children, adolescents, and families. *Pediatrics, 127*(4), 800-804.

Øverby, N. C., Klepp, K. I., & Bere, E. (2013). Changes in screen time activity in Norwegian children from 2001 to 2008: two cross sectional studies. *BMC Public Health, 13*(1), 80.

Oyedemi, T. (2015). Participation, citizenship and internet use among South African youths. *Telematics and Informatics, 32*(1), 11-22. http://dx.doi.org/10.1016/j.tele.2014.08.002

Page, A. S., Cooper, A. R., Griew, P., & Jago, R. (2010). Children's screen viewing is related to psychological difficulties irrespective of physical activity. *Pediatrics, 126*(5), e1011-e1017.

Park, A., Clery, E., Curtice, J., Phillips, M., & Utting, D. (Eds.). (2012). *British Social Attitudes*. London: Sage Publications.

Park, S.K., Kim, J.Y., & Cho, C.B. (2007). Prevalence of internet addiciton and correlations with family factors among South Korean adolescents. *Adolescence, 43*(172), 895-909.

Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching, 2*(3), 176-186.

Prince-Embury, S. (2006). *Resiliency scales for children and adolescents. A profile of personal strengths*. San Antonio, TX: Harcourt assessment.

Prince-Embury, S., & Saklofske, D.H. (Eds.). (2013). *Resilience in children, adolescents, and adults: Translating research into practice*. New York, NY: Springer.

Purcell, K., Rainie, L., Heaps, A., Buchanan, J., Friedrich, L., Jacklin, A., ... & Zickuhr, K. (2012). *How teens do research in the digital world*. Washington, DC: Pew Internet & American Life Project.

Raday, F. (2003). Culture, religion, and gender. *International Journal of Constitutional Law, 1*(4), 663-715.

Rutter, M., & Taylor, E. (2003). *Child and adolescent psychiatry (4th Ed.).* Malden, MA: Blackwell Science.

Savahl, S., September, R., Odendaal, W., & Moos, A. (2008). Information and communication technology: A descriptive study of children's communication patterns. *South African Journal of Psychology, 38*, 515-525.

Schofield-Clark, L. (2005). The constant contact generation: Exploring teen friendship networkds online. In S.R. Mazzarella (Ed.), *Girl wide web: Girls, the internet and the negotiation of identity* (pp. 203-221). New York, NY: Peter Lang.

Schouten, A.P., Valkenburg, P.M., & Peter, J. (2007). Precursors and underlying processes of adolescents' online self-disclosure: Developing and testing and "internet-attribute-perception" model. *Media Psychology, 10*, 292-314.

Schraml, K., Perski, A., Grossi, G., & Simonsson-Sarnecki, M. (2011). Stress symptoms among adolescents: The role of subjective psychosocial conditions, lifestyle, and self-esteem. *Journal of Adolescence, 34*(5), 987-996.

Shaffer, H. J., Peller, A. J., LaPlante, D. A., Nelson, S. E., & LaBrie, R. A. (2010). Toward a paradigm shift in internet gambling research: From opinion and self-report to actual behavior. *Addiction Research & Theory, 18*(3), 270-283.

Shank, D. B., & Cotten, S. R. (2014). Does technology empower urban youth? The relationship of technology use to self-efficacy. *Computers & Education*, *70*, 184-193. doi: 10.1016/j.compedu.2013.08.018

Shapiro, L. A. S., & Margolin, G. (2014). Growing up wired: Social networking sites and adolescent psychosocial development. *Clinical Child and Family Psychology Review*, *17*(1), 1-18.

Sigman, A. (2012). Time for view on screen time. *Archive of Disease in Childhood, 97*(11), 935-942.

Sroufe, L.A. (1996). *Emotional development: the organization of emotional life in the early years*. New York, NY: Cambridge University Press.

Suler, J. (2005). Adolescents in cyberspace: The good, the bad and the ugly. *Psychology in Cyberspace, 1*(5), 1-17.

Suoranta, J. (2003). The World Divided in Two: Digital Divide, Information and Communication Technologies, and the 'Youth Question.' *Journal for Critical Education Policy Studies, 1*(2), 1-31.

Telecommunication Development Sector (ITU-D), Secretariat of Telecommunication Development Bureau (BDT), United Nations (UN). (2014). *The world in 2014: ICT facts and figures*. Retrieved from http:///.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf

Tonioni, F., D'Alessandris, L., Lai, C., Martinelli, D., Corvino, S., Vasale, M., ... & Bria, P. (2012). Internet addiction: hours spent online, behaviors and psychological symptoms. *General Hospital Psychiatry*, *34*(1), 80-87.

Underwood, M.K., Rosen, L.H., More, D., Ehrenreich, S., & Gentsch, J.K. (2012). The BlackBerry Project: Capturing the content of adolescents' text messaging. *Developmental Psychology, 48*(2), 295-302. doi: 10.1037/a0025914

Valkenburg, P. M., & Peter, J. (2007). Online communication and adolescent well- being: Testing the stimulation versus the displacement hypothesis. *Journal of Computer- Mediated Communication, 12*(4), 1169-1182.

Valkenburg, P.M., & Peter, J. (2009). Social consequences of the internet for adolescents: A decade of research. *Current Directions in Psychological Science, 18*(1), 1-5.

Valkenburg, P. M., & Peter, J. (2011). Online communication among adolescents: An integrated model of its attraction, opportunities, and risks. *Journal of Adolescent Health, 48*(2), 121-127.

Valkenburg, P.M., Peter, J., & Schouten, A.P. (2006). Friend networking sites and their relationship to adolescents' well-being and social self-esteem. *Cyberpsychology and Behavior, 9*, 584-590.

Van der Merwe, P. (2013). South Africa's adolescents in a wired world. *International Journal of Criminology and Sociology, 2*, 348-361.

Van den Eijnden, R.J., Spijkerman, R., Vermulst, A. A., van Rooij, T. J., & Engels, R. C. (2010). Compulsive internet use among adolescents: bidirectional parent–child relationships. *Journal of Abnormal Child Psychology, 38*(1), 77-89.

Varner, F., & Mandara, J. (2013). Differential parenting of African American adolescents as an explanation for gender disparities in achievement. *Journal of Research on Adolescence, 24*(4), 667-680.

Wallace, P. (2014). Internet addiction disorder and youth. *EMBO Reports, 15*, 12-16. doi: 10.1002/embr.201338222

Weber, D. M., & Kauffman, R. J. (2011). What drives global ICT adoption? Analysis and research directions. *Electronic Commerce Research and Applications, 10*(6), 683-701.

Weinstein, A., Feder, L.C., Rosenberg, K.P., & Dannon, P. (2014). Internet addiction disorder: Overview and controversies. *Behavioral Addictions*, 99-117. http://dx.doi.org/10.1016/B978-0-12-407724-9.00005-7

White, R.W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66*, 297-333.

Yan, W., Li, Y., & Sui, N. (2014). The relationship between recent stressful life events, personality traits, perceived family functioning and internet addiction among college students. *Stress and Health*, *30*(1), 3-11.

Yao, M. Z., He, J., Ko, D. M., & Pang, K. (2014). The influence of personality, parental behaviors, and self-esteem on internet addiction: A study of Chinese college students. *Cyberpsychology, Behavior, and Social Networking*, *17*(2), 104-110.

Yu, L., & Shek, D. T. L. (2013). Internet addiction in Hong Kong adolescents: a three-year longitudinal study. *Journal of Pediatric and Adolescent Gynecology*, *26*(3), S10-S17.

Zheng, R., McAlack, M., Wilmes, B., Kohler-Evans, P., & Williamson, J. (2009). Effects of multimedia on cognitive load, self-efficacy, and multiple rule-based problem solving. *British Journal of Educational Technology, 40*(5), 790-803. doi: 10.1111/j.1467-8535.2008.00859.x

Zhou, Z., Zhu, H., Li, C., & Wang, J. (2014). Internet addictive individuals share impulsivity and executive dysfunction with alcohol-dependent patients. *Frontiers in Behavioral Neuroscience*, *8*, 288. doi: 10.3389/fnbeh.2014.00288

CHAPTER 4: ARTICLE 3

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THE USE OF INFORMATION AND COMMUNICATION

TECHNOLOGIES AND EMOTIONAL REGULATION IN

ADOLESCENCE

Abstract

Research on possible effects of the drastic increase in adolescent information and communication technology (ICT) use over recent years, mostly focus on potential adverse consequences. Few researchers highlight possible positive effects. This study examines the effect of the amount of ICT usage on adolescent emotional regulation, by studying its effect on the resilience-associated dimensions of emotional reactivity and affective strengths. Differences relating to gender and/or age are also mentioned. A random sample of 1000 adolescents (with varied demographic backgrounds) from ten high schools in South Africa's Free State Province, was used to obtain data in two waves (2 years apart). The mean ages of participants were 13.9 years (Wave 1 group) and 16.4 years (Wave 2 group). Data relating to age, gender and frequency of ICT use was gathered with a biographical questionnaire. The affective strengths subscale of the Behavioural and Emotional Rating Scale (BERS2) and the Emotional Reactivity subscale of the Resiliency Scales for Children and Adolescents (RCSA) were employed to obtain data pertaining to emotional regulation. 23% of the younger group and 16% of the older group reported excessive ICT use (exceeding six hours per day). The majority reported moderate ICT usage (0 to 6 hours per day). There were no significant gender differences between younger adolescent boys and girls with regards to both affective strength scores and emotional reactivity scores, but the older boys achieved significantly higher affective strength scores. The younger group's emotional reactivity were significantly affected by the amount of daily ICT use, with moderate users achieving better scores than excessive

users. The information on which this study is based, was obtained via self-reporting – a limitation that future studies can avoid by utilising objective ICT measuring questionnaires or electronic tracking of ICT use. Study results encourage care-givers to monitor ICT use in adolescents and to manage gradual exposure to ICTs for optimal skills development.

Introduction

In his 1985 book, *Amusing ourselves to death*, Neil Postman juxtaposes the futurist doctrines of Dystopian novelists Aldous Huxley and George Orwell. He points out that Orwell feared information deprivation, whilst Huxley's concern was an overload of information leading to passivity and egotism. Orwell envisaged a future where people would be controlled by pain, while Huxley felt that society would be controlled by an obsessive urge for pleasure. In today's ICT saturated society neither Huxley, nor Orwell, might have been right – a concern echoed by a plethora of published research (e.g., Judi, Ashaari, Zin, & Yusof, 2013; O'Keeffe & Clarke-Pearson, 2011).

The impact of growing up in a digital world has been actively studied in children and adolescents over the past twenty years (Strasburger et al., 2013). ICT currently pervades every aspect of adolescents' lives (Rideout, Foehr, & Roberts, 2010; Sigman, 2012) and most teenagers spend half of their waking hours engaging with ICT (Calvert & Wartella, 2014). Most adolescents have access to ICT and the internet and engage with ICT more regularly and for longer durations than in the past (Wallace, 2014). This global trend is also evident in South Africa, where more than two thirds of adolescents access the internet daily, mostly via mobile technology (Chuma, 2014; Louw & Winter, 2011; Van der Merwe, 2013). Only small variations in frequency of ICT use exist across rural-urban continuums, and among diverse socio-economic realities (Bosch, 2008; Mbinjama, 2013; Oyedemi, 2015).

Most research is concerned with possible dire consequences of ICT use on adolescents, ranging from physical health effects (Hardy, Denney-Wilson, Thrift, Okely, & Baur, 2010; Sigman, 2012), and mental health effects (Huang, 2010; Page, Cooper, Griew, & Jago, 2010), to potential negative fall-outs in academic (Tsitsika et al., 2011) and psychosocial functioning (Amichai-Hamburger & Hayat, 2011; Valkenburg & Peter, 2009).

There is, however, a minority discourse emanating from a small, but growing, volume of work, that focuses on positive developmental effects of adolescent ICT use (Chesley & Johnson, 2014). This has been especially evident in resiliency research (e.g., Burns, Durkin, & Nicholas, 2009; Li et al., 2010) with one focus-area of particular interest being adolescent emotional reactivity or regulation, and its interplay with ICT use (LaRose, Lin, & Eastin, 2003).

To understand researchers' interest in emotional regulation, one has to start with its important developmental role: Intense emotional reactivity and its dysregulation is associated with behavioural difficulties and predisposition to psychopathology (Friedman & Chase-Landsdale, 2003). Prince-Embury and Saklofske (2013, p.21) see emotional reactivity as the child's "arousability or the threshold of tolerance" prior to an activating event. Children's emotional reactivity varies greatly with regards to intensity, specificity, and recovery time (Siegel, 1999). The positive management of emotion, together with the redirection of emotional arousal is fundamentally important in building resilience (Cicchetti & Tucker, 1994; Eisenberg, Champion, & Ma, 2004), and

ultimately for effective adjustment of maturing adolescents in multiple contexts (Troy & Mauss, 2011).

The ability to vicariously give and receive affection is indicative of affective strengths and influence the adolescent's thinking and doing (Epstein, 2000). Emotional reactivity and its regulation is associated with said affective strengths (i.e., higher affective strengths is associated with reduced emotional reactivity) (Friedman & Chase-Landsdale, 2003). Skills used to negotiate ICT related communication include the teenager's affective response to ICT associated stimuli, as well as the management of elicited emotions (Johnson & Puplampu, 2008).

Adolescent brain development consists of two opposite processes: an emerging "bottom-up" system that exhibits amplified reaction to stimuli, and a later maturing "top-down" system associated with cognitive control regions (Casey & Jones, 2010). The former system is linked to sensation seeking and is gradually 'vetoed' by the latter (McRae et al., 2012). The imbalance and inherent tension between the two systems may lead to heightened emotional dysregulation and thus increased susceptibility for sensation seeking stimuli like ICT (Casey & Jones, 2010; Yuan et al., 2011).

The interplay between ICTs and adolescents can be explained via Bronfenbrenner's (2005) bio-ecological model, and Johnson and Puplampu's added (2008) techno-subsystem (see Figure 1).
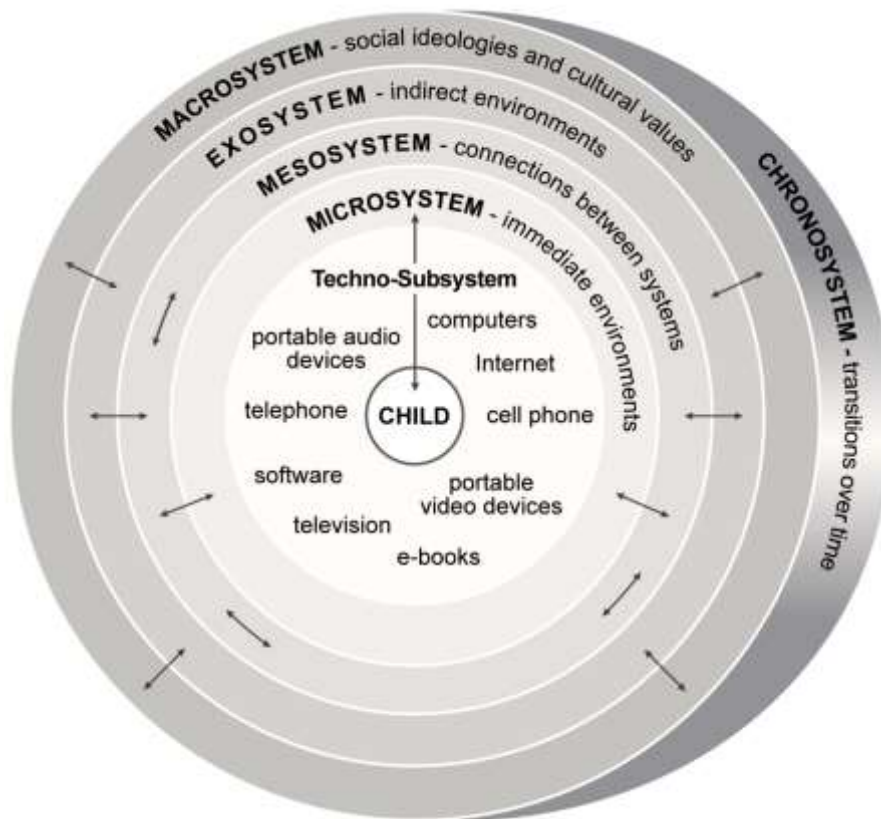
Figure 1. Bronfenbrenner's (2005) bio-ecological model with Johnson and

Puplampu's (2008) techno-subsystem dimension incorporated

The adolescent is situated within five interrelated systems, all of which interact

with the individual and each other (Darling, 2007). The microsystem explains

immediate interactions (e.g., teachers, friends, parents), and the mesosystem

interactions between immediate environments (e.g., peer-friends that meet

the adolescent's parents' approval, are more likely to be allowed to sleep over

and thus improve quality of that friendship) (Updegraff, McHale, Crouter, &

Kupanoff, 2001). The exosystem explains non-immediate environments and

its impact on the adolescent (e.g., a general strike of the teachers' union will

affect the adolescent's school functioning) (Bridges, 1992), while the

macrosystem refers to socio-cultural influences on the adolescent (e.g.,

culturally informed discourses on gender often direct gender-specific parenting practices towards girls and boys) (Mandara, Varner & Richman, 2010). The chronosystem explains changes over time in all of the above influences (e.g., the changes in the parent-child dyad as the child develops and mature) (Shearer, Crouter, & McHale, 2005). The chronosystem is especially important for this study, given the extensive changes over time associated with adolescent development. The techno-subsystem is an extension of the microsystem and explains the interaction between the adolescent and ICT, as well as interaction with the adolescent's microsystem mediated by ICT use (Johnson, 2010a). The influence of said interplay can reach across multiple systems (Johnson, 2010b). Bronfenbrenner's (2005) model and the added techno-subsystem explains the importance of ICTs on adolescent development, but clarification of the mechanism of influence is lacking (Johnson & Puplampu, 2008).

The threshold effect theory proposes a critical amount of hours of ICT use, after which negative effects begin to appear (Belanger, Akre, Berchtold, & Michaud, 2011). Consensus about the specific number of hours that can define such a threshold is yet to be reached, but empirical evidence is mounting in support of six or more hours of ICT use per day (Hawi, 2012; Weinstein, Feder, Rosenberg, & Dannon, 2014).

ICT engagement can affect adolescents positively by, for example, creating opportunities for expressing frustrations and for growing self-esteem (Shank & Cotton, 2014). It can encourage responsibility taking in communication,

because of the permanency of most ICT mediated discourses (Lewix, 2014). Electronic gaming can motivate emotional regulation by means of delayed action following intensely emotionally activating stimuli (Barlett, Vowels, Shanteau, Crow, & Miller, 2009; Gentile, 2011).

On the negative side, excessive ICT use has profound detrimental consequences for adolescents (Toa et al., 2010). The relationship between excessive ICT use and high emotional dysregulation in adolescence is bi-directional and complex (Koo & Kwon, 2014; Wallace, 2014). Younger adolescents are more vulnerable to excessive ICT use (Hawi, 2012), leading to low emotional regulation skills (Yu & Shek, 2013). Excessive ICT use can also affect mood negatively, impacting adversely on self-regulation and leading to even more ICT use and subsequent worsening of mood (LaRose et al., 2003). The more time an adolescent spends engaging with ICT, the more likely he or she is to develop excessive usage patterns – indicating a neurological priming of reward pathways (Durkee et al., 2012). ICT use activates dopamine release in the nucleus accumbens – an important reward pathway structure of the brain (often involved in addiction) (Cash, Rae, Steel, & Winkler, 2012). The associated receptors develop tolerance, resulting in a need for more ICT use to achieve increased stimulation or prevent withdrawal (Hong et al., 2013). The specific nature of ICT use functions on a variable ratio reinforcement schedule (VVRS) – a potent activator of the brain's reward pathways (Cash et al., 2012). It follows that adolescents with high reward dependence characteristics are often disproportionally represented in excessive ICT user groups, and that excessive users have negatively affected

response inhibition (Weinstein et al., 2014). Brain studies of adolescents that overuse ICTs, indicate undesirable structural and functional changes in regions involved in emotional processing, decision making, executive attention, and cognitive control (Lin et al., 2012). Excessive use might decrease over time during adolescence because (i) the novelty wears off, (ii) social and academic distractions increase, and (iii) emotional regulation and self-control improve with neurological maturation [1] (Yu & Shek, 2013). Effective parent-adolescent communication leads to moderate ICT use, and can even lower excessive ICT use patterns over time, but the reality is that, in excessive ICT use situations, parents usually 'give up' and overuse increases (Van den Eijnden, Spijkerman, Vermulst, van Rooij, & Engels, 2010). Stricter rule setting unaccompanied by a nurturing parent-adolescent relationship does not prevent excessive ICT use (Van den Eijnden et al., 2010). Resilience enhancement is associated with moderate ICT use (Li et al., 2010).

South African studies on ICT use and adolescent development are scarce (Savahl, September, Odendaal, & Moos, 2008), and either have small datasets with qualitative methodologies (e.g., Bosch, 2008; Chuma, 2014; Louw & Winter, 2011; Odendaal, Malcolm, Savahl, & September, 2006), or investigate a topic unrelated to adolescent ICT use and resilience (e.g., Gudmundsddottir, 2010; Mbinjama, 2013; Van der Merwe, 2013).

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[1] Brenhouse and Anderson (2011) lucidly describes the neurological developmental trajectories experienced by adolescent boys and girls during brain maturation towards adulthood. The maturing adolescent brain experience functional development of (i) affective circuits, of (ii) reward circuits, of (iii) cognition, and of (iv) response inhibition – all of which are less developed in younger adolescents compared to older adolescents (Brenhouse & Anderson, 2011)

Gender differences in ICT usage have declined (Cotton, Anderson & Tufekci, 2009; Volman, Van Eck, Heemskerk, & Kuiper, 2005), most probably mirroring a greater societal shift in gender roles and identities (Isaacs, 2002). The distinctions that remain (Drabowicz, 2014) indicate that female ICT use is often associated with information seeking and communication (Chen & Tzeng, 2010), while male use focusses on entertainment (Lai & Gwung, 2013). ICT use decreases with age in both genders (Yu & Shek, 2013), with girls generally spending less time using ICTs than boys (Harris, Straker, & Pollock, 2013). Boys are more susceptible to excessive ICT use, possibly because girls are supervised more protectively (Yu & Shek, 2013).

Purpose of the study

Few quantitative studies investigate the effect of different levels of ICT use on the adolescent resilience-associated dimensions of affective strengths and emotional reactivity (Yu and Shek's, 2013, article being a note-worthy exception). Quantitative studies on gender differences in adolescent ICT use and emotional reactivity and affective strengths are equally scarce – and completely absent for the South African context. This study will contribute to the local knowledge, while also adding to international topical research. It will do so by posing the following research question: "How do adolescent girls and boys, with different self-reported hours of ICT use, differ regarding emotional regulation?"

The null hypothesis (H_0) states that there is no significant statistical difference in adolescent emotional reactivity and affective strengths, as well as no gender nor age difference between the younger and older cohort, notwithstanding the amount of hours they engage with ICT.

Research methods

Participants and procedures

This project (investigating risk and resilience in a group of adolescents over a period of three years) was conducted by a team of researchers from the Department of Psychology at Free State University in South Africa, and employed a cohort group design for data gathering. Data was gathered in two waves (in 2010, first year in high school; and in 2012, third year in high school) from a random, stratified sample (across diverse socio-economic, and rural/urban assemblages) of 1000 adolescents. The adolescents were from the same ten schools in Free State Province, South Africa. The mean age for the 2010 cohort is 13.9 years [Wave 1] ($n = 817$; 337 girls and 480 boys), and 16.4 years for the 2012 cohort [Wave 2] ($n = 994$; 418 girls and 578 boys). Wave 2's larger total number of subjects, as well as the older than expected mean age, compared to that of Wave 1, can be contributed to the inclusion of learners that failed their grades in the previous two years.

Standardised (back translated) psychometric tests were used for both waves. These tests were available as booklets in all three official languages of the

province. The psychometric tests were distributed to and completed by designated groups of adolescents at their respective schools. They were supervised by registered psychologists and fieldworkers.

Measuring instruments

The following measuring instruments were used:

Biographical questionnaire. Closed-ended questions were used to congregate information about the adolescents' gender and age. Number of hours ICT use per day was determined by one question of the biographical questionnaire.

Behavioral and Emotional Rating Scale (BERS2) (Epstein, 2000). The interpersonal, intrapersonal and affective strengths, as well as the family involvement and school functioning of eleven to eighteen year old adolescents are evaluated by this 57-item scale. The Adolescent Risk and Resilience Project only made use of the first 52 self-reported behavioural and emotional strength items of the BERS2 (with five demographic questions omitted in favour of the the more locally relevant Biographical Questionnaire designed by the research team). These items have been shown across several studies to have high internal consistency (alpha coefficients ranging from the South African samples' 0.66 (De Villiers, 2009) to the American studies' 0.77 (Epstein & Sharma, 1998). This study incorporated the Affective Strengths subscale (7 items) of the BERS2 (Epstein, 2000). The higher the scores on

this subscale, the better the adolescent's ability to give or receive affect (Epstein & Sharma, 1998; Masten & Obradovic, 2006; Prince-Embury & Saklofske, 2013).

Resiliency Scales for Children and Adolescents (RCSA) (Prince-Embury, 2006). These scales (including the subscales for sense of relatedness, sense of mastery, and emotional reactivity) were used to measure participants' resilience. All three subscales have shown good alpha coefficients in previous research (0.89 to 0.91) (Prince-Embury & Saklofske, 2013) including South African contexts (0.90 to 0.93) (De Villiers, 2009). The *Emotional Reactivity* subscale (a 20-item questionnaire) examines the three theoretically linked constructs of *sensitivity* (i.e., both the adolescent's threshold for emotional reaction and the intensity with which he or she reacts), *recovery* (i.e., the time-duration necessary to recover from emotional upset) and *impairment* (i.e., the adolescent's experience of how much said emotional reaction affected his or her functioning) (Prince-Embury & Saklofske, 2013). The higher the emotional reactivity scores, the greater the vulnerability in this developmental area for the adolescent.

Ethical considerations

The Research Committee of Faculty of Humanities (Free State University) approved this study. Both the Department of Education and the principals of the target schools gave permission for research to be conducted at their schools. Prior to inclusion in the study, the participating adolescents' parents

gave informed consent, whilst the learners themselves gave assent. All information was obtained anonymously (thus ensuring adherence to strict standards of confidentiality), and field workers discussed the process with participants post-administration of questionnaires to address any possible emotional fall-outs associated with the process, and, if indicated, individual referrals for professional counselling were made. A brochure (that included effective emotional and behavioural strategies, as well as contact details of support and referral resources) were also provided to all the participating adolescents.

Data analysis

The frequency distribution for ICT use was collated from the number of hours of ICT use reported by participants. This ICT use frequency distribution was organised into four ICT use groups ranging from no use (Group1 – no hours of use per day), to moderate use (Group 2 – more than 0 to 3 hours of use per day, and Group 3 – more than 3 to 6 hours of use per day), to excessive use (Group 4 – more than 6 hours of use per day). All data were tested for assumptions of multivariate normality, multi-collinearity, and evidence of non-linear relationships, after which the data were analysed to determine significance of differences in the resilience and strengths scores of adolescents with different levels of ICT use. A normal distribution of data was confirmed by the Kolmogorov-Smirnov and Shapiro-Wilks tests, and no evidence was found of non-linear relationships, nor of any significant multi-collinearity. This confirmation of the normal distribution of data was followed

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by analysis of the relationship between the different study variables using a two-way multivariate analysis of variance for both the younger cohort (Wave 1) and the older cohort (Wave2) in order to determine the effects of number of hours of ICT use per day, as well as gender, on the participants' affective strengths and emotional reactivity. Wilk's lambda multivariate statistics were used to identify which of the ICT usage (in hours per day) groups differed significantly (Anderson, 2003).

Results

All participants (in both Wave 1 and Wave 2) were grouped into four groups, based on their reported frequency of daily ICT use: Group 1 reported no ICT use, Groups 2 and 3 moderate ICT use, and Group 4 excessive ICT use.

Table 1
Four combined groups of ICT use

Different groups of ICT use	ICT use Hours per day	WAVE 1						WAVE 2					
		Total group		Girls		Boys		Total group		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%	N	%
Group 1	0 hours	146	20,74%	99	24,03%	47	16,10%	2	0,23%	1	0,20%	1	0,27%
Group 2	More than 0 to 3 hours	270	38,35%	151	36,65%	119	40,75%	443	51,04%	256	51,30%	187	50,68%
Group 3	More than 3 to 6 hours	124	17,61%	65	15,78%	59	20,21%	285	32,83%	161	32,26%	124	33,60%
Group 4	More than 6 hours	164	23,30%	97	23,54%	67	22,95%	138	15,90%	81	16,23%	57	15,45%

There was a substantial drop in the number of adolescents who indicated no ICT use from Wave 1 to Wave 2, with only 2 adolescents in the older cohort reporting no use. This very small number of participants in Group 1 of Wave 2 (which is less than the four variables of this study) made the use of a MANOVA on the no ICT use group of the older cohort unfeasible. The number of adolescents reporting excessive ICT use declined from 23.3% in Wave 1 to 15.9% in Wave 2, indicating that as adolescents mature the prevalence of excessive ICT use decreases.

Table 2

Descriptive statistics for the affective strengths and emotional reactivity scales of the different groups

ICT use Hours per day		WAVE 1						WAVE 2					
		Total group		Girls		Boys		Total group		Girls		Boys	
		Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev
Group 1	Affective strengths	15,57	3,95	15,5	4,13	15,7	3,56						
0 hours	Emotional reactivity	31,39	15,02	30,34	14,96	33,6	15,07						
Group 2	Affective strengths	15,83	3,62	16,22	3,51	15,33	3,7	11,53	2,96	11,22	2,91	11,95	2,99
More than 0 to 3 hours	Emotional reactivity	29,85	14,93	28,58	14,16	31,45	15,77	30,66	14,76	32,35	14,83	28,38	14,39
Group 3	Affective strengths	16,11	4	16,02	4,15	16,21	3,85	11,78	2,94	11,47	2,76	12,17	3,11
More than 3 to 6 hours	Emotional reactivity	33,23	14,64	32,95	13,82	33,54	15,61	29,92	14,43	30,09	14,51	29,71	14,37
Group 4	Affective strengths	15,22	3,89	15,4	3,76	14,95	4,09	11,51	2,81	11,17	2,9	12,02	2,6
More than 6 hours	Emotional reactivity	36,41	16,07	34,79	14,66	38,79	17,79	32,07	16,49	31,6	16,8	32,75	16,15

Note. There were only 2 respondents in Wave 2 cohort who indicated 0 hours of ICT use per day. This was deemed too few respondents for further statistical analysis of that usage group's results.

For Wave 1 the mean scores for affective strengths reflect little variation among the no use, moderate use and excessive ICT use groups. On the other hand, the mean scores for emotional reactivity display greater variance for the different ICT use groups with scores ranging from 29.85 to 36.41. The highest emotional reactivity scores belong to the high ICT use groups. It is important to note that high emotional reactivity scores are indicative of lower emotional regulation. In Wave 1 boys consistently reported higher levels of emotional reactivity than girls. In older adolescents (Wave 2) little variance is recorded in affective strengths and emotional reactivity scores across the different ICT use groups. Contrary to the findings of Wave 1, the older adolescent girls reported higher levels of emotional reactivity than their male counterparts, with the exception of boys who reported more than 6 hours of ICT use per day.

Table 3

Effect of gender and number of hours of ICT use per day on emotional reactivity and affective strengths (multivariate test scores)

Effect	Wave	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
ICT hours per day	Wave 1	0.966	3.857	6.000	1342.000	**0.001***	0.017
	Wave 2	0.997	0.705	4.000	1610.000	0.589	0.002
Gender	Wave 1	0.993	2.277	2.000	671.000	0.103	0.007
	Wave 2	0.987	5,320	2.000	805.000	**0.005***	0.013
ICT hours per day x Gender	Wave 1	0.995	0.571	6.000	1342.000	0.754	0.003
	Wave 2	0.996	0.796	4.000	1610.000	0.528	0.002

* 5% $p \leq .05$.

As can be seen in Table 3, there was (for Wave 1) a significant difference on the combined dependent variable (i.e., emotional reactivity and affective strengths) between adolescents who spend different numbers of hours per day on ICT (F=3.857; p=0.001). There was, however, no statistical significant difference between girls and boys in so far as their combined emotional reactivity and affective strengths scores are concerned, nor was there any significant interaction effect between the number of hours spend on ICT and gender. In order to determine which of emotional reactivity and/or affective strengths variables differed between the different ICT use groups, further analysis was done.

In Wave 1 (see Table 4) adolescents who spend dissimilar numbers of hours per day on ICT differed only in terms of their emotional reactivity (F=6.811; p=0.000), with a significant difference in the emotional reactivity scores of adolescents who spend more than 0 hours per day to 3 hours per day on ICT, and those of adolescents who spend more than 6 hours per day on ICT (see Table 5). As can be seen in Table 2, the group that reported the lowest emotional reactivity was the group with moderate ICT use (more than 0 hours to 3 hours per day), followed by the group that reported no ICT use. The group that spends more than 3 hours to 6 hours per day reported the second highest emotional reactivity scores, with the more than 6 hours per day ICT group performing the highest on reported emotional reactivity scores.

Table 4

Between-subjects effects

Source	Dependent Variable	Wave	df	Mean Square	F	Sig.	Partial Eta Squared
ICT hours per day	Affective strengths	Wave 1	3	19.489	1.338	0.261	0.006
		Wave 2	2	3.634	0.429	0.651	0.001
	Emotional reactivity	Wave 1	3	1551.409	6.811	**0.000****	0.030
		Wave 2	2	203.088	0.961	0.383	0.002
Gender	Affective strengths	Wave 1	1	6.530	0.448	0.503	0.001
		Wave 2	1	85.303	10.070	**0.002***	0.012
	Emotional reactivity	Wave 1	1	1006.668	4.419	0.036	0.007
		Wave 2	1	98.356	0.465	0.495	0.001

* 5% $p \leq .05$. ** 1% $p \leq .01$

Table 5

Wilk's lambda statistics indicating specific group differences in emotional reactivity (Wave 1)

	ICT hours per day		Mean Difference	Std Error	Sig.
Emotional reactivity	0 hours	more than 0 to 3 hours	2.2009	1.58815	.509
		more than 3 to 6 hours	-1.3656	1.89124	.888
		more than 6 hours	-4.4783	1.75933	.054
	more than 0 to 3 hours	0 hours	-2.2009	1.58815	.509
		more than 3 to 6 hours	-3.5665	1.66545	.141
		more than 6 hours	-6.6792	1.51399	**.000****
	more than 3 to 6 hours	0 hours	1.3656	1.89124	.888
		more than 0 to 3 hours	3.5665	1.66545	.141
		more than 6 hours	-3.1127	1.82941	.324
	more than 6 hours	0 hours	4.4783	1.75933	.054
		more than 0 to 3 hours	6.6792	1.51399	**.000****
		more than 3 to 6 hours	3.1127	1.82941	.324

** 1% $p \leq .01$.

Analysis of Wave 2 data (see Table 3) shows a significant difference in the combined dependent variable (emotional reactivity and affective strengths) between adolescent girls and boys (F=5.320; p=0.005). No statistically meaningful difference was found in the combined dependent variable (emotional reactivity and affective strengths) and number of hours of ICT use, nor was there any significant interaction effect between number of hours of ICT use and gender. To determine exactly which of the emotional reactivity and/or affective strengths variables differed between the males and females, further analysis was needed. Table 4 shows that Wave 2 adolescent girls and

boys differed significantly only in terms of their affective strengths (F=10.070; p=0.002), with the girls reporting lower affective strengths than the boys (see Table 6).

Table 6

Gender differences in affective strengths (Wave 2)

	Gender			
	Male		Female	
	Mean	Standard Deviation	Mean	Standard Deviation
Affective strengths	12.10	2.97	11.26	2.88

Discussion

This study's results echo other recent published work with regards to prevalence rates for moderate ICT use (e.g., Kaess et al., 2014), with the majority of adolescents from both Wave 1 (56%) and Wave 2 (84%) reporting moderate daily ICT use. The increase in the percentage of moderate users between Waves 1 and 2 is accompanied by a decrease in the excessive ICT users (from 23.3% in Group 4 of the younger cohort to 15.9% in Group 4 of the older cohort). The younger adolescents' excessive use percentage is considerably higher than prevalence rates for excessive use mentioned in American and European studies (5% to 10%) (Park, Kim, & Cho, 2007), and slightly lower than Yu and Shek's (2013) Hong Kong study's prevalence rates of around 27%. The older cohort's excessive usage rate is on par with South

Korean and Taiwanese excessive usage percentages (15% to 20%) (Weinstein et al., 2014).

The decrease in excessive users between Wave 1 and Wave 2 corroborates the results of previous research, namely that younger adolescents are more susceptible to excessive ICT engagement (Durkee et al., 2012; Hawi, 2012), and that, with normal neurological maturing over time, the vulnerability factor decreases (Ernst & Korelitz, 2009), as their overall behavioural and emotional control abilities improve (Ernst, Pine, & Hardin, 2006). It follows, that older adolescents will use ICTs more moderately than younger adolescents, as they self-regulate better (Hare et al., 2008). The novelty factor that ICTs hold for younger adolescents, serves as another strong motivator of ICT usage. As adolescents mature, the novelty factor wears off, leading to less ICT use (Yu & Shek, 2013). Lastly, older adolescents are often more distracted by real-time developmental requirements, like social interaction with peers and large academic work volumes, which younger adolescents do not yet have to deal with (Yu & Shek, 2013).

The greatest difference between the two cohorts' measurements was in Group 1, where 20% of participants in the younger cohort displayed no ICT use, while only 2 adolescents (0.23%) in the older cohort reported no ICT use. This might be due to parenting effects, with younger adolescents' ICT use often being closely monitored and externally controlled by their parents, whilst older adolescents are afforded more autonomy and decision-making (Rosen, Cheever, & Carrier, 2008).

The number of girls and boys for each of the moderate ICT use groups, as well as the excessive use group, were almost equal in both waves. Only the younger cohort's no-use group size differed significantly between the two genders, with 24% of girls, but only 16% of the boys, indicating no ICT use. The similarity in the number of hours of ICT use for younger adolescent girls and boys is unexpected, and contrary to other studies that, although ICT use of both genders is often higher in younger adolescent groups than older adolescent groups (Yu & Shek, 2013), younger boys spend consistently more time on ICTs than the younger girls (Choi et al., 2009; Harris et al., 2013). Wave 2's boys and girls do not differ with regards to amount of ICT usage. This is in accordance with recent research trends that highlight a tendency over the past 10 years where gender differences have become less pronounced (Cotton, Anderson, & Tufekci, 2009; Jackson et al., 2008). The gender difference in Group 1 of Wave 1 might be indicative of societal bias with regards to how parents often monitor young adolescent daughters more closely and allow them less autonomy than young adolescent boys (Varner & Mandara, 2013).

The adolescents in both waves of this study reported lower levels of emotional reactivity across the different gender groups and levels of ICT use than the normative, American sample of Prince-Embury (2006), indicating lower reactivity and thus better control, i.e., better emotional regulation in the local sample. No comparison could be made between this study's strength scores

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and Epstein's (2000) American sample, because only normative scores were available for the American sample.

For Wave 1, significant differences were found in the emotional reactivity scores of the different ICT use groups. Group 2 (more than 0 to 3 hours of ICT use per day) differed significantly from group 4 (more than 6 hours of ICT use per day). The excessive ICT use group reported the highest emotional reactivity scores, reflecting the lowest level of emotional regulation. The threshold effect theory postulates that there is a limit in the amount of ICT use an individual can absorb, overwhich negative effects will be experienced (Belanger et al., 2011). These results (in the younger group) are supportive of the notions put forth by the threshold limit theory for ICT, and underline other empirical work that found younger adolescents to be particularly susceptible to changes in emotional reactivity when engaging in ICT use (Hawi, 2012). This young adolescent group of moderate users (more than 0 to 3 hours) had the best emotional reactivity scores (of Wave 1 groups). Studies have shown that moderate use can enhance emotional regulation for adolescents (Ghassemzadeh, Shahraray, & Moradi, 2008; Li et al., 2010) – this seems to be the case for Group 2 of Wave 1. The relationship between moderate use and emotional regulation that is gleaned from empirical work, seems to be bi-directional and complex in nature (Wallace, 2014). A possible explanation for the higher emotional reactivity scores (i.e., lower emotional regulation) in the no ICT use group (Wave 1) can be that over-controlling or anxious parents who severely limit or prevent ICT usage, catalyse frustration within the adolescent, that in turn leads to conflict and hostility (Van den Eijnden et al.,

2010; Yao, He, Ko, & Pang, 2014), which again negatively affects emotional reactivity (Friedman & Chase-Lansdale, 2003).

The two higher usage groups (Group 3 and 4) had the highest emotional reactivity scores – with a progressive worsening of emotional regulation as hours ICT use increase. This result indicates a gradual worsening of emotional reactivity with an increase in hours ICT use, and makes sense when the threshold effect theory is considered - the further you progress past the threshold limit, the greater the effect - and echoes results from other published studies (e.g., Durkee et al., 2012; Toa et al., 2010). Recent studies in the neuroscience of adolescent development also describe a normal maturation process and a bettering of the brain mechanisms responsible for emotional and behavioural control over time, as the adolescent progresses from early to late adolescence (Ernst et al., 2006). Younger adolescents, with already less mature emotional regulatory brain systems, are thus more vulnerable to ICT over-engagement and when they do excessively use ICTs, they are more vulnerable to experience the effects of overuse (Crews, He, & Hodge, 2007).

No gender differences and interactive effects were found for Wave 1. This is in line with the current zeitgeist in Neuroscience, where gender specific differences of underlying brain changes that regulate emotion and behavioural control during adolescence are seen as small, albeit complex (Brenhouse & Andersen, 2011). Most studies have shown emotional regulation to be varied and gender independent (Siegel, 1999).

For the older participants (Wave 2) the different ICT use groups did not differ significantly with regards to emotional reactivity and affective strength scores. This underline the results of other international empirical work, suggesting that older adolescents have more optimal emotional regulation and self-control because of normal neurological maturation (i.e., they are just better able to manage ICT use because of more mature neuro-mechanisms to control emotion and behaviour (Casey, Jones, & Hare, 2008; Yu & Shek, 2013).

Significant gender differences have been found in the affective strengths for the older adolescents, with the male participants displaying higher levels of affective strengths. Recent studies highlight the heightened stress experienced by especially older adolescent girls, and the higher levels of self-esteem experienced by older adolescent boys in relation to their female counterparts (Moksnes, Moljord, Espnes, & Byrne, 2010; Schraml, Perski, Grossi, & Simonsson-Sarnecki, 2011). Heightened stress negatively effects the ability to give and receive affection, thus influencing the affective strengths of especially older adolescent girls (Friedman & Chase-Lansdale, 2003). It should also be noted that older adolescent girls are more vulnerable to develop depression and anxiety symptoms than older adolescent boys, and that the affective strength results can point towards the presence of possible primary mood disorders in some of the older female participants (Joinson, Heron, Lewis, Croudance, & Araya, 2011; Naninck, Lucassen, & Bakker, 2011).

Lastly, the discussion of the results of both waves shows that the null hypothesis is partially rejected for this study. For Wave 1 the null hypothesis is rejected vis-à-vis frequency of ICT use and emotional reactivity, whilst for Wave 2 the null hypothesis is rejected for the affective strengths of boys and girls.

Conclusion

Adolescent ICT use has increased exponentially during the last decade. Bronfenbrenner's (2005) model contextualises the important interplay between environmental systems and the developing adolescent, and together with Johnson and Puplampu's (2008) postulated techno-subsystem, it describes the potential effect of ICT use on healthy adolescent development. This article explored the possible influence of ICT use on adolescent development by investigating the effect of different levels of ICT use on the adolescent resilience-related dimensions of affective strengths and emotional reactivity, while also taking into account possible gender differences and changes with age.

The prevalence of excessive ICT use was 23% among Wave 1 adolescents and 16% for Wave 2. This is on par with other prevalence rates noted in research from other developing countries (e.g., Weinstein et al., 2014 and Yu & Shek, 2013), but higher than excessive use prevalence rates recorded for American and European samples (Park et al., 2007). The younger adolescent boys and girls (Wave 1) did not significantly differ in the amount of hours of

ICT use, which was somewhat unexpected, as international research has shown younger adolescent boys to have higher ICT usage than the girls (Harris et al., 2013), despite other published data showing gender differences for adolescent ICT use are becoming less prominent (Banerjee, Kang, Bagchi-Sen, & Rao, 2005; Cotton et al., 2009).

The amount of hours of ICT use significantly affected the emotional reactivity scores of the Wave 1 subjects. Group 2 (who use ICTs more than 0 hours up to 3 hours a day) had the best emotional reactivity scores.   This result indicates a progressive increase in emotional reactivity with a rise in the amount of ICT use, supporting the threshold effect theory.   The fact that adolescents with no ICT use had higher emotional reactivity scores (i.e., lower emotional regulation) than moderate users, is best explained by the possible effects of specific over-controlling or anxious parenting dynamics, or alternatively the convergence of adversity related to socio-economic pressures and deprivation.

The null hypothesis pertaining to gender differences was accepted for Wave 1 as there were no differences found between the younger group of adolescent boys and girls. The null hypothesis for differences in adolescent emotional reactivity and affective strengths and amount of hours of ICT use was rejected in full, as there were significant differences in emotional reactivity, based on the amount of hours of use in Wave 1.

In Wave 2 the older adolescent girls' affective strengths measured lower than that of the older adolescent boys. This result is associated with gender specific experiences of heightened stress by older adolescent girls, and an increased vulnerability for developing mood and anxiety disorders (Cyranowski, Frank, Young, & Shear, 2000; Moksnes et al., 2010).

The older adolescent boys and girls did not statistically differ in their amount of ICT use, and neither did the amount of ICT usage significantly effect emotional regulation. These results are supported by other empirical research studies that found gender differences to have become less pronounced over the past decade (Jackson et al., 2008). The non-significant effect of amount of ICT use is in line with theoretical and empirical work associated with emotional and neurological maturing towards older adolescence, that provide the adolescent with better emotional regulation and self-control (Ernst et al., 2006).

The null hypothesis pertaining to gender differences in Wave 2 was partially accepted, as there were gender differences in affective strengths between older adolescent girls and boys, but no gender differences relating to hours of ICT use. Finally, the null hypothesis relating to the effect that amount of ICT use will have on emotional reactivity and affective strengths, was accepted in full for Wave 2, as amount of hours of ICT use had no significant effect on the older group of adolescents.

Lastly, the bettering of emotional reactivity scores from Wave 1 to Wave 2 underline a normal neurological maturation from young adolescence to late adolescence into early adulthood (Hare et al., 2008).

The results of this study reinforce the idea that moderate use can be beneficial to adolescent development, specifically as it pertains to emotional reactivity and affective strengths. An important deduction to be made is that young adolescents (because of their still immature and developing emotional and behavioural regulatory neuro-systems), are more susceptible to excessive ICT engagement and the adverse effects thereof than older adolescents. Monitoring of young adolescents' ICT use (especially the amount of hours of use) is therefore important.

Lastly, Bronfenbrenner's (2005) bio-ecological model explains the different influences that affect an adolescent's life – some directly, others indirectly (Johnson, 2010a, 2010b). The clear effect of ICT use on emotional reactivity, and the decrease in emotional regulation with increased ICT usage in younger adolescents, support both the theoretical contextual dimensions of Bronfenbrenner's (2005) model and Johnson and Puplampu's (2008) techno-subsystem. It also contributes empirically to the threshold effect hypothesis.

Limitations and recommendations

The methodology made use of self-reported data, which is generally problematic (Shaffer, Peller, Laplante, Nelson, & LaBrie, 2010), but especially

so in ICT-related research where the amount of ICT use has been shown to be sometimes over- and/or under-reported (Moreno, Jelenchick, Cox, Young, & Christakis, 2011). This can be rectified in future research by utilising electronic monitoring of actual ICT use (e.g., Underwood, Rosen, More, Ehrenreich, & Gentsch, 2012), by employing objective psychometric questionnaires measuring ICT use (Laconi, Rodgers, & Chabrol, 2014), and by corroborating information received from multiple sources (e.g., parents, teachers, peers, and participants).

This research project involved a purely quantitative study focusing on the effect of amount of ICT use on adolescent emotional reactivity and affective strengths. In order for follow-up studies to further investigate the particular nature of the differences between the different variables, a mixed method study is recommended (e.g., Magee, Agosto, Forte, & Dickard, 2014). The specific meaning adolescents attach to ICTs (e.g., mobile phones are associated with greater autonomy, Bosch, 2008), or the detail of the social media practices of the adolescents (e.g., Purcell et al., 2012), as well as more in-depth qualitative questions that explore the excessive usage group's reasons for engaging with ICTs (e.g., Wan & Chiou, 2006) are all possibilities for future studies with qualitative components.

Future research that looks at the directionality of influence between adolescent ICT use and suboptimal emotional regulation is also proposed. Is it, for instance, 'bad' emotional regulation that lead to excessive ICT use, or does excessive ICT use worsen emotional regulation? Other studies have

started to investigate the possible bi-directional relationship between adolescent ICT use and emotional regulation, but more empirical work on this (especially in a South African context) is needed.

This study employed a cohort design with data-gathering points 2 years apart. A different longitudinal research design with more regular data-gathering points, for example every six months, would have provided invaluable additional information with regards to any changes over time.

The fast rate of change in ICT and its usage, might create a scenario where, because of the time-lapse between the data gathered in Wave 1 and the data gathered in Wave 2, the information analysed from the first cohort might become rapidly aged and thus less relevant and limited in its application. A possible recommendation in this regards is to limit the scope of ICT usage investigated to one or two social media platforms (e.g., Twitter or Facebook) from which real-time data can be congregated over time.

Results from this study suggest that gradual and supervised exposure to ICTs should be encouraged by adolescent caregivers. Preventing adolescents from using ICTs might be counterproductive in terms of their emotional regulatory maturation, with moderate usage delivering the most optimal developmental benefits.

Value of current study

The results from this study add to the body of empirical work on ICT use and its effect on adolescent development, specifically as it pertains to emotional reactivity and affective strengths.

The meticulous research methodology (including the criterion group design with its two separate waves of data gathering from a large sample) used for this empirical study, delivers clear and significant results. The study, furthermore, is the first large quantitative study of adolescent ICT use and emotional regulation ever done in South Africa, and thus contribute fundamentally to this topic, not only within a South African context, but also internationally.

Lastly, the unique value of this study is found in the empirical underpinning of a realisation that is rooted in the results, namely that if children are gradually exposed to ICTs, and if ICT use is monitored and mentored, they will learn how to manage it for optimal development.

References

Amichai-Hamburger, Y., & Hayat, Z. (2011). The impact of the internet on the social lives of users: A representative sample from 13 countries. *Computers in Human Behavior, 27*(1), 585-589.

Anderson, T.W. (2003). *An introduction to multivariate statistical analysis.* New York, NY: Wiley.

Banerjee, S., Kang, H., Bagchi-Sen, S., & Rao, H.R. (2005). Gender divide in the use of the internet applications. *International Journal of E-Business Research, 1*(2), 24-39.

Barlett, C. P., Vowels, C. L., Shanteau, J., Crow, J., & Miller, T. (2009). The effect of violent and non-violent computer games on cognitive performance. *Computers in Human Behavior, 25*(1), 96-102. doi:10.1016/ j.chb.2008.07.008

Belanger, R.E., Akre, C., Berchtold, A., & Michaud, P.A. (2011). A u-shaped association between intensity of internet use and adolescent health. *Pediatrics, 127*(2), e330-e335.

Bosch, T.E. (2008). WOTS ur ASLR? Adolescent girls' use of cellphones in Cape Town. *Commonwealth Youth and Development, 6*(2), 52-69.

Brenhouse, H. C., & Andersen, S. L. (2011). Developmental trajectories during adolescence in males and females: a cross-species understanding of underlying brain changes. *Neuroscience and Biobehavioral Reviews*, *35*(8), 1687-1703.

Bridges, E.M. (1992). *The incompetent teacher.* Oxford, UK: Routledge.

Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives of human development*. Thousand Oaks, CA: Sage.

Burns, J. M., Durkin, L. A., & Nicholas, J. (2009). Mental health of young people in the United States: what role can the internet play in reducing stigma and promoting help seeking? *Journal of Adolescent Health*, *45*(1), 95-97. doi: 10.1016/j.jadohealth.2008.12.006

Calvert, S. L., & Wartella, E. A. (2014). Children and electronic media. In E.T. Gershoff, R.S. Mistry, & D.A. Crosby (Eds.), *Societal contexts of child development: Pathways of influence and implications for practice and policy* (pp. 175-187). New York, NY: Oxford University Press.

Casey, B. J., & Jones, R. M. (2010). Neurobiology of the adolescent brain and behavior: implications for substance use disorders. *Journal of the American Academy of Child & Adolescent Psychiatry, 49*(12), 1189-1201.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*(1), 111-126.

Cash, H., Rae, C. D., Steel, A. H., & Winkler, A. (2012). Internet addiction: A brief summary of research and practice. *Current Psychiatry Reviews*, *8*(4), 292-298. doi: 10.2174/157340012803520513

Chen, S.Y., & Tzeng, J.Y. (2010). College female and male heavy internet users' profiles of practices and their academic grades and psychosocial adjustment. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 257-262.

Chesley, N., & Johnson, B. E. (2014). Information and communication technology use and social connectedness over the life course. *Sociology Compass, 8*(6), 589-602.

Choi, K., Son, H., Park, M., Han, J., Kim, K., Lee, B., & Gwak, H. (2009). Internet overuse and excessive daytime sleepiness in adolescents. *Psychiatry and Clinical Neurosciences, 63*(4), 455-462. doi: 10.1111/j.1440-1819.2009.01925.x

Chuma, W. (2014). The social meanings of mobile phones among South African's 'digital natives': a case study. *Media, Culture and Society, 36*(3), 398-408. doi: 10.1177/0163443713517842.

Cicchetti, D., & Tucker, D. (1994). *Development and self-regulatory structures of the mind. Development and Psychopathology, 6*(4), 533-549.

Cotton, S., Anderson, W., & Tufekci, Z. (2009). Old wine in a new technology, or a different type of digital divide? *New Media and Society, 11*(7), 1163-1186.

Cyranowski, J.M., Frank, E., Young, E., & Shear, M.K. (2000). Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Archives of General Psychiatry*, *57*(1), 21-27.

Darling, N. (2007). Ecological systems theory: The person in the center of the circles. *Research in Human Development, 4*, 203-217.

De Villiers, M. (2009). *Die ontwikkeling en evaluering van 'n intervensieprogram om kinders se stresweerstandigheid te bevorder. [The development and evaluation of an intervention programme to promote child resiliency].* (Unpublished doctoral dissertation). University of the Free State, Bloemfontein, South Africa.

Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: A comparitive study of 39 countries. *Computers and Education, 74*, 98-111.

Durkee, T., Kaess, M., Carli, V., Parzer, P., Wasserman, C., Floderus, B., ... & Wasserman, D. (2012). Prevalence of pathological internet use among

adolescents in Europe: demographic and social factors. *Addiction*, *107*(12),
2210-2222. doi: 10.1111/j.1360-0443.2012.03946.x

Eisenberg, N., Champion, C., & Ma, Y. (2004). Emotion-related regulation:
An emerging construct. *Merrill-Palmer Quarterly, 50*, 236-259.

Epstein, M.H. (2000). The behavioral and emotional rating scale: A strength-
based approach to assessment. *Diagnostique, 25*(3). doi:10.1177/
073724770002500304

Epstein, M.H., & Sharma, J. (1998). *Behavioral and emotional rating scale:
A strength-based approach to assessment*. Austin, Texas: Pro-Ed.

Ernst, M., & Korelitz, K. E. (2009). Cerebral maturation in adolescence:
behavioral vulnerability. *Encephale*, *35*, S182-9.

Ernst, M., Pine, D. S., & Hardin, M. (2006). Triadic model of the neurobiology
of motivated behavior in adolescence. *Psychological Medicine*, *36*(03), 299-
312.

Friedman, R.J., & Chase-Lansdale, P.L. (2003). Chronic adversities. In M.
Rutter & E.Taylor (Eds.), *Child and adolescent psychiatry (4th Ed.)* (pp.265-
276). Malden, MA: Blackwell Science.

Gentile, D.A. (2011). The multiple dimensions of video game effects. *Child Development Perspectives*, *5*(2), 75-81.

Ghassemzadeh, L., Shahraray, M., & Moradi, A. (2008). Prevalence of internet addiction and comparison of internet addicts and non-addicts in Iranian high schools. *CyberPsycholog & Behavior, 11*(6), 731-733.

Gudmundsdottir, G.B. (2010). From digital divide to digital equity: Learner's ICT competence in four primary schools in Cape Town, South Africa. *International Journal of Educaiton and Development using Information and Communication Technology, 6*(2), 84-105.

Hardy, L. L., Denney-Wilson, E., Thrift, A. P., Okely, A. D., & Baur, L. A. (2010). Screen time and metabolic risk factors among adolescents. *Archives of Pediatrics and Adolescent Medicine, 164*(7), 643-649.

Hare, T. A., Tottenham, N., Galvan, A., Voss, H. U., Glover, G. H., & Casey, B. J. (2008). Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-nogo task. *Biological Psychiatry*, *63*(10), 927-934.

Harris, C., Straker, L., & Pollock, C. (2013). The influence of age, gender and other information technology use on young people's computer use at school and home. *Work: A Journal of Prevention, Assessment and Rehabilitation, 44*(Supplement 1), S61-S71.

Hawi, N. S. (2012). Internet addiction among adolescents in Lebanon. *Computers in Human Behavior*, *28*(3), 1044-1053.

Hong, S. B., Zalesky, A., Cocchi, L., Fornito, A., Choi, E. J., Kim, H. H., ... & Yi, S. H. (2013). Decreased functional brain connectivity in adolescents with internet addiction. *PloS One*, *8*(2), e57831. doi:10.1371/journal.pone. 0057831

Huang, C. (2010). Internet use and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 241-249.

Isaacs, S. (2002, November). IT's Hot for Girls! ICTs as an instrument in advancing girls' and women's capabilities in school education in Africa. In *United Nations Division for the advancement of Women Expert Group Meeting "Information and Communication Technologies and their impact on and use as an instrument for the advancement and empowerment of women" Seoul, Republic of Korea* (pp. 11-14).

Jackson, L.A., Zhao, Y., Kolenic, A., Fitzgerald, H.E., Harold, R., & Von Eye, A. (2008). Race, gender and information technology use: The new digital divide. *Cyberpsychology and Behavior, 11*(4), 437-442.

Johnson, G. M. (2010a). Internet use and child development: The techno-microsystem. *Australian Journal of Educational & Developmental Psychology, 10*, 32-43.

Johnson, G. M. (2010b). Internet use and child development: Validation of the ecological techno-subsystem. *Educational Technology & Society, 13*(1), 176-185.

Johnson, G.M., & Puplampu, P. (2008). A conceptual framework for understanding the effect of the internet on child development: The ecological techno-subsystem. *Canadian Journal of Learning and Technology, 34*, 19-28.

Joinson, C., Heron, J., Lewis, G., Croudace, T., & Araya, R. (2011). Timing of menarche and depressive symptoms in adolescent girls from a UK cohort. *The British Journal of Psychiatry*, *198*(1), 17-23.

Judi, H. M., Ashaari, N., Zin, N. A. M., & Yusof, Z. M. (2013). Framework of ICT impact on adolescent. *Procedia Technology, 11*, 1034-1040.

Kaess, M., Durkee, T., Brunner, R., Carli, V., Parzer, P., Wasserman, C., …Wasserman, D. (2014). Pathological internet use among European adolescents: Psychopathology and self-destructive behaviours. *European Child and Adolescent Psychiatry, 23*(1), 1093-1102. doi:10.1007/s00787-014-0562-7

Koo, H. J., & Kwon, J. H. (2014). Risk and protective factors of internet addiction: A meta-analysis of empirical studies in Korea. *Yonsei Medical Journal*, *55*(6), 1691-1711.

Laconi, S., Rodgers, R.F., & Chabrol, H. (2014). The measurement of internet addiction: A critical review of existing scales and their psychometric properties. *Computers in Human Behavior, 41*, 190-202.

Lai, C-H., & Gwung, H-L. (2013). The effect of gender and internet usage on physical and cyber interpersonal relationships. *Computers and Education, 69*, 303-309.

LaRose, R., Lin, C. A., & Eastin, M. S. (2003). Unregulated internet usage: Addiction, habit, or deficient self-regulation?. *Media Psychology*, *5*(3), 225-253.

Lewix, B. (2014). *Raising children in a digital age: Enjoying the best, avoiding the worst*. Oxford, UK: Lion Books.

Li, X., Shi, M., Wang, Z., Shi, K., Yang, R., & Yang, C. (2010, August). Resilience as a predictor of internet addiction: The mediation effects of perceived class climate and alienation. In *Web Society (SWS), 2010 IEEE 2nd Symposium on* (pp. 66-70). IEEE. doi: 10.1109/SWS.2010.5607478

Lin, F., Zhou, Y., Du, Y., Qin, L., Zhao, Z., Xu, J., & Lei, H. (2012). Abnormal white matter integrity in adolescents with internet addiction disorder: a tract-based spatial statistics study. *PloS One*, *7*(1), e30253. doi:10.1371/journal.pone.0030253

Louw, A.E., & Winter, M. (2011). The use and trends of information and communication technology (ICT) during middle childhood. *Journal of Child and Adolescent Mental Health, 23*(1), 29-42. doi:10.2989/17280583. 2011.594247

Magee, R. M., Agosto, D. E., Forte, A., & Dickard, M. (2014). Examining teens' non-use of technologies. *Technology*, *15*, 289-292.

Mandara, J., Varner, F., & Richman, S. (2010). Do African American mothers really "love" their sons and "raise" their daughters? *Journal of Family Psychology*, *24*, 41–50. doi:10.1037/a0018072

Masten, A.S. & Obradovic, J. (2006). Competence and resilience in development. *Annals of the New York Academy of Science, 1094*, 13-27.

Mbinjama, A. (2013). Language and cultural ideologies on the internet: Social media use of adolescents in semi-rural South Africa. *Journal of Intercultural Disciplines, 11*, 58.

McRae, K., Gross, J. J., Weber, J., Robertson, E. R., Sokol-Hessner, P., Ray, R. D., ... & Ochsner, K. N. (2012). The development of emotion regulation: an fMRI study of cognitive reappraisal in children, adolescents and young adults. *Social Cognitive and Affective Neuroscience, 7*(1), 11-22.

Moksnes, U.K., Moljord, I.E., Espnes, G.A., & Byrne, D.G. (2010). The association between stress and emotional states in adolescents: The role of gender and self-esteem. *Personality and Individual Differences, 49*(5), 430-435.

Moreno, M. A., Jelenchick, L., Cox, E., Young, H., & Christakis, D. A. (2011). Problematic internet use among US youth: a systematic review. *Archives of Pediatrics and Adolescent Medicine, 165*(9), 797-805.

Naninck, E. F. G., Lucassen, P. J., & Bakker, J. (2011). Sex differences in adolescent depression: do sex hormones determine vulnerability?. *Journal of Neuroendocrinology, 23*(5), 383-392.

Odendaal, W., Malcolm, C., Savahl, S., & September, R. (2006). Adolescents, their parents, and information and communication technologies: Exploring adolescents' perceptions on how these technologies present in parent-adolescent relationships. *Indo-Pacific Journal of Phenomenology, 6*(1),1-8.

O'Keeffe, G. S., & Clarke-Pearson, K. (2011). The impact of social media on children, adolescents, and families. *Pediatrics, 127*(4), 800-804.

Oyedemi, T. (2015). Participation, citizenship and internet use among South African youths. *Telematics and Informatics, 32*(1), 11-22. http://dx.doi.org/ 10.1016/j.tele.2014.08.002

Page, A. S., Cooper, A. R., Griew, P., & Jago, R. (2010). Children's screen viewing is related to psychological difficulties irrespective of physical activity. *Pediatrics, 126*(5), e1011-e1017.

Park, S.K., Kim, J.Y., & Cho, C.B. (2007). Prevalence of internet addiction and correlations with family factors among South Korean adolescents. *Adolescence, 43*(172), 895-909.

Postman, N. (1985). *Amusing ourselves to death: Public discourse in the age of show business.* London, UK: Penguin Books.

Prince-Embury, S. (2006). *Resiliency scales for children and adolescents. A profile of personal strengths.* San Antonio, TX: Harcourt assessment.

Prince-Embury, S., & Saklofske, D.H. (Eds.). (2013). *Resilience in children, adolescents, and adults: Translating research into practice.* New York, NY: Springer.

Purcell, K., Rainie, L., Heaps, A., Buchanan, J., Friedrich, L., Jacklin, A., ... & Zickuhr, K. (2012). *How teens do research in the digital world.* Washington, DC: Pew Internet & American Life Project.

Rideout, V.J., Foehr, U.G., & Roberts, D.F. (2010). *Generation M² – Media in the lives of 8- to 18-year-olds.* Menlo Park, CA: Kaiser Family Foundation.

Rosen, L. D., Cheever, N. A., & Carrier, L. M. (2008). The association of parenting style and child age with parental limit setting and adolescent MySpace behavior. *Journal of Applied Developmental Psychology*, *29*(6), 459-471.

Savahl, S., September, R., Odendaal, W., & Moos, A. (2008). Information and communication technology: A descriptive study of children's communication patterns. *South African Journal of Psychology, 38*, 515-525.

Schraml, K., Perski, A., Grossi, G., & Simonsson-Sarnecki, M. (2011). Stress symptoms among adolescents: The role of subjective psychosocial conditions, lifestyle, and self-esteem. *Journal of Adolescence*, *34*(5), 987-996.

Shaffer, H.J., Peller, A.J., LaPlante, D.A., Nelson, S.E., & LaBrie, R.A. (2010). Toward a paradigm shift in internet gambling research: from opinion and self-report to actual behaviour. Addiction Research and Theory, 18(3), 270-283.

Shank, D.B., & Cotton, S.R. (2014). Does technolog empower urban youth? The relationship of technology use to self-efficacy. *Computers and Education, 70*, 184-193. http://dx.doi.org/10.1016/j.compedu.2013.08.018

Shearer, C. L., Crouter, A. C., & McHale, S. M. (2005). Parents' perceptions of changes in mother-child and father-child relationships during adolescence. *Journal of Adolescent Research*, *20*(6), 662-684.

Siegel, D.J. (1999). *The developing mind: How relationships and the brain interact to shape who we are.* New York, NY: Guilford.

Sigman, A. (2012). Time for view on screen time. *Archive of Disease in Childhood, 97*(11), 935-942.

Strasburger, V. C., Hogan, M. J., Mulligan, D. A., Ameenuddin, N., Christakis, D. A., Cross, C., & Swanson, W. S. L. (2013). Children, adolescents, and the media. *Pediatrics, 132*(5), 958-961.

Tao, R., Huang, X., Wang, J., Zhang, H., Zhang, Y., & Li, M. (2010). Proposed diagnostic criteria for internet addiction. *Addiction, 105*(3), 556-564. doi: 10.1111/j.1360-0443.2009.02828.x

Troy, A.S., & Mauss, I.B. (2011). Resilience in the face of stress: Emotion regulation as a protective factor. In S.M. Southwick, B.T. Litz, D. Charney, & M.J. Friedman (Eds), *Resilience and mental health: Challenges across the lifespan* (pp.30-44). Cambridge, UK: Cambridge University Press.

Tsitsika, A., Critselis, E., Louizou, A., Janikian, M., Freskou, A., Marangou, E., ... & Kafetzis, D. A. (2011). Determinants of internet addiction among adolescents: A case-control study. *The Scientific World Journal, 11*, 866-874. doi: 10.1100/tsw.2011.85

Underwood, M. K., Rosen, L. H., More, D., Ehrenreich, S. E., & Gentsch, J. K. (2012). The BlackBerry project: capturing the content of adolescents' text messaging. *Developmental Psychology*, *48*(2), 295-302. doi:10.1037/a0025914

Updegraff, K.A., McHale, S.M., Crouter, A.C., & Kupanoff, K. (2001). Parents' involvement in adolescents' peer relationships: A comparison of mothers' and fathers' roles. *Journal of Marriage and Family, 63*(3), 655-668. doi: 10.1111/j.1741-3737.2001.00655.x

Valkenburg, P.M., & Peter, J. (2009). Social consequences of the internet for adolescents: A decade of research. *Current Directions in Psychological Science, 18*(1), 1-5.

Van den Eijnden, R.J., Spijkerman, R., Vermulst, A.A., van Rooij, T.J., & Engels, R.C. (2010). Compulsive internet use among adolescents: bidirectional parent–child relationships. *Journal of Abnormal Child Psychology*, *38*(1), 77-89. doi: 10.1007/s10802-009-9347-8

Van der Merwe, P. (2013). South Africa's adolescents in a wired world. *International Journal of Criminology and Sociology, 2*, 348-361.

Varner, F., & Mandara, J. (2013). Differential parenting of African American adolescents as an explanation for gender disparities in achievement. *Journal of Research on Adolescence, 24*(4), 667-680.

Volman, M., Van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education, 45*(1), 35-55.

Wallace, P. (2014). Internet addiction disorder and youth. *EMBO Reports, 15*(1), 12-16. doi: 10.1002/embr.201338222

Wan, C. S., & Chiou, W. B. (2006). Why are adolescents addicted to online gaming? An interview study in Taiwan. *CyberPsychology and Behavior, 9*(6), 762-766.

Weinstein, A., Feder, L. C., Rosenberg, K. P., & Dannon, P. (2014). Internet addiction disorder: Overview and controversies. *Behavioral Addictions*, 99-117. http://dx.doi.org/10.1016/B978-0-12-407724-9.00005-7

Yao, M.Z., He, J., Ko, D.M., Pang, K. (2014). The influence of personality, parental behaviors, and self-esteem on Internet addiction: a study of Chinese college students. *Cyberpsychology, Behavior and Social Networking, 17*(2), 104-110. doi: 10.109/cyber.2012.0710

Yu, L., & Shek, D. T. L. (2013). Internet addiction in Hong Kong adolescents: a three-year longitudinal study. *Journal of Pediatric and Adolescent Gynecology, 26*(3), S10-S17. http://dx.doi.org/10.1016/j.jpag.2013.03.010

Yuan, K., Qin, W., Wang, G., Zeng, F., Zhao, L., Yang, X., ... & Tian, J. (2011). Microstructure abnormalities in adolescents with internet addiction disorder. *PloS One, 6*(6), e20708.

CHAPTER 5

CONCLUSION

In this chapter, a brief summary of the relevant literature, as well as some of the most pertinent research findings of the study are presented. The contributions and limitations of the research are discussed, and recommendations for future studies are made.

Summary of literature

Information and communication technology (ICT) has become the preferred pastime for children and adolescents globally (Huhman et al., 2012; International Telecommunication Union, 2013; Kaess et al., 2014). International data indicate that the growth in adolescent ICT use is exponential and not slowing down (Telecommunication Development Sector, 2014). Bronfenbrenner's (2005) bio-ecological model gives a conceptual understanding of how adolescents (through interaction with their environment) adapt to these fast-changing and dynamic aspects of their environment. Johnson and Puplampu's (2008) techno-subsystem explains the specific interplay between information and communication technologies (ICTs) and the adolescent.

Psychological strengths (that encapsulate interpersonal strengths, family involvement, school functioning, intrapersonal strengths, and affective strengths) continue to develop in adolescence and assist the adolescent in negotiating and managing the daily demands (including ICT use) of the environment (Epstein, 2004). How well the individual adolescent negotiates his or her environment is not solely dependent on psychological strengths, but

also on what Prince-Embury and Saklofske (2013) refer to as personal resiliency. The three core developmental systems for personal resiliency (originating from empirical work) is sense of relatedness, sense of mastery, and emotional reactivity (Prince-Embury & Saklofske, 2013).

Thus, to understand the effect of ICT use on developing adolescents' ability to optimally interact with the environment, one should investigate ICT use and its effect on adolescent resilience (Blanchard, Metcalf, Degney, Herman, & Burns, 2008), in particular, the psychological strengths and personal resiliency systems associated with (i) social involvement, (ii) intrapersonal functioning, and (iii) emotional regulation (Pollard & Rosenberg, 2003; Prince-Embury & Saklofske, 2013).

In the last decade the volume of research focusing on the effect of ICT use on adolescents has grown expeditiously (O'Keeffe & Clarke-Pearson, 2011; Strasburger et al., 2013; Tam & Walter, 2013), with the majority of studies focusing on the negative impact of adolescent ICT use (Moreno, Jelenchick, Cox, Young, & Christakis, 2011; Page, Cooper, Griew, & Jago, 2010; Sigman, 2012). Empirical research on resilience, along with the study of adolescent development, have, however, shown that the specific way in which the developing adolescent negotiates and manages ICT use, dictates the eventual influence and effect that it has on his/her development (Lai, Lin, Chen, Gwung, & Li, 2013; Ma, Li, & Pow, 2011). This insight led to a more balanced research agenda, with more empirical research examining the potential positive effects of ICT use on adolescent development (Huang,

2010; Valkenburg & Peter, 2009, 2011). Recent studies have moved away from a dichotomous viewpoint (Suoranta, 2003) – of ICT effects being either 'good/beneficial' or 'bad/detrimental' – to a more balanced approach regarding the analyses and study of the effects of ICT use on adolescent development (Greenfield & Yan, 2006). This approach often focuses on the frequency of adolescent ICT use and its consequences (Ahiauzu & Odili, 2012; Belanger, Akre, Berchtold, & Michaud, 2011).

The three theoretical hypotheses that attempt to explain how ICT use affect adolescent development (i.e., adversely or positively) are (i) the *augmentation/stimulation hypothesis*, (ii) the *displacement hypothesis*, and (iii) the *threshold effect hypothesis* (Endestad, Heim, Kaare, Torgersen, & Brandtzaeg, 2011; Valkenburg & Peter, 2007). The augmentation/stimulation hypothesis asserts that the use of one medium can enhance the use of other mediums (e.g., ICT communication can enrich face-to-face interaction with established friends) (Allen, Ryan, Gray, McInerney, & Waters, 2014). The displacement hypothesis states that excessive ICT use keeps the adolescent from engaging with other developmentally important activities (e.g., excessive time spent playing computer games 'displaces' or replaces time the adolescent could have exercised or socialised with friends) (Endestad et al., 2011). The threshold effect hypothesis refers to a maximum amount of hours of ICT use before adverse effects start to occur (e.g., while moderate ICT use enhances already established friendships and increases an adolescent's sense of well-being, excessive ICT use will have the opposite effect, leading

to feelings of disconnection and loneliness) (Belanger, Akre, Berchtold, & Michaud, 2011).

A substantial volume of research investigates excessive ICT use and its effects (Cash, Rae, Steel, & Winkler, 2012). There have been far fewer studies looking at the potential positive effects of moderate ICT use (Belanger et al., 2011; Calvert & Wartella, 2014). Another gap in research output relates to definitional aspects of what constitutes moderate use and how much ICT use is seen as excessive (Laconi, Rodgers, & Chabrol, 2014). Even though there is no consensus in current academic discourse as to the specific frequency (in number of hours per day) of ICT exposure that would represent a critical time-threshold boundary between moderate and excessive use (Belanger et al., 2011), empirical support is mounting in favour of six or more hours per day (Weinstein, Feder, Rosenberg, & Dannon, 2014).

Research has focused on ICT use and gender differences (Drabowicz, 2014), as well as on how ICT use differs for different adolescent age groups (e.g., young adolescents and older adolescents) (Greenfield & Yan, 2006), but large quantitave studies investigating the effects of ICT use on adolescent resilience, and comparing effects between different adolescent age groups, and between adolescent boys and girls, are lacking. Research from diverse fields (e.g., developmental psychopathology and neurosciences) have started investigating neurological maturation, especially the maturation of emotional and behavioural control systems in the brain, from young adolescence to late adolescence, that negate the impact of ICTs (Casey, Jones, & Hare, 2008; Hare et al., 2008). Some of their findings clearly indicate that younger

adolescents (because of these still evolving neurological regulatory systems) are more prone to excessive ICT use (Zhou, Zhu, Li, & Wang, 2014) and at the same time neurologically more susceptible to the effects of (excessive) ICT use (Crews, He, & Hodge, 2007; Ernst & Korelitz, 2009).

There is an absence of research on adolescent ICT use and resilience within the South African context. Local peer-reviewed publications, either consists of small data-sets (e.g., Chuma, 2014; Louw & Winter, 2011), are qualitative studies (e.g., Mbinjama, 2013; Odendaal, Malcolm, Savahl, & September, 2006), or utilised cross-sectional or survey research designs (e.g., Mbinjama, 2013; Oyedemi, 2015) for data gathering (making any interpretation of age-related variables over time problematic) (Shipman, 2014). None of the South African studies focused on potential positive effects of ICT use in adolescent development.

Summary of empirical findings

The overarching aim of this study was to elucidate the effect of frequency of ICT use on adolescent resilience, and to identify any gender or age differences with regards to ICT use and its effect on resilience. It was achieved by investigating the effects of frequency of ICT use on three adolescent resilience-associated dimensions, namely social involvement, intrapersonal functioning, and emotional regulation. This quantitative study made use of criterion group design, and the data were collected in two waves

(two years apart) from a stratified, random cohort of adolescent girls and boys from the Free State Province, South Africa.

Results of the empirical study

Frequency of ICT use

Results reflected the pervasive use of ICT by adolescents, with prevalence rates for daily ICT usage of just under 80% for the younger cohort and approaching 100% in the older cohort. International data suggests comprehensive uptake of ICTs in adolescents' daily routines with almost 100% daily use in industrialised countries (Telecommunication Development Sector, 2014). Although ICT penetration in developing countries is still lagging slightly, the improvement in mobile technology is leading to exponential growth of daily ICT use among young people (Van der Merwe, 2013). This study's data indicates that pervasive daily ICT use by younger adolescents is even higher than other recent South African studies suggest (e.g., 70% in Oyedemi, 2015), while daily use for the older group is equal to adolescent usage rates in developed countries. The ubiquitous rates of ICT usage found in this study, becomes a strong *raison d'être* for the study itself.

An important result is that the majority of adolescents in both Wave 1 (56%) and Wave 2 (84%) spend a moderate number of hours per day using ICTs. This is vital to consider, because the augmentation hypothesis argues that gradual exposure to ICT, monitored by parents and other significant adults,

provides them with the opportunity to acquire skills to manage ICT in a way that will lead to continued moderate ICT use and its possible positive effects (Cohen, Pooley, Ferguson, & Harms, 2011; Livingstone & Helsper, 2008). These results also provide factual arguments that can inform more balanced discussions in the current public realm, where common discourse (especially in the popular press) (eg. Clinton & Steyer, 2012; Sawyer, 2012) on adolescent ICT use, is mostly one of 'gloom and doom'.

The downward trend in the number of ICT non-users (over the two year period between cohorts) is mirrored by the self-reported prevalence rates for excessive ICT use. More than 23% of the younger adolescents used ICTs for more than 6 hours per day, while less than 16% of the older adolescents reported excessive daily use. The Wave 1 participants' excessive use rate is much higher than that published in American and European studies (5-10%) (Park, Kim, & Cho, 2007), but still lower than the 27% excessive usage rate reported in Yu and Shek's (2013) study. The percentage of Wave 2 participants who disclosed more than 6 hours of ICT use every day is in line with prevalence rates from other non-Western countries (e.g., South Korea and Taiwan, 15-20%) (Weinstein et al., 2014).

Effect of ICT use on resilience

Resilience is a product of complex interactions between environmental realities and personal attributes, mediated by internal mechanisms (Luthar, Cicchetti, & Becker, 2000). The Resiliency Scales for Children and

Adolescents (RSCA) (Prince-Embury, 2006) utilised in this study to measure participants' personal resiliency, are reflective of three core developmental systems (i.e., sense of relatedness, sense of mastery, and emotional reactivity), and respects the complex relationship between these systems (Prince-Embury & Saklofske, 2013). An integrative presentation of all three articles' resiliency results is thus presented.

The null hypotheses associated with the three resiliency constructs (i.e., sense of relatedness in Article 1, sense of mastery in Article 2, and emotional reactivity in Article 3) state that there is no difference in these constructs for adolescents notwithstanding the number of hours they use ICTs per day. The null hypothesis has been rejected for frequency of ICT use and both sense of relatedness and emotional reactivity (young cohort), as well as for sense of mastery (older cohort).

The younger (Wave 1) adolescents' **sense of relatedness** was significantly affected by the frequency of daily ICT use, with moderate users (more than 0 to 6 hours per day) reporting the most optimal sense of relatedness scores, and both the non-user group and the excessive users presenting with significantly lower sense of relatedness scores (the no ICT use group's score was slightly higher than that of the excessive user group). No statistically significant effect was found for frequency of ICT use and the older adolescents' sense of relatedness. The optimal sense of relatedness scores achieved by moderate users in the young cohort correlates satisfactory with the underlying thesis of the augmentation/stimulation hypothesis that ICT use

can enrich already established relationships (Allen et al., 2014). To the same extent, the results, as they pertain to the excessive ICT users in Wave 1's low sense of relatedness score, support possibly both the threshold effect hypothesis, where detrimental effects supplant any positive effects of moderate use when a certain threshold (in this case 6 hours of ICT use) is reached, and the displacement hypothesis, where an adolescent, for example, who plays online games for hours, becomes less socialy involved with his friends, and spends less face-to-face time with them. It also echoes research that indicates that isolated and lonely adolescents, often with social problems, escape from their present difficulties by engaging with ICTs more, even though it makes them feel progressively less socially involved (Thadani & Cheung, 2011). A possible bi-directional relationship is mentioned in studies, where social isolation catalyse an escape into ICTs and thus excessive use, whilst excessive use leads to less social involvement, more withdrawal, and eventual isolation (Lai et al., 2013; Wang & Wang, 2013).

The number of hours of ICT use by Wave 1 participants showed to have no significant effect on their **sense of mastery**. This result was not anticipated, as previous studies highlighted possible enhancing effects of ICT use on sense of mastery (Valkenburg & Peter, 2007). A conceivable explanation for this counter-intuitive result, is that sense of mastery develops over many years, with especially the middle childhood period being viewed as important for optimal sense of mastery development (Grolnick, Gurland, Jacob, & Devourcey, 2002). It can, therefore, be argued that sense of mastery was already an established construct for the younger adolescents when the study

started and was not significantly influenced by a new environmental factor (i.e., ICTs), with effects only showing a few years later. This is supported by the significant effect of number of hours of ICT use on the older adolescents' sense of mastery scores. The more than 3 to 6 hour ICT use group had the most optimal sense of mastery scores of all Wave 2 usage groups. As mentioned, other studies (e.g., Shank & Cotten, 2014; Weinstein et al., 2014) suggested a possible strong effect of frequency of ICT use on self-efficacy and adaptability (and thus sense of mastery) (Prince-Embury & Saklofske, 2013). The finding that ICT use significantly affected the older, and not the young adolescent group, supports the theoretical assertion of the Augmentation/Stimulation hypothesis. Another factor to consider is the possible mediating effect of stricter limit-setting and closer supervision of ICT use for younger adolescents compared to older adolescents (Rosen, Cheever, & Carrier, 2008), because even though the stricter control of young adolescents' ICT environment might deter excessive use, the more non-constraining parental encouragement of older adolescents' ICT use, enhance their sense of autonomy and control, increase self-efficacy and eventually lead to a better sense of mastery (Brown, 2014).

Adolescents from the young cohort who spent different number of hours engaging with ICTs, significantly differed in terms of their **emotional reactivity**. This was not the case for the older cohort's adolescents, where dissimilar ICT use had no significant effect on emotional reactivity scores. In Wave 1, the lowest emotional reactivity scores were obtained by the more than 0 to 3 hours per day ICT use group, followed by higher emotional

reactivity scores for the no use group, even higher scores for the more than 3 to 6 hours group, while the excessive use group presented with the highest emotional reactivity scores. It is important to note here that higher scores on the Emotional Reactivity Scale are representative of higher reactivity and suggest higher vulnerability and lower emotional regulation (Prince-Embury & Saklofske, 2013).

These results can be understood in terms of the natural maturation of regulatory mechanisms in the adolescent's brain, specifically as it pertains to neurological developmental trajectories associated with the affective circuits, the reward pathways, and response inhibition sectors, all of which is less developed in younger adolescents than older adolescents and fundamentally important in the management of emotional reactivity (Brenhouse & Andersen, 2011). The older adolescents' emotional and behavioural control systems have matured (compared to those of the younger cohort), and is more robust and less likely to experience emotional dysregulation (Hare et al., 2008). It also provides an explanation as to why frequency of ICT use does not have the same significant effect on older adolescents' brains as on younger adolescents' brains, especially on the emotional regulatory systems associated with emotional reactivity (Casey et al., 2008).

There is empirical work that highlights a possible bi-directional relationship between brain regulatory immaturity (as for example in younger adolescents or older adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD) and excessive ICT use (Koo & Kwon, 2014) - with low emotional regulation

making the adolescent more vulnerable or prone to excessive engagement with ICTs (Casey et al., 2008), whilst excessive ICT use affects the exact same emotional and behavioural control systems adversly, leading to higher emotional reactivity (Hong et al., 2013; Zhou et al., 2014). The fact that the more than 0 to 3 hours ICT use group had the lowest emotional reactivity scores, further support other studies' findings, namely that moderate ICT use have the capacity to enhance emotional regulation by, for example, creating opportunities to express frustrations (Shank & Cotten, 2014), encouraging responsible communication and response inhibition because of the permanency of 'digital footprints' (Lewix, 2014), and by means of delayed action after intense emotionally activating stimuli (Gentile, 2011). The highest emotional reactivity score (i.e., lowest emotional regulation) of the young cohort was for the excessive ICT use group – a result that supports the threshold effect hypothesis in that all possible emotional regulation enhancing effects associated with moderate usage were negated when the threshold to excessive use was crossed.

Effect of ICT use on emotional and behavioural strengths

Developmental phenomena in adolescence can only be comprehended fully with an integrated focus on the complete adolescent: their internal realities, external environment, and the dynamic relationship between adolescent and environment (Jimerson, Sharkey, Nyborg, & Furlong, 2004). Research has shown that youths' strengths are fundamentally important to consider when assessing their capacity for functioning optimally in general, but especially

regarding specific variables like the effect of ICTs on their social involvement capacities, intrapersonal functioning levels and emotional regulation abilities (Buckley & Epstein, 2004; Mathers et al., 2009). This study included the assessment of emotional and behavioural strengths of participants, and investigated the possible effects of frequency of ICT use on said strengths. The integrated emotional and behavioural strength results for all three articles will be presented.

The null hypothesis (H_0) pertaining to the five strengths (or subscales) of the BERS-2 used for this study (i.e., school functioning, family involvement, interpersonal strength, intrapersonal strength and affective strength), asserts that there will be no difference in any of these emotional or behavioural strength scores for participating adolescents, notwithstanding their reported frequency rates of daily ICT use.

The results pertaining to the effect of amount of hours of daily ICT on the emotional and behavioural strengths of the participants were surprising, in that frequency of ICT use was found to have no statistically significant effect on any of the five subscales (i.e., school functioning, family involvement, interpersonal strength, intrapersonal strength and affective strength) of the BERS-2.

The majority of published studies that investigated the effects of frequency of ICT use on behavioural and emotional strengths found ICT to influence said strengths significantly, with moderate use enhancing strengths (explained by

the augmentation/stimulation effect hypothesis) or excessive use adversely affecting strengths (explained with the threshold effect hypothesis) (Endestad et al., 2011; Valkenburg & Peter, 2007). Moderate use will, for example, enhance interpersonal strengths (Valkenburg & Peter, 2011; Schiffrin, Edelman, Falkenstern, & Stewart, 2010), as well as intrapersonal strengths (Koo & Kwon, 2014; Shank & Cotten, 2014), whilst excessive use will adversely affect school functioning (Skoric, Teo, & Neo, 2009), family involvement (Lanigan, 2009) or affective strengths (LaRose, Lin, & Eastin, 2003). A possible explanation for the non-significant effects found in this study for frequency of ICT use on all of the above strengths, can be one relating to the study's methodology: because of the self-reporting of frequency of ICT use, it might be that participants either under-reported or over-reported their daily ICT use (Van den Einden, Spijkerman, Vermulst, Van Rooij, & Engels, 2010), with the result that the groups end up not differing significantly. Another potential elucidation is the likelihood that ICT use started relatively recently for most participants, even in the older adolescent cohort (at most only a few years), and that behavioural and emotional strengths develop over a much longer period and was already robust by the time participants started engaging with ICTs (Pašousek, 2011). Thus, the real effects of ICT might only be visible in a few years (e.g., early adulthood).

The null hypothesis, pertaining to the effect of ICT use on the emotional and behavioural strengths of participants, has been accepted in full, with no statistically signficant effect observed.

Gender

The last decade has seen a decrease (but not a disappearance) in gender dissimilarities in ICT use (Banerjee, Kang, Bagchi-Sen, & Rao, 2005; Drabowicz, 2014), echoing a greater societal shift in gender identities and roles (Williams, Sonsalvo, Caplan, & Yee, 2009). The biological, emotional and behavioural differences between adolescent boys and girls, and the importance that these differences hold in regards to a better understanding of adolescent resilience, are well documented (Oberle, Schonert-Reichl, & Thomson, 2010; Werner, 2013). This study investigated the possible differential effects of frequency of ICT use on adolescent boys and girls, whilst results also elucidate significant differences in resilience and strength scores between male and female participants. Integrated results associated with gender will be presented for all three articles.

The null hypothesis (H_0), relevant to gender variable, declare that there will be no significant differences between adolescent boys and girls with regards to their amount of hours of ICT use per day, nor in any of their resilience (i.e., sense of relatedness, sense of mastery, and emotional reactivity) or strength-based (social involvement, school functioning, interpersonal strength, intrapersonal strength, and emotional reactivity) scores.

The percentage of younger adolescent girls (Wave 1) that indicated that they use no ICTs during the day (24%) is significantly more than the percentage of boys reporting non-use (16%). The dissimilarity in no use between the girls

and boys of the first cohort can be understood against the backdrop of research that discusses a possible gender-bias in terms of how parents and other caregivers approach young adolescent females, compared to young adolescent males. The girls typically reported far less autonomy and stricter limit-setting than the boys (Pettit, Laird, Dodge, Bates, & Criss, 2001), especially as it pertains to ICT exposure (Eastin, Greenberg, & Horschire, 2006). The lack of gender differences found in all other ICT usage groups of both cohorts support the dominant discourse in current research that gender dissimilarities in ICT use is fading (Williams et al., 2009).

The mean scores of males and females for social involvement variables (i.e., sense of relatedness, interpersonal strength, family involvement, and school functioning), for intrapersonal functioning variables (i.e., sense of mastery and intrapersonal strength), and for affective strengths were very similar for both Wave 1 and Wave 2.

The Wave 1 boys universally reported higher levels of emotional reactivity than the Wave 1 girls. Whilst counter-intuitive to the trend seen in Wave 1 emotional reactivity scores, the Wave 2 girls reported higher levels of emotional reactivity than their male counterparts in all groups (i.e., in both moderate usage groups), with the exception of the excessive users where the boys' scores were higher than that of the girls.

Older adolescent girls' well-being are compromised by elevated stress levels, and high parental and societal expectations (American Psychological

Association, 2014). They have more responsibilities, but less autonomy (than older adolescent boys) (Varner & Mandara, 2013), and have an increased vulnerability for depression or anxiety symptoms (Legerstee et al., 2013; Sharp & Lipsky, 2002). The cumulative effect of the above-mentioned realities affect older adolescent girls' emotional brain centres, and can lead to higher emotional reactivity scores (Moksnes, Moljord, Espnes, & Byrne, 2010). The only exception is the excessive use group (Wave 2) where the boys' emotional reactivity scores are higher than that of the girls. Boys with higher emotional reactivity are more likely to excessively use ICTs (Zhou et al., 2014). The bi-directionality between excessive ICT use and emotional dysregulation has been previously discussed.

Statistical analysis indicated that the older adolescent males and females differed significantly in terms of their interpersonal strengths, with the boys reporting higher interpersonal strengths that their female counterparts. Previous studies describe how older adolescent females experience much higher levels of stress compared to both younger adolescent females and adolescent males in general (Salmela-Aro & Tynkkynene, 2012; Schraml, Perski, Grossi, & Simonsson-Sarnecki, 2011). These heightened stress-levels can affect the adolescent girl's ability to engage and maintain her everyday relationships (Lewandowski, Mattingly, & Pedreiro, 2014), and thus affect her interpersonal strength scores (Jordan, 2013). Another explanatory possibility for older adolescent girls' significantly lower interpersonal strength scores (when compared to that of the older boys), is that the incidence rates for depression and anxiety disorders for older adolescent girls are much

higher than for the boys (Beesdo, Knappe, & Pine, 2009; Sharp & Lipsky, 2002). The gender difference in interpersonal strength scores might indicate to some degree the possibility of related mood and anxiety symptoms, which might mediate feelings of isolation and social rejection, affecting negatively the older adolescent girls' interpersonal strengths (Barger, Messerli-Bürgy, & Barth, 2014).

The statistical analysis of the intrapersonal functioning variables found significant differences between the two genders' Wave 1 intrapersonal strength scores, as well as between their Wave 2 intrapersonal strength scores. Although both genders' intrapersonal strengths (in this study) decrease as they develop through adolescence, the difference (between the girls and boys) with regards to these changes are important to consider: in the younger group the girls' intrapersonal scores were higher than that of the boys, while in the older group the boys' intrapersonal scores were higher.

Societal expectations increase as individuals mature, and these expectations translate into more responsibilities and associated stressors for the developing adolescent, but also allow for more autonomous decision-making (Tolan, 2014). Gender-biased approaches by parents (e.g., expecting more disciplined work from girls, and allowing more autonomy to boys) further contribute to adolescents' overall experience of themselves and their own competencies (Varner & Mandara, 2013). How successful adolescents negotiate these changing expectations with associated responsibilities and decision-making freedoms contribute to their sense of well-being (Moksnes et

al., 2010). Studies have shown that the majority of adolescents experience more stress in late adolescence than early adolescence, but this is especially true for older adolescent girls (American Psychological Association, 2014). Adolescents' perceptions of themselves, their competencies, and their accomplishments influence their core self-concept and thus their intrapersonal strengths (Trout, Ryan, La Vigne, & Epstein, 2003). These gender differences, both in terms of expectations and responsibilities, as well as the stress levels that older adolescent girls report and its cumulative effect on their intrapersonal strengths reported in research literature, would explain the gender differences in the results for intrapersonal strengths over time.

There were no significant differences in both cohorts between girls and boys with regards to sense of mastery, indicating that in both waves the girls and boys reported similar levels of optimism, self-efficacy, and adaptability (Prince-Embury & Saklofske, 2013).

The results obtained from statistical analysis found no significant gender differences between the emotional reactivity scores of both the younger and older adolescent groups, nor between the affective strength scores of the younger cohort. The only statistically significant result produced (as it pertains to gender differences in emotional regulation) was with Wave 2 affective strength scores, with the girls reporting lower affective strengths than the boys. The lack of significant difference between the young adolescent girls and boys with regards to emotional regulation (i.e., affective strengths and emotional reactivity scores) underlines current thinking in neuroscience

that shows emotional regulation to be gender independent (Brenhouse & Andersen, 2011). It can be inferred from the results that the significantly lower affective strength scores of the older adolescent girls are reflective of a decreased ability (compared to the older adolescent boys) to give and receive affection (Steinberg, 2005). As previously discussed (in terms of significant gender differences in older adolescent inter- and intrapersonal strengths), but also now here in terms of affective strengths, the cumulative effect of changing societal expectations (including parental gender-biased approaches) (Pettit et al., 2001), coupled with the heightened levels of stress reported by older adolescent girls in numerous studies (American Psychological Association, 2014), as well as the raised possibility of depressive or anxiety symptoms, fundamentally affect their self-esteem, as well as their ability to connect to peers and family, and to maintain relationships (Moksnes et al., 2010), eventually adversely affecting their ability to give and receive affection.

For this study the null hypothesis, relevant to the gender variable, is partialy rejected. Even though there were no statistically significant differences between adolescent girls and boys as with regards to their frequency of ICT use, there were significant gender differences found for social involvement, intrapersonal functioning and emotional regulation.

Age (differences between Wave 1 & Wave 2)

Bronfenbrenner's (2005) bio-ecological model's postulated chronosystem recognises the influence of inter-related change in individuals and environments over time (Pinquart & Silbereisen, 2004). This provides a conceptual understanding for biological, psycho-emotional and relational developmental trajectories from early to late adolescence, including the establishment and enhancement/inhibition of core strengths and personal resiliency (Ungar, Ghazinour, Richter, 2013). The further inclusion of Johnson and Puplampu's (2008) techno-subsystem within Bronfenbrenner's model, provide a theoretical framework within which the changing effect of ICTs on developing adolescents (over time) can be understood and studied (Blignaut & Els, 2010). Empirical work asserts that in the last decade (despite an increase in over-all uptake of ICTs (Kaess et al., 2014) a consistent usage pattern has begun to crystallise, with a decrease in excessive use from early adolescence to late adolescence, mirrored by an increase in moderate use towards late adolescence (Belanger et al., 2011). The results in this study highlight these time-associated differences, both in terms of ICT use and differences in resilience and behavioural and emotional strengths from early to late adolescence.

The null hypothesis, relating to differences between the two age groups of Wave 1 and Wave 2, states that there will be no significant differences between the younger adolescents of the first cohort (Wave1) and the older adolescents of the second cohort (Wave 2) regarding their amount of hours of

ICT use per day, nor in any of their resilience (i.e., sense of relatedness, sense of mastery, and emotional reactivity) or strength-based (social involvement, school functioning, interpersonal strength, intrapersonal strength, and emotional reactivity) scores.

There is substantial decrease from Wave 1 to Wave 2 in both the number of adolescents reporting no ICT use per day (21% to 0.23%) and the number of participants admitting to excessive ICT use of more than 6 hours per day (23% to 16%). In an almost mirror-image of the excessive use trend, the moderate use of ICTs increased from the 2010 cohort (56%) to the 2012 cohort (84%). Research from the fields of developmental psychology and family studies describes how younger adolescents are often exposed to stricter limit-setting and close-monitoring, and allowed less autonomy by their care-givers, than their older counterparts (Rosen et al., 2008). This can serve to explain and understand the drastic decrease in the number of participants that reported not using any ICTs, as parental monitoring decreased, with a resultant increase in adolescent autonomy (Livingstone & Helsper, 2008).

The change in the frequency of daily ICT use in both the moderate and excessive use groups from the younger to the older adolescents is to be expected, and in support of current neuro-scientific research that reveals a maturation of behavioural and emotional control systems in adolescent brains over time (Casey, Jones, & Hare, 2008; Ernst, Pine, & Hardin, 2006; Hare et al., 2008). Better behavioural and emotional control makes older adolescents less vulnerable to excessive ICT use (and, therefore, more inclined to use

ICTs moderately), and also less susceptible to the adverse neurological consequences of excessive use than younger adolescents (Ernst & Korelitz, 2009). The phenomenon of close parental monitoring of ICT use in most households with young adolescents (Rosen et al., 2008; Varner & Mandara, 2013), that becomes less strict and provide more autonomy as the adolescent develops and self-regulatory mechanisms mature (Livingstone & Helsper, 2008; Tolan, 2014), can explain the majority of young cohort participants' moderate ICT use in this study, notwithstanding their inferred immature neuro-regulatory systems (Rosen et al., 2008). Lastly, it is worth noting that two other possible suggestions (derived from peer-reviewed studies) for the drop in excessive use over the two year period between the first and the second cohort exist: the first is that younger adolescents experience ICTs as novel and this novelty factor becomes a strong reinforcer of continued and increasing ICT use (Yu & Shek, 2013). With normal maturation, said novelty factor dissipates, culminating in less excessive ICT use in later adolescence. Secondly, older adolescents have more distractions associated with important developmental requirements (e.g., face-to-face interaction and socialisation with peers and important academic responsibilities) giving them less time to engage with ICTs than their younger counterparts (Yu & Shek, 2013).

The mean interpersonal strength, intrapersonal strength, affective strength, family involvement, and school functioning scores of the older group are significantly lower than those of the younger group for all the different groups that engage with ICTs every day. As previously discussed in this chapter, the difference in mean inter- and intrapersonal, as well as affective strength

scores, between the younger and older cohort can be partially explained by increased stress levels, associated with older adolescence, and the effects of said stress levels on both the adolescent's self-esteem and how he/she relates to and engages with others (e.g., parents and peers) (Lewandowski, Mattingly, & Pedreiro, 2014). Older adolescents have, in general, more autonomy than younger adolescents, and their primary focus for socialisation has shifted from family to peers (Collins & Laursen, 2004). This focus on peer-relationships might also impact on family involvement, as well as academic functioning (Wentzel, 2005) .

The moderate ICT users in the older adolescent cohort's mean sense of relatedness score is significantly lower than that of their younger counterparts. Even though moderate ICT use have been shown to enhance adolescents sense of relatedness (Allen et al., 2014), it can be reasoned that the increased responsibilities (academic and societal), as well as raised levels of experienced stress (American Psychological Association, 2014), affect the older adolescents' feelings of being supported and comforted by others adversely (Moknes et al., 2010; Schraml et al., 2011), thus producing lower mean sense of relatedness scores than the younger adolescents.

The null hypothesis, relating to differences between the two age groups (i.e., Wave 1 and Wave 2), is rejected in part, with significant differences in frequency of ICT use, as well as between the social involvement, intrapersonal functioning and emotional regulation results of the younger and older cohort.

Contributions of this study

This study is the first of its kind in South Africa. The large sample size, the quantitative methodology, and the criterion group design's two separate waves of data-gathering have provided invaluable data that delivered clear and significant results on adolescent ICT use, and its effects on adolescent resilience and strengths over time. The findings furthermore contribute in a substantial way to international empirical work on adolescent development and resilience-focused research. Results provided an empirical base for three explanatory postulated hypotheses (i.e., the augmentation/stimulation hypothesis, the displacement hypothesis and the threshold effect hypothesis) on the mechanism of impact of ICT use on adolescents.

A most important meta-finding across all three articles is that the optimal beneficial effects on adolescent resilience are associated with moderate ICT use. Juxtaposed to the clear benefits of moderate ICT use, are the results highlighting the detrimental effect of excessive ICT use, and the counter-intuitive findings that no ICT use is less beneficial for resilience development than moderate use.

The research results highlight the natural maturation process that develops between early adolescence and late adolescence. The suboptimal scores on multiple resiliency variables of older adolescent girls (when compared to older adolescent boys) raise concerns about changes from early to late adolescence that adversely affect these older adolescent girls.

Limitations of this study

The study data was obtained by means of self-report from the participants. The research issues inherent to self-report methodologies are well documented (e.g., Shaffer, Peller, Laplante, Nelson, & LaBrie, 2010), and specifically in research pertaining to adolescent ICT use the methodological challenges of over- and under-reporting should be taken into consideration (Moreno et al., 2012). The information provided by the adolescents themselves thus can be seen as a limitation of this study. Real-time electronic tracking of adolescent ICT use (Underwood, Rosen, More, Ehrenreich, & Gentsch, 2012), using well-researched and objective measuring instruments for gathering information on ICT use (see Laconi and colleagues' (2014) review article pertaining to existing scales and their psychometric properties). None of the measuring instruments - with acceptable validity and reliability - referred to in said review article was available at the conception and start of this research project (e.g., Monetti et al., 2011), and employing two or multiple sources of information of the adolescent's ICT use (e.g., the adolescent, his or her caregivers, teachers, and some of his or her peers, as well as mobile phone data usage records) (Stone et al., 2009), can all help to negate or solve the issues associated with self-report generated data.

The cohort methodology of this study (utilising cohort-data measured in two separate waves) provided excellent quantitative data on frequency of ICT use and its effect on adolescent resilience factors, as well as the presence of any significant gender or age differences. The quantitative data could, however,

only give an indication of whether or not there are significant differences between variables. To examine the specific nature of these differences further, a study combining qualitative and quantitative methods (i.e., a mixed method research design) is proposed (Ostlund, Kidd, Wengström, & Rowa-Dewar, 2011). In particular, it would be informative to employ qualitative methods to further investigate the adolescents that report excessive ICT use – their experiences of ICT use and the meanings they attach to ICTs, as well as any antecedent factors identifiable for their excessive user patterns.

Even though this study employed a cohort design and gathered data in two waves (two years apart), a study employing a different longitudinal research design would have been even better in providing us with insight into changes over time. Furthermore, the variance found between Wave 1 and Wave 2 in a longitudinal study can be accounted for by the specific subjects, but not necessarily in a cohort study, because the small number of subjects included in the one wave but not in the other wave, might contribute to the recorded difference (Prentice, 1995). One proposal, in this regard, would be to increase the frequency of data-gathering points, from the two data-gathering points (two years apart) of this study, to once every six months over a two to three year period. Such an increase in data-gathering points over shorter periods of time would provide invaluable information on changing effects (including those associated with age and gender) of ICT use on developing adolescents' resilience.

Another limitation that should be considered, is that the exponential tempo of change associated with ICT and its use, and the time-lapse between datasets, inherent to the longitudinal methodology employed by this study, creates possible interpretive scenarios where the tempo of change exceed the tempo of data-gathering, interpretation and publication of results.

Lastly the changing ICT user-behaviour patterns of adolescents, require consideration, specificially in so far as the data gathering process is concerned. Ever-increasing uptake of online ICT platforms (for example 'Facebook'), should be carefully contemplated for future studies, both in terms of the mentioned usefulness as data-gathering platform (where real-time updated data is available for analyses), as well as the focus of future studies looking at possible, specific effects (of for example Facebook use) as it pertains to adolescent ICT use.

Recommendations

This study's results suggest that preventing adolescents from engaging with ICTs might be counterproductive and non-beneficial, or even detrimental to, their development. The benefits of moderate ICT use, gained from the study's findings, serves to inform, as well as encourage, parents, educators and policy-makers to act in ways that will steer adolescents towards moderate ICT use. This can be done by supervision and monitoring of their ICT use, and by communicating and implementing limits for daily use (especially for younger adolescents). Adult encouragement of a more balanced life-style and routine

in general for the adolescents, that includes various activities that promote diverse interpersonal, cognitive, and emotional skills, is highly recommended.

These research findings can also be assimilated into psycho-educative programmes or material, that can convey to adolescents the positives and negatives associated with ICT use, and ultimately encourage and steer them towards moderate ICT use.

The research findings of this study highlight some developmental concerns regarding older adolescent girls, that necessitate further empirical investigation. Any future follow-up study should include formal screening tools for depression (e.g., *Beck Depression Inventory-II (BDI-II)*, Dolle et al., 2012) and anxiety (e.g., *Screen for Child Anxiety Related Emotional Disorders-71 (SCARED-71)*, Bodden, Bögels, & Muris, 2009) symptoms (Beesdo et al., 2009; Sharp & Lipsky, 2002). It is also proposed that parents, educators and other significant adults in older adolescent girls' lives specifically, provide them with the necessary support to nurture their emotional and behavioural strengths.

Future research projects should investigate the directionality of influence in the relationship between adolescent ICT use and emotional regulation. Even though some international studies have started to explore the possible bi-directionality of influence (Wallace, 2014), there is still a complete dearth of South African published work in this important field. This would require experimental evaluations in highly controllable settings (e.g., a well-equipped

neuroscience laboratory) with stringent protocols (e.g., taking fMRI whilst the

participant does a particular experimental action).

Personal reflection

"Two roads diverged in a wood, and I—

I took the one less traveled by,

And that has made all the difference."

The unseeing undercurrent of our lives so often unfathomably guides our flow – and the direction of its intent can only be guessed by the reality of the surface movement. This research is about resilience and technology, but it also encapsulates the thoughts and ideas that deeply occupy me as person: it is about *balance* and *the society we are becoming*. I have come to the end of my long walk in the symbolic yellow wood of Robert Frost's (1916) sublime poem, and I am truly grateful that I took this road; it has made a profound difference in my life. But I know that the undercurrent is already busy steering me towards another journey, and that this end is another beginning…

REFERENCES

Ahern, N.R., & Norris, A.E. (2011). Examining factors that increase and decrease stress in adolescent community college students. *Journal of Pediatric Nursing, 26*(6), 530-540.

Ahiauzu, L.U., & Odili, S. O. (2012). The Influence of information and communication technologies (ICTS) on parents/adolescents relationship. *Mediterranean Journal of Social Sciences, 3*(13), 127-136. doi:10.5901/mjss.2012.v3n13p127

Ahn, J. (2011). The effect of social network sites on adolescents' social and academic development: current theories and controversies. *Journal of the American Society for Information Science and Technology, 62*(8), 1435-1445. doi: 10.1002/asi.21540

Allen, K. A., Ryan, T., Gray, D. L., McInerney, D. M., & Waters, L. (2014). Social media use and social connectedness in adolescents: The positives and the potential pitfalls. *The Australian Educational and Developmental Psychologist, 31*(1), 18-31. doi:10.1017/edp.2014.2.

American Psychological Association. (2014). *Are teens adopting adults' stress habits?* Washington, DC: American Psychological Association

Amichai-Hamburger, Y., & Hayat, Z. (2011). The impact of the internet on the social lives of users: A representative sample from 13 countries. *Computers in Human Behavior, 27*(1), 585-589.

Anderson, A. R., Christenson, S. L., Sinclair, M. F., & Lehr, C. A. (2004). Check & Connect: The importance of relationships for promoting engagement with school. *Journal of School Psychology, 42*(2), 95-113.

Anderson, T.W. (2003). *An introduction to multivariate statistical analysis*. New York, NY: Wiley.

Arnett, J. J. (2014). Chapter 4: Identity development from adolescence to emerging adulthood: What we know and (especially) don't know. In K.C. McLean & M. Syed (Eds.), *The Oxford Handbook of Identity Development* (pp. 53-64). Oxford, UK: Oxford University Press.

Bailin, A., Milanaik, R., & Adesman, A. (2014). Health implication of new age technologies for adolescents: a review of the research. *Current Opinion in Pediatrics, 26*(5), 605-619. doi: 10.1097/MOP.0000000000000140

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148.

Banerjee, S., Kang, H., Bagchi-Sen, S., & Rao, H.R. (2005). Gender divide in the use of the internet applications. *International Journal of E-Business Research, 1*(2), 24-39.

Barber, B. K., & Schluterman, J. M. (2008). Connectedness in the lives of children and adolescents: A call for greater conceptual clarity. *Journal of Adolescent Health, 43*(3), 209-216.

Barger, S. D., Messerli-Bürgy, N., & Barth, J. (2014). Social relationship correlates of major depressive disorder and depressive symptoms in Switzerland: nationally representative cross sectional study. *BMC Public Health, 14*(1), 273.

Barlett, C. P., Vowels, C. L., Shanteau, J., Crow, J., & Miller, T. (2009). The effect of violent and non-violent computer games on cognitive performance. *Computers in Human Behavior, 25*(1), 96-102. doi:10.1016/ j.chb.2008.07.008

Beesdo, K., Knappe, S., & Pine, D. S. (2009). Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. *Psychiatric Clinics of North America, 32*(3), 483-524. doi:10.1016/j.psc. 2009.06.002

Belanger, R.E., Akre, C., Berchtold, A., & Michaud, P.A. (2011). A u-shaped association between intensity of internet use and adolescent health. *Pediatrics, 127*(2), e330-e335.

Berners-Lee, T. (2000). *Weaving the Web*. New York, NY: HarperCollins.

Blair, B. L., & Fletcher, A. C. (2011). "The only 13-year-old on Planet Earth without a cell phone": Meanings of cell phones in early adolescents' everyday lives. *Journal of Adolescent Research*, *26*(2), 155-177.

Blakemore, S. J. (2012). Development of the social brain in adolescence. *Journal of the Royal Society of Medicine*, *105*(3), 111-116.

Blanchard, M., Metcalf, A., Degney, J., Herman, H., & Burns, J. (2008). Rethinking the digital divide: findings from a study of marginalised young people's information communication technology (ICT) use. *Youth Studies Australia*, *27*(4), 35-42.

Bland, J.M., & Altman, D.G. (1995). Multiple significance tests: The Bonferroni method. *British Medical Journal, 310*(6973), 170.

Blignaut, S., & Els, C. (2010). Towards a research framework for ICT use in developing contexts. *Journal of Systemics, Cybernetics & Informatics, 8*(1), 25-33.

Bodden, D.H.M., Bögels, S.M., & Muris, P. (2009). The diagnostic utility of the Screen for Child Anxiety Related Emotional Disorders-71 (SCARED-71). *Behaviour Research and Therapy, 47*, 418-425. doi:10.1016/j.brat. 2009.01.015

Bonetti, L., Campbell, M.A., & Gilmore, L. (2010). The relationship of loneliness and social anxiety with children's and adolescents' online communication. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 279-285.

Bosch, T.E. (2008). WOTS ur ASLR? Adolescent girls' use of cellphones in Cape Town. *Commonwealth Youth and Development, 6*(2), 52-69.

Brand, M., Young, K. S., & Laier, C. (2014). Prefrontal control and Internet addiction: A theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience*, *8*, 375-388. doi:10.3389/fnhum.2014.00375

Brenhouse, H. C., & Andersen, S. L. (2011). Developmental trajectories during adolescence in males and females: a cross-species understanding of underlying brain changes. *Neuroscience and Biobehavioral Reviews*, *35*(8), 1687-1703.

Bridges, E.M. (1992). *The incompetent teacher*. Oxford, UK: Routledge.

Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives of human development*. Thousand Oaks, CA: Sage.

Bronfenbrenner, U., & Morris, P. A. (2006). The bio-ecological model of human development. In W. Damon & R. M. Lerner (Eds. in Chief.) & R. M. Lerner (Vol. Ed.), *Handbook of child psychology: Vol: 1. Theoretical models of human development* (6th ed.) (pp. 793-828). Hoboken, NJ: Wiley.

Brown, T.M. (2014). "I just want to work hard": Self-efficacy and the social contexts in adolescents' ICT use. *Youth and Society, 46*(6), 853-874. doi:10.1177/0044118X12455026

Brownlee, K., Rawana, J., Franks, J., Harper, J., Bajwa, J., O'Brien, E., & Clarkson, A. (2013). A systematic review of strengths and resilience outcome literature relevant to children and adolescents. *Child and Adolescent Social Work Journal, 30(*5), 435-459. doi: 10.1007/s10560-013-0301-9

Buckingham, D. (2013). *After the death of childhood*. Cambridge, United Kingdom: John Wiley & Sons.

Buckley, J. A., & Epstein, M. H. (2004). The Behavioral and Emotional Rating Scale-2 (BERS-2): Providing a comprehensive approach to strength-based assessment. *The California School Psychologist, 9*(1), 21-27.

Burns, J. M., Durkin, L. A., & Nicholas, J. (2009). Mental health of young people in the United States: what role can the internet play in reducing stigma and promoting help seeking? *Journal of Adolescent Health*, *45*(1), 95-97. doi: 10.1016/j.jadohealth.2008.12.006

Calvert, S. L., & Wartella, E. A. (2014). Children and electronic media. In E.T. Gershoff, R.S. Mistry, & D.A. Crosby (Eds.), *Societal contexts of child development: Pathways of influence and implications for practice and policy* (pp. 175-187). New York, NY: Oxford University Press.

Campbell, R. (2006). Teenage girls and cellular phones: Discourses of independence, safety and 'rebellion'. *Journal of Youth Studies, 9*(2), 195-212.

Carr, N. (2010). *The shallows: What the internet is doing to our brains*. New York, NY: W.W. Norton & Company.

Casey, B. J., & Jones, R. M. (2010). Neurobiology of the adolescent brain and behavior: implications for substance use disorders. *Journal of the American Academy of Child & Adolescent Psychiatry, 49*(12), 1189-1201.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*(1), 111-126.

Cash, H., Rae, C. D., Steel, A. H., & Winkler, A. (2012). Internet addiction: A brief summary of research and practice. *Current Psychiatry Reviews*, *8*(4), 292-298. doi: 10.2174/157340012803520513

Chatfield, T. (2012). *How to thrive in the digital age*. London, UK: Macmillan.

Chen, P., & McGrath, D. (2003). Knowledge construction and knowledge representation in high school students' design of hypermedia documents. *Journal of Educational Multimedia and Hypermedia, 12*(1), 33-61.

Chen, S.Y., & Tzeng, J.Y. (2010). College female and male heavy internet users' profiles of practices and their academic grades and psychosocial adjustment. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 257-262.

Chesley, N., & Johnson, B. E. (2014). Information and communication technology use and social connectedness over the life course. *Sociology Compass, 8*(6), 589-602.

China Internet Network Information Center (CNNIC). (2010). *Statistical survey report on internet development in China*. Beijing, China: CINIC.

Choi, K., Son, H., Park, M., Han, J., Kim, K., Lee, B., & Gwak, H. (2009). Internet overuse and excessive daytime sleepiness in adolescents. *Psychiatry and Clinical Neurosciences, 63*(4), 455-462. doi: 10.1111/j.1440-1819.2009.01925.x

Cicchetti, D., & Tucker, D. (1994). *Development and self-regulatory structures of the mind. Development and Psychopathology, 6*(4), 533-549.

Clinton, C., & Steyer, J.P. (2012, May 21). Is the internet hurting children? Retrieved from http://edition.cnn.com

Collins, W. A., & Laursen, B. (2004). Changing relationships, changing youth interpersonal contexts of adolescent development. *The Journal of Early Adolescence, 24*(1), 55-62. doi: 10.1177/0272431603260882

Crews, F., He, J., & Hodge, C. (2007). Adolescent cortical development: a critical period of vulnerability for addiction. *Pharmacology Biochemistry and Behavior, 86*(2), 189-199.

Christakis, D.A., & Zimmerman, F.J. (2006). *Media as public health issue. Archives of Pediatric and Adolescent Medicine, 160*, 445-446.

Christakou, A., Gershman, S.J., Niv, Y., Simmons, A., Brammer, M., & Rubia, K. (2013). Neural and psychological maturation of decision-making in adolescence and young adulthood. *Journal of Cogntive Neuroscience, 25*(11), 1807-1823. doi: 10.1162/jocn_a_00447

Chuma, W. (2014). The social meanings of mobile phones among South Africa's 'digital natives': A case study. *Media, Culture & Society, 36*(3), 398-408. doi: 10.1177/0163443713517842

Clark, N.L., & Worger, W.H. (2013). *South Africa: the rise and fall of Apartheid (2nd Ed.).* New York, NY: Routledge.

Cohen, L., Pooley, J.A., Ferguson, C., & Harms, C. (2011). Psychologists' understanding of resilience: Implications for the discipline of psychology and psychology practice. *The Australian Community Psychologist, 23*(2), 7-22.

Cotton, S., Anderson, W., & Tufekci, Z. (2009). Old wine in a new technology, or a different type of digital divide? *New Media & Society, 11*(7), 1163-1186.

Crisp, B. R. (2010). Belonging, connectedness and social exclusion. *Journal of Social Inclusion*, *1*(2), 123-132.

Crockett, L.J., & Silbereisen, R.K. (2000). Social change and adolescent development: Issues and challenges. *Faculty Publications, Department of Psychology, University of Nebraska – Lincoln*. Paper 243. Retrieved from http://digitalcommons. unl.edu/psychfacpub/243

Cyranowski, J.M., Frank, E., Young, E., & Shear, M.K. (2000). Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Archives of General Psychiatry*, *57*(1), 21-27.

Dahl, R.E. (2004). Adolescent brain development: A period of vulnerabilities and opportunities. Keynote address. *Annals of the New York Academy of Sciences, 1021*, 1-22. doi:10.1196/annals.1308.001

Darling, N. (2007). Ecological systems theory: The person in the center of the circles. *Research in Human Development, 4*, 203-217.

De Saint-Exupéry, A. (1942). *Flight to Arras*. New York, NY: Harbrace Paperbound Library.

De Saint-Exupéry, A. (1945). *The little prince*. London, UK: Heinemann.

De Villiers, M. (2009). *Die ontwikkeling en evaluering van 'n intervensieprogram om kinders se stresweerstandigheid te bevorder*. *[The development and evaluation of an intervention programme to promote child resiliency]*. (Unpublished doctoral dissertation). University of the Free State, Bloemfontein, South Africa.

Dolle, K., Schulte-Körne, G., O'Leary, A. M., von Hofacker, N., Izat, Y., & Allgaier, A. K. (2012). The Beck Depression Inventory-II in adolescent mental health patients: Cut-off scores for detecting depression and rating severity. *Psychiatry Research*, *200*(2), 843-848.

Doong, S.H., & Ho, S-C. (2012). The impact of ICT development on the global digital divide. *Electronic Commerce Research and Applications, 11*, 518-533. doi: 10.1016/j.elerap.2012.02.002.

Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: A comparitive study of 39 countries. *Computers and Education, 74,* 98-111.

Duran, R. L., Kelly, L., & Rotaru, T. (2011). Mobile phones in romantic relationships and the dialectic of autonomy versus connection. *Communication Quarterly, 59*(1), 19-36.

Durkee, T., Kaess, M., Carli, V., Parzer, P., Wasserman, C., Floderus, B., ... & Wasserman, D. (2012). Prevalence of pathological internet use among adolescents in Europe: demographic and social factors. *Addiction*, *107*(12), 2210-2222. doi: 10.1111/j.1360-0443.2012.03946.x

Eastin, M., Greenberg, B.S., & Hofschire, L. (2006). Parenting the internet. *Journal of Communication, 56*, 486-504.

Eisenberg, N., Champion, C., & Ma, Y. (2004). Emotion-related regulation: An emerging construct. *Merrill-Palmer Quarterly, 50*, 236-259.

Endestad, T., Heim, J., Kaare, B., Torgersen, L., & Brandtzæg, P.B. (2011). Media user types among young children and social displacement. *Nordicom Review, 32(1),* 17-30.

Epstein, M.H. (2004). *BERS2 Behavioral and emotional rating scale: A strength-based approach to assessment.* Austin, TX: Pro-Ed.

Epstein, M.H. (2000). The behavioral and emotional rating scale: A strength-based approach to assessment. *Assessment for Effective Intervention, 25*(3), 249-256. doi: 10.1177/073724770002500304

Epstein, M. H., & Sharma, J. (1998). *Behavioural and emotional rating scale: A strength-based approach to assessment.* Austin, TX: Pro-Ed.

Erikson, E.H. (1968). *Identity, youth and crisis.* New York, NY: W. W. Norton.

Ernst, M., & Korelitz, K.E. (2009). Cerebral maturation in adolescence: behavioral vulnerability. *Encephale, 35*, S182-189. doi:10.1016/S0013-7006(09)73469-4

Ernst, M., Pine, D. S., & Hardin, M. (2006). Triadic model of the neurobiology of motivated behavior in adolescence. *Psychological Medicine, 36*(03), 299-312.

Erol, R.Y., & Orth, U. (2011). Self-esteem development from age 14 to 30 years: A longitudinal study. *Journal of Personality and Social Psychology, 101*(3), 607-619. doi: 10.1037/a0024299

Flook, L., & Fuligni, A.J. (2008). Family and school spillover in adolescents' daily lives. *Child Development, 79*(3), 776-787. doi: 10.1111/j.1467-8624.2008.01157.x

Friedman, R., & Chase-Landsdale, P.L. (2003). Chronic adversities. In M. Rutter & E. Taylor (Eds.), *Child and adolscent psychiatry (4th Ed.)* (pp. 261-276). Malden, Massachusetts: Blackwell Science.

Frost, R. (1916). *Mountain interval*. New York, NY: Henry Holt & Company.

Gentile, D.A. (2011). The multiple dimensions of video game effects. *Child Development Perspectives*, *5*(2), 75-81.

Ghassemzadeh, L., Shahraray, M., & Moradi, A. (2008). Prevalence of Internet addiction and comparison of Internet addicts and non-addicts in Iranian high schools. *CyberPsychology & Behavior*, *11*(6), 731-733.

Gilmore, K., & Meersand, P. (2014). Normal child and adolescent development. In R.E. Hales, S.C. Yudofsky, & L.W. Roberts (Eds.), *The American Psychiatric Publishing Textbook of Psychiatry (6th Ed)* (pp.139-174). Arlington, VA: American Psychiatric Publishing, Inc.

Greenfield, P., & Yan, Z. (2006). Children, adolescents, and the internet: A new field of inquiry in developmental psychology. *Developmental Psychology, 42*, 391-394.

Grieve, R., Indian, M., Witteveen, K., Anne Tolan, G., & Marrington, J. (2013). Face-to-face or Facebook: Can social connectedness be derived online?. *Computers in Human Behavior, 29*(3), 604-609.

Grolnick, W.S., Gurland, S.T., Jacob, K.F., & Decourcey, W. (2002). The development of self-determination in middle childhood and adolescence. In A.

Wigfield & J.S. Eccles (Eds.), *The development of achievement motivation* (pp. 147-171). San Diego, CA: Academic Press.

Gross, E.F., Juvonen, J., & Gable, S.L. (2002). Internet use and well being in adolescence. *Journal of Social Issues, 58*(1), 75-98.

Gudmundsdottir, G.B. (2010). From digital divide to digital equity: Learner's ICT competence in four primary schools in Cape Town, South Africa. *International Journal of Educaiton and Development Using Information and Communication Technology, 6*(2), 84-105.

Haig, B.D. (2014). *Investigating the psychological world: Scientific method in the behavioral sciences*. Cambridge, MA: MIT Press

Han, D.H., Bolo, N., Daniels, M.A., Arenella, L., Lyoo, I.K., & Renshaw, P.F. (2011). Brain activity and desire for internet video game play. *Comprehensive Psychiatry, 52*, 88-95.

Hardy, L. L., Denney-Wilson, E., Thrift, A. P., Okely, A. D., & Baur, L. A. (2010). Screen time and metabolic risk factors among adolescents. *Archives of Pediatrics and Adolescent Medicine, 164*(7), 643-649.

Hare, T. A., Tottenham, N., Galvan, A., Voss, H. U., Glover, G. H., & Casey, B. J. (2008). Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-nogo task. *Biological Psychiatry*, *63*(10), 927-934.

Harris, C., Straker, L., & Pollock, C. (2013). The influence of age, gender and other information technology use on young people's computer use at school and home. *Work: A Journal of Prevention, Assessment and Rehabilitation, 44*(Supplement 1), S61-S71.

Harris, E.E. (2013). *Hypothesis and perception: The roots of scientific method.* New York, NY: Routledge.

Hawi, N.S. (2012). Internet addiction among adolescent in Lebanon. *Computers in Human Behavior, 28*, 1044-1053. doi: 10.1016/j.chb.2012.01.007

Hines, M. (2011). Gender development and the human brain. *Annual Review of Neuroscience, 34*, 69-88. doi: 10.1146/annurev-neuro-061010-113654

Holtz, P., & Appel, M. (2011). Internet use and video gaming predict problem behavior in early adolescence. *Journal of Adolescence, 34*, 49-58.

Hong, S. B., Zalesky, A., Cocchi, L., Fornito, A., Choi, E. J., Kim, H. H., ... & Yi, S. H. (2013). Decreased functional brain connectivity in adolescents with internet addiction. *PloS One*, *8*(2), e57831. doi:10.1371/journal.pone. 0057831

Huang, C. (2010). Internet use and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 241-249.

Huhman, M., Lowry, R., Lee, S. M., Fulton, J. E., Carlson, S. A., & Patnode, C. D. (2012). Physical activity and screen time: Trends in US children aged 9 to 13 years, 2002-2006. *Journal of Physical Activity and Health, 9*(4), 508.

International Telecomunication Union. (2013). *World telecommunication/ICT indicators database 2013 (17th edition).*

Isaacs, S. (2002, November). IT's Hot for Girls! ICTs as an instrument in advancing girls' and women's capabilities in school education in Africa. In *United Nations Division for the advancement of Women Expert Group Meeting "Information and Communication Technologies and their impact on and use as an instrument for the advancement and empowerment of women" Seoul, Republic of Korea* (pp. 11-14).

Jackson, L.A., von Eye, A., Fitzgerald, H.E. (2010). Self-concept, self-esteem, gender, race and information technology use. *Computers in Human Behaviour, 26*, 323-328.

Jackson, L.A., von Eye, A., Fitzgerald, H.E., Witt, E.A., & Zhao, Y. (2011). Internet use, videogame playing and cell phone use as predictors of children's body mass index (BMI), body weight, academic performance, and social and overall self-esteem. *Computers in Human Behavior, 27*, 599-604.

Jackson, L.A., Zhao, Y., Kolenic, A., Fitzgerald, H.E., Harold, R., & von Eye, A. (2008). Race, gender and information technology use: The new digital divide. *Cyberpsychology and Behavior, 11*(4), 437-442.

Jimerson, S.R., Sharkey, J.D., Nyborg, V., & Furlong, M.J. (2004). Strength-based assessment and school psychology: A summary and synthesis. *The California School Psychologist, 9*, 9-19.

Johnson, G. M. (2010a). Internet use and child development: The techno-microsystem. *Australian Journal of Educational & Developmental Psychology, 10*, 32-43.

Johnson, G. M. (2010b). Internet use and child development: Validation of the ecological techno-subsystem. *Educational Technology & Society, 13*(1), 176-185.

Johnson, G.M. (2006). Internet use and cognitive development: A theoretical framework. *E-Learning, 4*, 565-573.

Johnson, G.M., & Puplampu, P. (2008). A conceptual framework for understanding the effect of the internet on child development: The ecological techno-subsystem. *Canadian Journal of Learning and Technology, 34*(1), 19-28.

Joinson, C., Heron, J., Lewis, G., Croudace, T., & Araya, R. (2011). Timing of menarche and depressive symptoms in adolescent girls from a UK cohort. *The British Journal of Psychiatry, 198*(1), 17-23.

Jordan, J. V. (2013). Relational resilience in girls. In S. Goldstein & R.B. Brooks (Eds.), *Handbook of resilience in children* (pp. 73-86). New York, NY: Springer. doi: 10.1007/978-1-4614-3661-4

Jose, P. E., Ryan, N., & Pryor, J. (2012). Does social connectedness promote a greater sense of well-being in adolescence over time? *Journal of Research on Adolescence, 22*(2), 235-251.

Judi, H. M., Ashaari, N., Zin, N. A. M., & Yusof, Z. M. (2013). Framework of ICT Impact on Adolescent. *Procedia Technology, 11*, 1034-1040.

Kaess, M., Durkee, T., Brunner, R., Carli, V., Parzer, P., Wasserman, C., …Wasserman, D. (2014). Pathological internet use among European adolescents: psychopathology and self-destructive behaviours. *European Child and Adolescent Psychiatry, 23*(1), 1093-1102. doi:10.1007/s00787-014-0562-7

Karlsen, J. E., Gual, A., & Anderson, P. (2013). Foresighting addiction and lifestyles in Europe 2030+. *European Journal of Futures Research, 1*(1), 1-10.

Keating, D. P. (2012). Cognitive and brain development in adolescence. *Enfance, 3*, 267-279. http://dx.doi.org/10.4074/S0013754512003035

Ko, C. H., Liu, T. L., Wang, P. W., Chen, C. S., Yen, C. F., & Yen, J. Y. (2014). The exacerbation of depression, hostility, and social anxiety in the course of internet addiction among adolescents: a prospective study. *Comprehensive Psychiatry, 55,* 1377-1384.

Koo, H. J., & Kwon, J. H. (2014). Risk and protective factors of internet addiction: A meta-analysis of empirical studies in Korea. *Yonsei Medical Journal, 55*(6), 1691-1711.

Kraut, R., Kiesler, S., Boneva, B., Cummings, J., Helgeson, V., & Crawford, A. (2002). Internet paradox revisited. *Journal of Social Issues, 58*(1), 49-74.

Laconi, S., Rodgers, R. F., & Chabrol, H. (2014). The measurement of internet addiction: A critical review of existing scales and their psychometric properties. *Computers in Human Behavior*, *41*, 190-202.

Lai, C-H., & Gwung, H-L. (2013). The effect of gender and internet usage on physical and cyber interpersonal relationships. *Computers and Education, 69*, 303-309.

Lai, C. H., Lin, C. Y., Chen, C. H., Gwung, H. L., & Li, C. H. (2013). Can internet usage positively or negatively affect interpersonal relationship?. In *Advances in Intelligent Systems and Applications-Volume 1* (pp. 373-382). Berlin: Springer

Lakey, B., & Orehek, E. (2011). Relational regulation theory: a new approach to explain the link between perceived social support and mental health. *Psychological Review, 118*(3), 482.

Lam, L. T. (2014). Risk factors of internet addiction and the health effect of internet addiction on adolescents: A systematic review of longitudinal and prospective studies. *Current Psychiatry Reports*, *16*(11), 1-9. doi:10.1007/ s11920-014-0508-2

Lanigan, J.D. (2009). A sociotechnological model for family research and intervention: How information and communication technologies affect family life. *Journal of Marriage & Family Review, 45*, 587-609. doi: 10.1080/ 01494920903224194

LaRose, R., Lin, C. A., & Eastin, M. S. (2003). Unregulated internet usage: Addiction, habit, or deficient self-regulation?. *Media Psychology*, *5*(3), 225-253.

Legerstee, J. S., Verhulst, F. C., Robbers, S. C., Ormel, J., Oldehinkel, A. J., & van Oort, F. V. (2013). Gender-specific developmental trajectories of anxiety during adolescence: Determinants and outcomes. The TRAILS Study. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *22*(1), 26-34.

Leonard, J. (2011). Using Bronfenbrenner's ecological theory to understand community partnerships: A historical case study of one urban high school. *Urban Education, 46*(5), 987-1010. doi: 10.1177/0042085911400337

Lewandowski, G. W., Mattingly, B. A., & Pedreiro, A. (2014). Under pressure: the effects of stress on positive and negative relationship behaviors. *The Journal of Social Psychology*, *154*(5), 463-473.

Lewix, B. (2014). *Raising children in a digital age: Enjoying the best, avoiding the worst.* Oxford, UK: Lion Books.

Li, X., Shi, M., Wang, Z., Shi, K., Yang, R., & Yang, C. (2010, August). Resilience as a predictor of internet addiction: The mediation effects of perceived class climate and alienation. In *Web Society (SWS), 2010 IEEE 2nd Symposium on* (pp. 66-70). IEEE. doi: 10.1109/SWS.2010.5607478

Lin, F., Zhou, Y., Du, Y., Qin, L., Zhao, Z., Xu, J., & Lei, H. (2012). Abnormal white matter integrity in adolescents with internet addiction disorder: a tract-based spatial statistics study. *PloS One, 7*(1), e30253. doi:10.1371/ journal.pone.0030253

Livingstone, S., & Helsper, E.J. (2008). Parental mediation and children's internet use. Journal of broadcasting & electronic media, 52(4), 581-599. doi: 10.1080/08838150802437396.

Louw, D., & Louw, A. (2007). *Child and adolescent development.* Bloemfontein, South Africa: Psychology Publications.

Louw, A.E., & Winter, M. (2011). The use and trends of information and communication technology (ICT) during middle childhood. *Journal of Child and Adolescent Mental Health, 23*(1), 29-42. doi:10.2989/ 17280583.2011.594247

Luszczynska, A., Gutierrez-Dona, B., & Schwarzer, R. (2005). General self-efficacy in various domains of human functioning: Evidence from five countries. *International Journal of Psychology, 40*(2), 80-89.

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543-562.

Luthar, S.S., & Zelazo, L.B. (2003). Research on resilience: An integrative review. In S.S. Luthar (Ed.), *Resilience and vulnerability: Adaption in the context of childhood adversities* (pp. 510-549). New York, NY: Cambridge University Press.

Lynch, J.G. (2012). *Perceived stress and the buffering hypothesis of perceived social support on Facebook*. (Unpublished doctoral dissertation). Antioch University, Los Angeles, CA.

Ma, H.K., Li, S.C., & Pow, J.W.C. (2011). The relation of internet use to prosocial and antisocial behavior in Chinese adolescents. *Cyberpsychology, Behavior, and Social Networking, 14*(3), 123-130.

Magee, R. M., Agosto, D. E., Forte, A., & Dickard, M. (2014). Examining teens' non-use of technologies. *Technology*, *15*, 289.

Mandara, J., Varner, F., & Richman, S. (2010). Do African American mothers really "love" their sons and "raise" their daughters? *Journal of Family Psychology*, *24*, 41–50. doi:10.1037/a0018072

Masten, A.S., Burt, K.B., & Coatsworth, J.D. (2006). Competence and psychopathology in development. In D. Cicchetti & D. Cohen (Eds.), *Handbook of developmental psychopathology* (2ⁿᵈ Ed., Vol. 3) (pp. 696-738). New York, NY: Wiley.

Masten, A.S. & Obradovic, J. (2006). Competence and resilience in development. *Annals of the New York Academy of Science, 1094*, 13-27.

Mathers, M., Canterford, L., Olds, T., Hesketh, K., Ridley, K., & Wake, M. (2009). Electronic media use and adolescent health and well-being: cross-sectional community study. *AcademicPpediatrics, 9*(5), 307-314.

Mbinjama, A. (2013). Language and cultural ideologies on the internet: Social media use of adolescents in semi-rural South Africa. *Journal of Intercultural Disciplines, 11*, 58.

McLuhan, M. (1964). *Understanding media: The extensions of man*. London, UK: Routledge.

McNelles, L.R., & Connolly, J.A. (1999). Intimacy between adolescent friends: Age and gender differences in intimate affect and intimate behaviors. *Journal of Research on Adolescence, 9*, 143-159.

McRae, K., Gross, J. J., Weber, J., Robertson, E. R., Sokol-Hessner, P., Ray, R. D., ... & Ochsner, K. N. (2012). The development of emotion regulation: an

fMRI study of cognitive reappraisal in children, adolescents and young adults. *Social Cognitive and Affective Neuroscience, 7*(1), 11-22.

Meerkerk, G.J., Van den Eijnden, R.J., Vermulst, A.A., & Garretsen, H.F. (2009). The compulsive internet use scale (CIUS): some psychometric properties. *CyberPsychology & Behavior, 12*(1), 1-6.

Mills, K.L. (2014). Effects of internet use on the adolescent brain: Despite popular claims, experimental evidence remains scarce. *Trends in Cognitive Sciences, 18*(8), 385-387.

Misra, S., Cheng, L., Genevie, J., & Yuan, M. (2014). The iPhone effect: The quality of in-person social interactions in the presence of mobile devices. *Environment and Behavior*, 1-24. doi:10.1177/0013916514539755.

Moksnes, U. K., Moljord, I. E., Espnes, G. A., & Byrne, D. G. (2010). The association between stress and emotional states in adolescents: The role of gender and self-esteem. *Personality and Individual Differences*, *49*(5), 430-435.

Monetti, D. M., Whatley, M. A., Hinkle, K. T., Cunningham, T., Breneiser, J. E., & Kisling, R. (2011). A factor analytic study of the internet usage scale. *Journal of Research in Education*, *21*(2), 14-23

Moreno, M.A., Jelenchick, L.A., & Christakis, D.A. (2013). Problematic internet use among older adolescents: A conceptual framework. *Computers in Human Behavior, 29*, 1879-1887.

Moreno, M. A., Jelenchick, L., Cox, E., Young, H., & Christakis, D. A. (2011). Problematic internet use among US youth: a systematic review. *Archives of Pediatrics &Aadolescent Medicine, 165*(9), 797-805.

Moreno, M. A., Jelenchick, L., Koff, R., Eikoff, J., Diermyer, C., & Christakis, D. A. (2012). Internet use and multitasking among older adolescents: An experience sampling approach. *Computers in Human Behavior*, *28*(4), 1097-1102.

Naninck, E. F. G., Lucassen, P. J., & Bakker, J. (2011). Sex differences in adolescent depression: do sex hormones determine vulnerability?. *Journal of Neuroendocrinology*, *23*(5), 383-392.

Oberle, E., Schonert-Reichl, K.A., & Thomson, K.C. (2010). Understanding the link between social and emotional well-being and peer relations in early adolescence: Gender-specific predictors of peer acceptance. *Journal of Youth and Adolescence, 39*(11), 13330-1342.

Odendaal, W., Malcolm, C., Savahl, S., & September, R. (2006). Adolescents, their parents, and information and communication technologies: Exploring adolescents' perceptions on how these technologies present in parent-adolescent relationships. *Indo-Pacific Journal of Phenomenology*, *6*(1),1-8.

O'Keeffe, G. S., & Clarke-Pearson, K. (2011). The impact of social media on children, adolescents, and families. *Pediatrics, 127*(4), 800-804.

Ostlund, U., Kidd, L., Wengstrom, Y., & Rowa-Dewar, N. (2011). Combining qualitative and quantitative research within mixed method research designs: a methodological review. *International Journal of Nursing Studies*, *48*(3), 369-383.

Øverby, N. C., Klepp, K. I., & Bere, E. (2013). Changes in screen time activity in Norwegian children from 2001 to 2008: two cross sectional studies. *BMC public health, 13*(1), 80.

Oyedemi, T. (2015). Participation, citizenship and internet use among South African youths. *Telematics and Informatics, 32*(1), 11-22. http://dx.doi.org/ 10.1016/j.tele.2014.08.002

Padilla-Walker, L. M., Fraser, A. M., Black, B. B., & Bean, R. A. (2014). Associations between friendship, sympathy, and prosocial behavior toward friends. *Journal of Research on Adolescence*. doi: 10.1111/jora.12108

Page, A. S., Cooper, A. R., Griew, P., & Jago, R. (2010). Children's screen viewing is related to psychological difficulties irrespective of physical activity. *Pediatrics, 126*(5), e1011-e1017.

Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives*. New York, NY: Basic Books

Papoušek, M. (2011). Resilience, strengths, and regulatory capacities: Hidden resources in developmental disorders of infant mental health. *Infant Mental Health Journal, 32*(1), 29-46. doi: 10.1002/imhj.20282

Park, A., Clery, E., Curtice, J., Phillips, M., & Utting, D. (Eds.). (2012). *British social attitudes*. London: Sage Publications.

Park, S.K., Kim, J.Y., & Cho, C.B. (2007). Prevalence of internet addiciton and correlations with family factors among South Korean adolescents. *Adolescence, 43*(172), 895-909.

Pettit, G. S., Laird, R. D., Dodge, K. A., Bates, J. E., & Criss, M. M. (2001). Antecedents and behavior- problem outcomes of parental monitoring and psychological control in early adolescence. *Child Development, 72*, 583–598. doi:10.1111/1467- 8624.00298

Pew Research Center. (2014). *The web at 25*. Retrieved from http://www.pewinternet.org/2014/02/25/the-web-at-25-in-the-us

Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching, 2*(3), 176-186.

Pinquart, M., & Silbereisen, R.K. (2004). Human development in times of social change: Theoretical considerations and research needs. *International Journal of Behavioral Development, 28*(4), 289-298. doi: 10.1080/01650250344000406

Pollard, E.L., & Rosenberg, M.L. (2003). The strength-based approach to child. In M.H. Borstain, L.Davidson, C.L.M. Keys, & K.A. Moore (Eds.), *Well-being. Positive development across the life course* (pp. 13-22). London, UK: Lawrence Erlbaum.

Popper, K. (2002). *Conjectures and refutations: The growth of scientific knowledge.* New York, NY: Routledge.

Postman, N. (1985). *Amusing ourselves to death: Public discourse in the age of show business.* London, UK: Penguin Books.

Prentice, R.L. (1995). Design issues in cohort studies. *Statistical methods in medical research, 4*(4), 273-292. doi: 10.1177/096228029500400402

Prince-Embury, S. (2006). *Resiliency scales for children and adolescents. A profile of personal strengths.* San Antonio, TX: Harcourt assessment.

Prince-Embury, S., & Saklofske, D.H. (Eds.). (2013). *Resilience in children, adolescents, and adults: Translating research into practice.* New York, NY: Springer.

Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. *Computers in Human Behavior*, *29*(4), 1841-1848.

Purcell, K., Rainie, L., Heaps, A., Buchanan, J., Friedrich, L., Jacklin, A., ... & Zickuhr, K. (2012). *How teens do research in the digital world*. Washington, DC: Pew Internet & American Life Project.

Raday, F. (2003). Culture, religion, and gender. *International Journal of Constitutional Law, 1*(4), 663-715.

Rideout, V.J., Foehr, U.G., & Roberts, D.F. (2010). *Generation M² – Media in the lives of 8- to 18-year-olds.* Menlo Park, CA: Kaiser Family Foundation.

Rosen, L.D. (2012). *iDisorder: understanding our obsession with technology and overcoming is hold on us.* New York, NY: Palgrave MacMillan.

Rosen, L. D., Cheever, N. A., & Carrier, L. M. (2008). The association of parenting style and child age with parental limit setting and adolescent MySpace behavior. *Journal of Applied Developmental Psychology*, *29*(6), 459-471.

Rutter, M. (2012). Resilience as a dynamic concept. *Development and psychopathology, 24*(02), 335-344.

Rutter, M., & Taylor, E. (2003). *Child and adolescent psychiatry (4th Ed.).* Malden, MA: Blackwell Science.

Salmela-Aro, K., & Tynkkynen, L. (2012). Gendered pathways in school burnout among adolescents. *Journal of Adolescence, 35*(4), 929-939. doi:10.1016/j.adolescence.2012.01.001

Sapienza, J. K., & Masten, A. S. (2011). Understanding and promoting resilience in children and youth. *Current Opinion in Psychiatry, 24*(4), 267-273.

Savahl, S., September, R., Odendaal, W., & Moos, A. (2008). Information and communication technology: A descriptive study of children's communication patterns. *South African Journal of Psychology, 38*, 515-525.

Sawyer, M. (2012, December). Are your kids addicted to computers? *Fairlady*, 40-45.

Schiffrin, H., Edelman, A., Falkenstern, M., & Stewart, C. (2010). The associations among computer-mediated communication, relationships, and well-being. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 299-306.

Schofield-Clark, L. (2005). The constant contact generation: Exploring teen friendship networks online. In S.R. Mazzarella (Ed.), *Girl wide web: Girls, the internet and the negotiation of identity* (pp. 203-221). New York, NY: Peter Lang.

Schouten, A.P., Valkenburg, P.M., & Peter, J. (2007). Precursors and underlying processes of adolescents' online self-disclosure: Developing and testing and "internet-attribute-perception" model. *Media Psychology, 10*, 292-314.

Schraml, K., Perski, A., Grossi, G., & Simonsson-Sarnecki, M. (2011). Stress symptoms among adolescents: The role of subjective psychosocial conditions, lifestyle, and self-esteem. *Journal of adolescence*, *34*(5), 987-996.

Shaffer, H. J., Peller, A. J., LaPlante, D. A., Nelson, S. E., & LaBrie, R. A. (2010). Toward a paradigm shift in internet gambling research: From opinion and self-report to actual behavior. *Addiction Research & Theory*, *18*(3), 270-283.

Shank, D. B., & Cotten, S. R. (2014). Does technology empower urban youth? The relationship of technology use to self-efficacy. *Computers & Education*, *70*, 184-193. doi: 10.1016/j.compedu.2013.08.018

Shapira, N.A., Goldsmith, T.D., Keck, P.E., Khosla, U.M., & McElroy, S.L. (2000). Psychiatric features of individuals with problematic internet use. *Journal of Affective Disorders, 57*(1-3), 267-272.

Shapiro, L. A. S., & Margolin, G. (2014). Growing up wired: Social networking sites and adolescent psychosocial development. *Clinical Child and Family Psychology Review*, *17*(1), 1-18.

Sharp, L. K., & Lipsky, M. S. (2002). Screening for depression across the lifespan. *American Family Physician*, *66*(6), 1001-1008.

Shearer, C. L., Crouter, A. C., & McHale, S. M. (2005). Parents' perceptions of changes in mother-child and father-child relationships during adolescence. *Journal of Adolescent Research*, *20*(6), 662-684.

Shek, D.T., & Yu, L. (2012). Internet addiction in Hong Kong adolescents: profiles and psychosocial correlates. *International Journal on Disability and Human Development, 11*(2), 133-142. doi: 10.1515/ijdhd-2012-0023

Shipman, M. (2014). *The limitations of social research (4th ed.)*. New York, NY: Routledge.

Siegel, D.J. (1999). *The developing mind: How relationships and the brain interact to shape who we are.* New York, NY: Guilford.

Sigelman, C.K., & Rider, E.A. (2014). *Life-span human development*. Belmont, CA: Cengage Learning.

Sigman, A. (2012). Time for view on screen time. *Archive of Disease in Childhood, 97*(11), 935-942.

Silvers, J. A., McRae, K., Gabrieli, J. D. E., Gross, J. J., Remy, K. A., & Ochsner, K. N. (2012). Age-related differences in emotional reactivity, regulation, and rejection sensitivity in adolescence. *Emotion, 12*(6), 1-13. doi: 10.1037/a0028297

Skoric, M.M., Teo, L.L.C., & Neo, R.L. (2009). Children and video games: Addiction, engagement, and scholastic achievement. *Cyberpsychology and Behavior, 12(5), 567-572.*

Smith, D. (2014, November 30). *For the first time ever, Americans spend more time using mobile devices than TV* [Online article, published in Business Insider]. Retrieved from http://www.businessinsider.com/chart-of-the-day-americans-spend-more-time-using-mobile-devices-than-tv-2014-11

Sroufe, L.A. (1996). *Emotional development: the organization of emotional life in the early years.* New York, NY: Cambridge University Press.

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences, 9*(2), 69-74. doi: 10.1016/j.tics.2004.12.005

Strasburger, V. C., Hogan, M. J., Mulligan, D. A., Ameenuddin, N., Christakis, D. A., Cross, C., & Swanson, W. S. L. (2013). *Children, adolescents, and the media*. Pediatrics, 132(5), 958-961.

Stone, A.A., Turkkan, J.S., Bachrach, C.A., Jobe, J.B., Kurtzman, H.S., & Cain, V.S. (Eds.) (2009). *The science of self-report: Implications for research and Practice*. Mahwah, NJ: Taylor and Francis.

Suler, J. (2005). Adolescents in cyberspace: The good, the bad and the ugly. *Psychology in Cyberspace, 1*(5), 1-17.

Suoranta, J. (2003). The world divided in two: Digital divide, information and communication technologies, and the 'Youth Question'. *Journal for Critical Education Policy Studies, 1*(2), 1-31.

Tam, P., & Walter, G. (2013). Problematic internet use in childhood and youth: evolution of a 21st century affliction. *Australasian Psychiatry*, 1-4 doi:10.1177/ 1039856213509911.

Tao, R., Huang, X., Wang, J., Zhang, H., Zhang, Y., & Li, M. (2010). Proposed diagnostic criteria for internet addiction. *Addiction, 105*(3), 556-564. doi: 10.1111/j.1360-0443.2009.02828.x

Telecommunication Development Sector (ITU-D), Secretariat of Telecommunication Development Bureau (BDT), United Nations (UN). (2014). *The world in 2014: ICT facts and figures.* Retrieved from http:///.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf

Thadani, D. R., & Cheung, C. (2011, January). Online social network dependency: theoretical development and testing of competing models. In *Proceedings of the 44th Hawaii International Conference on System Sciences* (pp. 1-9). IEEE.

Theron, L.C., & Theron, A.M.C. (2010). A critical review of studies of South African youth resilience, 1990-2008. *South African Journal of Science, 106*(7-8), 1-8.

Tolan, P. (2014). Forward thinking: Preparing our youth for the coming world. *Journal of Research on Adolescence, 24*(3), 411-416. doi: 10.1111/jora.12155

Tonioni, F., D'Alessandris, L., Lai, C., Martinelli, D., Corvino, S., Vasale, M., ... & Bria, P. (2012). Internet addiction: hours spent online, behaviors and psychological symptoms. *General Hospital Psychiatry, 34*(1), 80-87.

Trout, A.L., Ryan, J.B., La Vigne, S.P., & Epstein, M.H. (2003). Behavioral and emotional rating scale: Two studies of convergent validity. *Journal of Child and Family Studies, 12*(4), 399-410. doi:10.1023/A:1026059906344

Troy, A.S., & Mauss, I.B. (2011). Resilience in the face of stress: Emotion regulation as a protective factor. In S.M. Southwick, B.T. Litz, D. Charney, & M.J. Friedman (Eds), *Resilience and mental health: Challenges across the lifespan* (pp.30-44). Cambridge, UK: Cambridge University Press.

Tsitsika, A., Critselis, E., Louizou, A., Janikian, M., Freskou, A., Marangou, E., ... & Kafetzis, D. A. (2011). Determinants of internet addiction among adolescents: A case-control study. *The Scientific World Journal, 11*, 866-874. doi: 10.1100/tsw.2011.85

Tudge, J.R.H., Mokrova, I., Hatfield, B.E., & Karnik, R.B. (2009). Uses and misuses of Bronfenbrenner's bioecological theory of human development. *Journal of Family Theory & Review, 1*, 198-210.

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other.* New York, NY: Basic Books.

Underwood, M.K., Rosen, L.H., More, D., Ehrenreich, S., & Gentsch, J.K. (2012). The BlackBerry Project: Capturing the content of adolescents' text messaging. *Developmental Psychology, 48*(2), 295-302. doi:10.1037/ a0025914

Ungar, M., Ghazinour, M., & Richter, J. (2013). Annual Research Review: What is resilience within the social ecology of human development? *Journal of Child Psychology and Psychiatry, 54*(4), 348-366.

Updegraff, K.A., McHale, S.M., Crouter, A.C., & Kupanoff, K. (2001). Parents' involvement in adolescents' peer relationships: A comparison of mothers' and fathers' roles. *Journal of Marriage and Family, 63*(3), 655-668. doi: 10.1111/j.1741-3737.2001.00655.x

Valkenburg, P. M., & Peter, J. (2007). Online communication and adolescent well- being: Testing the stimulation versus the displacement hypothesis. *Journal of Computer- Mediated Communication, 12*(4), 1169-1182.

Valkenburg, P.M., & Peter, J. (2009). Social consequences of the internet for adolescents: A decade of research. *Current Directions in Psychological Science, 18*(1), 1-5.

Valkenburg, P. M., & Peter, J. (2011). Online communication among adolescents: An integrated model of its attraction, opportunities, and risks. *Journal of Adolescent Health, 48*(2), 121-127.

Valkenburg, P.M., Peter, J., & Schouten, A.P. (2006). Friend networking sites and their relationship to adolescents' well-being and social self-esteem. *Cyberpsychology and Behavior, 9*, 584-590.

Van den Berg, H.S., George, A.A., Du Plessis, E.D., Botha, A., Basson, N., De Villiers, M., & Makola, S. (2013). The Pivotal Role of Social Support in the Well-Being of Adolescents. In M.P. Wissing (Ed.), *Well-Being Research in South Africa* (pp. 315-339). Amsterdam, Netherlands: Springer.

Van Den Eijnden, R.J., Spijkerman, R., Vermulst, A.A., van Rooij, T.J., & Engels, R.C. (2010). Compulsive internet use among adolescents: bidirectional parent–child relationships. *Journal of Abnormal Child Psychology*, *38*(1), 77-89.

Van der Merwe, P. (2013). South Africa's adolescents in a wired world. *International Journal of Criminology and Sociology, 2*, 348-361.

Varner, F., & Mandara, J. (2013). Differential parenting of African American adolescents as an explanation for gender disparities in achievement. *Journal of Research on Adolescence, 24*(4), 667-680. doi: 10.1111/jora.12063

Visser, M. (2007). *Contextualising community psychology in South Africa*. Pretoria, South Africa: Van Schaik

Volman, M., Van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education, 45*(1), 35-55.

Wallace, P. (2014). Internet addiction disorder and youth. *EMBO Reports*, *15*(1), 12-16. doi: 10.1002/embr.201238222

Wan, C. S., & Chiou, W. B. (2006). Why are adolescents addicted to online gaming? An interview study in Taiwan. *CyberPsychology and Behavior*, *9*(6), 762-766.

Wang, E.S.T., & Wang, M.C.H. (2013). Social support and social interaction ties on internet addiction: integrating online and offline contexts. *Cyberpsychology, Behavior, and social Networking, 16*(11), 843-849. doi: 10.1089/cyber.2012.0557.

Weber, D. M., & Kauffman, R. J. (2011). What drives global ICT adoption? Analysis and research directions. *Electronic Commerce Research and Applications*, *10*(6), 683-701.

Weinstein, A., Feder, L.C., Rosenberg, K.P., & Dannon, P. (2014). Internet addiction disorder: Overview and controversies. *Behavioral Addictions*, 99-117. http://dx.doi.org/10.1016/B978-0-12-407724-9.00005-7

Wentzel, K.R. (2005). Peer relationships, motivation, and academic performance at school. In A.J. Elliot & C.S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 279-296). New York, NY: Guilford Press.

Werner, E.E. (2013). What can we learn about resilience from large-scale longitudinal studies? In S. Goldstein & R.B. Brooks (Eds.), *Handbook of resilience in children* (pp. 87-109). New York, NY: Springer.

White, R.W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66*, 297-333.

Williams, D., Consalvo, M., Caplan, S., & Yee, N. (2009). Looking for gender: Gender roles and behaviors among online gamers. *Journal of Communication*, *59*(4), 700-725.

Wright, M.O., & Masten, A.S. (2013). Resilience processes in development. In S.Goldstein & R.B. Brooks (Eds.), *Handbook of resilience in children (2nd Ed.)* (pp. 15-37). New York, NY: Springer.

Yan, W., Li, Y., & Sui, N. (2014). The relationship between recent stressful life events, personality traits, perceived family functioning and internet addiction among college students. *Stress and Health*, *30*(1), 3-11.

Yao, M.Z., He, J., Ko, D.M., Pang, K. (2014). The influence of personality, parental behaviors, and self-esteem on Internet addiction: a study of Chinese college students. *Cyberpsychology, Behavior and Social Networking, 17*(2), 104-110. doi: 10.109/cyber.2012.0710

Yu, L., & Shek, D. T. L. (2013). Internet addiction in Hong Kong adolescents: a three-year longitudinal study. *Journal of Pediatric and Adolescent Gynecology*, *26*(3), S10-S17. http://dx.doi.org/10.1016/j.jpag.2013.03.010

Yuan, K., Qin, W., Wang, G., Zeng, F., Zhao, L., Yang, X., ... & Tian, J. (2011). Microstructure abnormalities in adolescents with internet addiction disorder. *PloS One, 6*(6), e20708.

Zheng, R., McAlack, M., Wilmes, B., Kohler-Evans, P., & Williamson, J. (2009). Effects of multimedia on cognitive load, self-efficacy, and multiple rule-based problem solving. *British Journal of Educational Technology, 40*(5), 790-803. doi: 10.1111/j.1467-8535.2008.00859.x

Zhou, Z., Zhu, H., Li, C., & Wang, J. (2014). Internet addictive individuals share impulsivity and executive dysfunction with alcohol-dependent patients. *Frontiers in Behavioral Neuroscience, 8*, 288. doi: 10.3389/fnbeh.2014.00288

Zimring, F.E. (2014). *The changing legal world of adolescence*. New Orleans, LA: Quid Pro Books.

APPENDICES

Appendix A: Biographical Questionnaire

1.   Age: _____

2.   Gender: Male   ☐

              Female   ☐

3.   Race: Asian   ☐

              Black   ☐

              Coloured   ☐

              White   ☐

              Other   ☐   Specify: _____

4.   Do you own a cell phone? Yes   ☐

                          No   ☐

5.   How many hours do you spend communicating with other people on
electronic social communication systems combined?

      (write the approximate no of <u>hours per day</u> - <u>not</u> more than <u>24
hours</u> per day)

*   During weekdays: _____
*   During weekends: _____ (average per day)