International Journal of Gender, Science and Technology
http://genderandset.open.ac.uk

Attracting Girls to a Career in Programming: A New Zealand Investigation

Alison Hunter[1], and Raewyn Boersen[2],

Manukau Institute of Technology[1] and Eastern Institute of Technology[2], New Zealand

ABSTRACT
Various interventions to attract girls into computing careers have been instigated around the world in recent years. There have also been many efforts to understand factors influencing girls' career choices, and several career choice models have been developed.

This pilot study investigated the career preferences of teenage girls who participated in a New Zealand-based intervention: the Programming Challenge 4 Girls. Results revealed three sociability needs as the girls' primary factors influencing career choice. The girls wanted a career that will allow them to engage socially, with a sense of fun, and in a 'cool' environment.

The study also investigated sources of information about programming careers. Most girls did not know where to seek programming career information and their parents and career advisors were found to need more knowledge about IT careers. A government careers website was unsatisfactory with respect to teenage girls' preferences, whereas an industry-based programme partially addressed girls' needs. The paper distinguishes between formal and informal sources of programming career information and proposes a modification to a widely-cited model of girls' career choices.

KEYWORDS
Computing; career choice models; girls; interventions; programming.

INTRODUCTION

Since 1989 there have been interventions in New Zealand aiming to encourage teenage girls to consider a computer programming career. The goal has been to help address the long-standing under-representation of women in New Zealand's IT industry, especially in programming roles. Interventions have had to adapt to rapidly changing audiences; today's teenage girls have unprecedented access to digital technologies, unlike the very limited access girls had 20-plus years ago.

Teenage girls' career choices are influenced by many factors (Genrich, Toleman, & Roberts, 2014; Gorbacheva, Craig, Beekhuyzen, & Coldwell, 2014). These factors have been represented in a variety of career choice models, including a frequently-cited model by Adya & Kaiser (2005). Teenage girls have certain criteria which are important to them in their future career and they receive career information from many different sources. In order to influence more girls to choose programming as a career, the information supplied needs to be comprehensive and in accord with the girls' criteria.

This paper reports on an investigation into girls' preferences regarding their future careers and appraises information available to girls who may be interested in a programming career. Data were collected in 2013 as part of a pilot study which also sought to evaluate the effectiveness of a New Zealand intervention: the Programming Challenge 4 Girls (PC4G). Throughout this paper we use the acronyms IT (Information Technology) and ICT (Information and Communication Technology) interchangeably, and at times we also refer to 'computing', but programming was the particular focus of the pilot study.

The paper makes several contributions. We specifically consider the career preferences and information needs of the current generation of teenage girls who may be interested in a programming career. We differentiate between informal sources of career information, for example family and friends, and formal sources such as government websites and school careers education programmes, and argue that formal sources have a particular responsibility to provide suitably comprehensive, gender-inclusive information that appeals to today's teenage girls. The classification of sources of career information as informal or formal, and therefore the distinction between and relative importance of these, is missing from Adya & Kaiser's (2005) model. Another contribution of this paper is therefore to propose a modification to Adya & Kaiser's (2005) model.

The paper is structured as follows: we first provide background details, followed by research aims and a literature review. The methodology section identifies our specific research questions and describes our participants and survey instrument. We next explain ethical procedures, data collection, and analysis methods. We then present our results, and finish by acknowledging limitations of the study, suggesting future possibilities, and stating our conclusions.

BACKGROUND TO THE STUDY

The Under-Representation of Women in IT

Women have been under-represented in New Zealand's IT industry for many years (Hunter, 2012). Currently only 25% of professional IT roles are occupied by women (Statistics New Zealand, 2014) and data concerning programming roles show even greater gender disparity, with women occupying only 10% of "software and application programming" roles (Statistics New Zealand, 2014). New Zealand's tertiary education statistics also reveal significant under-representation; in 2013 women received only 14% of Bachelor's degrees in Computer Science and 19% in Information Systems (Education Counts Statistics, 2014).

Many other Western countries report a similar long-term under-representation of women in IT, for example Canada (Hango, 2013), the USA (National Center for Women & Information Technology, 2015), Australia (Craig, 2014), the UK (Careers Research and Advisory Centre 2008; Griffiths & Moore, 2010) and Sweden (Statistics Sweden, 2012).

There have been many attempts to understand girls' career choices in these countries and many interventions aiming to influence girls towards an IT career have been instigated. However the interventions have often not been adequately evaluated (Craig, 2014; Craig, Lang, & Fisher, 2008) and the continuing low number of girls opting for IT careers raises doubts about their effectiveness (Griffiths, Moore, & Richardson, 2007).

IT Education in New Zealand High Schools

New Zealand has just over 500 high schools ranging in size from under 100 to approximately 3000 students. Each school is given a "decile rating" by the Ministry of Education according to the socio-economic level of households in the school community, a system which allows the government to allocate extra funding to schools with greater need. Decile ratings range from 1 to 10; with 1 indicating the highest proportion of students from low socio-economic communities, and 10 indicating the lowest proportion.

During the first two years of high school, Years 9 and 10, when students are aged 13 and 14 respectively, the curriculum is broad and there are no formal examinations. Over the last three years, Years 11, 12 and 13, learning becomes progressively more focussed and students seek formal qualifications. Most schools offer the New Zealand based National Certificate of Educational Achievement (NCEA) qualification system.

Since 2011 a new 'Digital Technology' curriculum has been progressively introduced into Years 11 to 13. The new curriculum has five strands, one of which is called Programming and Computer Science, and students studying these subjects are assessed using the NCEA system. Uptake of the Programming and Computer Science strand of the new curriculum has been limited, with only 55 schools offering this strand in 2013 (Education Counts Statistics, 2013). Reasons for the limited uptake included: a widespread lack of understanding of computer science;

the fact that the curriculum was a new discipline area for many teachers; the limited time and resources available to teachers to prepare for the new curriculum (Bell, 2014).

These challenges, however, do not account for the marked gender imbalance in Programming and Computer Science classes; in Years 11, 12, and 13 in 2013, of all students taking the subject, the proportions of girls were 23%, 24%, and 31% respectively (Education Counts Statistics, 2013). Furthermore, both the proportion and number of girls undertaking these classes had decreased over the years 2011 to 2013 (Bell et al., 2014).

The Programming Challenge 4 Girls

The Programming Challenge 4 Girls (PC4G) is a New Zealand-based intervention that endeavours to attract more teenage girls into programming careers. Since commencing in 2008, the PC4G has expanded rapidly to now have more than 650 girls participating throughout the six countries identified earlier as having significant under-representation of women in IT. Its primary aim is to provide a fun introduction to programming for Year 10 high school girls so that they might choose Digital Technology subjects in the future. During the one-day event, girls work in pairs to experientially learn the programming language Alice and then compete in a programming challenge. The girls also meet female role models who describe their experiences of IT work and present medals to girls who produced meritorious work. A secondary aim is to provide support for teachers, by offering a professional development session which gives teachers an opportunity to keep their programming skills up-to-date, thereby addressing some of the curriculum challenges identified earlier.

This pilot study was the first formal research undertaken to investigate the effectiveness of the PC4G. Results produced preliminary evidence that the PC4G provides a positive experience for girls and encourages them to consider a programming career (Hunter & Boersen, 2014). Subsequent to the event, 91% of the participants wanted to know more about programming careers and 61% said they would consider a programming career (Hunter & Boersen, 2014).

Formal Sources of Careers Information

For the girls' interest in programming to be fostered, accurate and appropriately appealing information about programming needs to be readily available to them. This section describes three formal sources of career information available to girls to supplement advice provided by informal sources such as family and friends.

Careers Education in New Zealand Secondary Schools

High schools in New Zealand are required to provide students with Careers Information, Advice, Guidance and Education (CIAGE). Schools are supplied with guidelines outlining good practice and a set of benchmarks designed for self-review purposes (Education Review Office, 2012). CIAGE requires schools to take a "school-wide" approach to their provision of career education – it is the collective responsibility of the school careers advisor, teachers, and school leaders who must

ensure relationships are developed with families, employers, tertiary institutions and relevant community organisations (Education Review Office, 2012).

Careers New Zealand Website

The New Zealand government provides career information through the Careers New Zealand website (www.careers.govt.nz). This site has been developed with school students as one target audience. It is the central repository for "all things career" and is available for school careers advisors, school students, and adults.

ICT-Connect

The ICT-Connect programme (now TechHub) is managed by New Zealand's professional computing body, the Institute of IT Professionals New Zealand (IITP), and is delivered in high schools in order to attract more students (male and female) into the ICT industry.
In 2013 the ICT-Connect website (http://www.ictconnect.org.nz/) stated that the programme:

> … inspires and educates young people about their future in IT. Its goal is to increase the visibility and desirability of a career in IT for the next generation of IT Professionals. It's designed to inspire and educate young people about future options in the ICT sector. The programme puts role model IT professionals face-to-face with students in schools, introducing and discussing what a future in IT means to them. The IT professionals explain what they do in a short series of weekly presentations, plus illustrate the diverse opportunities and pathways available in our great industry.

The ICT-Connect programme appears to be highly organised and well-resourced with considerable support from industry stakeholders.

RESEARCH AIMS

The current paper focuses on the second objective of the pilot study, which was to investigate factors teenage girls consider when choosing a career and what information would therefore need to be provided to encourage the girls to consider a programming career. Assuming that teenage girls might consider money an important factor, we eliminated this from our data collection instrument.
Specific research aims were therefore:

1. To identify factors (excluding money) that teenage girls would consider when choosing a career, with reference to Adya & Kaiser's (2005) model of girls' career choices.
2. To appraise the adequacy of three formal sources of information regarding programming careers available to teenage girls, in relation to factors identified in 1.

LITERATURE REVIEW

Models Explaining Girls' Career Choices

Numerous studies worldwide (e.g., Barker & Aspray, 2006; Cohoon, 2011; Varma, Prasad, & Kapur, 2006) have investigated reasons for the low numbers of women

choosing an IT career, although these seldom focussed explicitly on programming. Some studies (e.g., Crump, Logan, & McIlroy, 2007; Hayes, 2010) concentrated on women's experiences in the IT workplace; others (e.g., Bell et al., 2014; Lang, 2012; Morton, 2013) investigated IT education environments. These studies are complemented by research (e.g., Genrich et al., 2014; Gorbacheva et al., 2014) that investigated girls' career choices and factors influencing these choices, and it is these findings that are most relevant to the current study.

By the time girls reach high school they often already have well-developed career aspirations (Hutchinson, Moore, Davies, Thomas, & Marriott, 2013). Career choices made over these early years are influenced by many factors, generally classified as either social or structural (Adya & Kaiser, 2005; Trauth, 2002). According to Adya & Kaiser's (2005) widely-cited model of girls' career choices, social factors include family, peer group, and media, each of which may motivate girls towards or away from particular careers. Structural factors identified in the model relate to the institutional support girls receive for their career decisions, including teachers, schools careers advisors, the school environment (e.g., same-sex or co-educational), and access to technology. In recognition of Trauth's (2002) "individual differences perspective on gender and IT", Adya & Kaiser's (2005) model notes that both social and structural factors are mediated by a girl's ethnic culture and her individual differences. The 'individual differences perspective on gender and IT" (Trauth, 2002) proposes that each woman's participation in IT work will differ according to her individual characteristics and the particular socio-cultural influences she experiences.

Aspects of Adya & Kaiser's (2005) model have been challenged. Some factors included in the model were found to have little influence, for example same-sex education (Gorbacheva et al., 2014) and some other factors such as socio-economic status were identified as missing (Clayton, Beekhuyzen, & Nielsen, 2012). We contend that some important sources of career information are missing from Adya & Kaiser's (2005) model. It does not recognise that career information is also provided by sources such as government, professional bodies, and industry associations, sources that we classify as "formal". We argue that in comparison to parents, media, and peer groups, (sources that are recognised in Adya & Kaiser's (2005) model and which we classify as "informal"), the "formal" sources have a specific responsibility to provide credible and comprehensive information, specific to the needs of all their target audiences.

We now discuss social and structural factors relevant to the current paper.

Family Guidance

Families play a significant role in girls' career choices (Barker & Aspray, 2006; Denner, 2009). Some studies identify mothers as most influential (Meszaros, Creamer, Burger, & Matheson, 2005; Trauth, Quesenberry, & Huang, 2008) and others claim that fathers have most influence (Adya & Kaiser, 2005). However family knowledge about IT careers is often limited (Clayton et al., 2012) and therefore families rarely promote IT as a career option (Genrich et al., 2014). Parental influence is sometimes limited to supporting a girl's independent choice of

an IT career (Denner, 2009). Girls making autonomous career decisions would appear to have the self-confidence identified by Trauth (2002).

Gender Stereotypes in the Media

Stereotypical representations of IT work in the media are alleged to significantly discourage girls from pursuing a computing career. For example, describing IT workers as "geeky" (Hendery, 2006) and "nerdy" (New Zealand Herald, 2008, February 12) provokes images which are thought to be especially off-putting to women (Klawe, Whitney, & Simard, 2009; Misa, 2010). Furthermore, gendered media messages about socially acceptable careers for women may also dissuade girls from IT work. For example, in a sample of children's television programmes in New Zealand, only one out of the 1480 women featured were shown to be working in IT (National Advisory Council on the Employment of Women, 2012). Stereotypical images in the media can undermine women's confidence and confidence is important for women entering a male-dominated field such as IT (Hunter, 2012).

However, as Misa (2010) has noted, stereotypes do eventually change, and there are indications that the term 'geek' is becoming a label to be proud of, rather than avoided (Genrich et al., 2014). In this study, for example, 96% of the girls agreed or strongly agreed with the statement "I don't mind if people think I'm a geek" (Hunter & Boersen, 2014).

Careers Advice in Schools

The effectiveness of schools' career education has been questioned in many countries. In the UK there have been claims that careers advisors often lack real workplace experience and therefore give students unsuitable advice (Education Journal, 2013 June 28). In the USA, Adya & Kaiser (2005) found that career advisors and teachers provide very little career direction to students. More positively, high school students in Australia were "quite satisfied" with the school career advice provided (Rothman & Hillman, 2008).

In New Zealand, an investigation of 44 high schools by the Education Review Office (2012) found that 9% of schools provided "low quality", and a further 43% provided only limited CIAGE. Later, 31% of 74 schools were identified as needing to improve their careers education (Education Review Office, 2013). Irving, cited in Furbish (2012), claimed that school careers advisors often do not have appropriate qualifications, training, or knowledge. An investigation of student perspectives of careers education in New Zealand schools would usefully complement these reports.

With regards to computing career advice specifically, many IT teachers in Australia were found to have limited knowledge and experience of IT, and therefore did not help students understand IT work or encourage them to consider an IT career (Genrich et al., 2014). Similarly, undergraduate IT students in the UK reported that computing had not been well-promoted by their high schools (Careers Research and Advisory Centre, 2008). In New Zealand, Snell & Snell-Siddle (2006) found that there was little understanding within schools of IT careers and therefore little advice

about these careers was given to students. Ryan's (2014) claim that students often need to teach themselves programming because their teachers lack the skills to do so, raises doubt that teachers can provide useful IT career advice. These reports match Bell's (2014) claim of a lack of understanding of computer science within schools.

METHODOLOGY

Introduction

Specific research questions of this study were:

1. What factors, excluding money, do the girls consider when choosing a career, and what is the relative importance of these to the girls?
2. Do the girls know where they can find out about a career in programming?
3. Do the girls perceive their parents and school careers advisors as being knowledgeable about careers in computing in general?
4. How adequately do three formal sources of programming career information meet the needs of the girls according to the girls' specified factors?

Formal sources of career information are an aspect that is missing from Adya & Kaiser's (2005) model of girls' career choices.

Several data collection methods were used. For the first three questions we collected primary data using a survey, and for the final question we collected data from three additional sources, namely, the Careers New Zealand and ICT-Connect websites.

Participants

Participants were recruited from the population of girls who took part in the PC4G at one New Zealand site in 2013. All girls at the site, 52 girls from 13 schools, were eligible to participate and a small incentive was offered to encourage participation. Altogether 12 out of the 13 school principals gave permission for the research to proceed, and 40 girls from these 12 schools initially agreed to participate. From the original pool of 40, 23 girls took part, giving an acceptable response rate of 58%.

The participants were aged 14 or 15 years and their schools were located in Auckland, New Zealand's largest and most ethnically-diverse city. Of the 12 schools, five had a decile 1 rating, and five had a decile rating of 8, 9, or 10, meaning that almost half the girls were drawn from extremely low socio-economic communities compared with almost half who were drawn from very high socio-economic communities. Many ethnicities were represented among the participants, but we did not pursue ethnicity in our data analysis due to the small numbers involved.

Being 14 or 15 years old, the participants belonged to the age group commonly referred to as "Generation Z" (Gen-Z). McCrindle (2013) described Gen-Z individuals as being technologically "saturated", young people who are "visually engaged", "digital integrators". McCrindle's (2013) terminology refers to the

seamless integration of digital technology into everything Gen-Zers do, their interactions with wide social groups using a range of social media, juggling devices effortlessly – iPods, cell phones, tablets, laptops, etc. Gen-Zers prefer to watch video that summarises information rather than reading static information from articles (McCrindle, 2013). Another characteristic of Gen-Zers is their short attention span (McCrindle, 2015), reported by the National Center for Biotechnology Information, (2014) to be around eight seconds. This means Gen-Zers' use of technology is fragmented and transitory, accessing digital information in very short but continuous bursts, swapping between tasks and devices with ease. These factors are relevant to the way in which career information is presented to today's teenage girls, including the participants in this study.

Instrument

The survey used for this pilot study was paper-based and consisted of several sections. As mentioned previously, the purpose of the survey was twofold and the present paper reports on findings from the final section of the survey only. This final section, created by the researchers, consisted of three closed-ended questions and two open-ended questions as follows.

Question 1:

	Yes	No	Don't know
I know where to go if I want to find out how to become a programmer			N/A
The careers advisor at school knows a lot about jobs available in computing			
My parents/guardians know a lot about careers in computing			

Note: Participants were instructed to answer Question 1 only if they might consider a programming career.

Question 2:
When it is time for you to apply for full-time work, let's pretend you have two job offers, both offering the same amount of money, both attractive to you. What factors would you consider when trying to decide which job offer to accept? Please list all your factors.

Question 3:
Please rank your top 3 factors from your list above (assuming you have 3 or more).

The statements in Question 1 were informed by the LSAY questionnaire reported by Rothman and Hillman (2008). We constructed Questions 2 and 3 as an alternative to other surveys, for example that of Genrich and colleagues (2014), which presented participants with a range of possible factors influencing career choice. Rather, we wished to identify factors the girls would spontaneously identify, and as this was a pilot study, questions could be modified in the future if necessary.

Procedure

Ethical Permissions

Because our participants were school students aged under 16 years, adult consent procedures were insufficient and additional steps were necessary. Firstly, school

principals were asked to give permission for their schools to be involved in the research, with reassurance that the identity of their school and all participants would be kept confidential. Secondly, girls from consenting schools were given information about the research and an invitation to participate. Girls wishing to participate could do so only if their parents/guardians also consented. Teachers assisted by giving girls the information to take home and girls returned their consent forms to their teachers. Prior to the PC4G event, teachers returned the consent documents to the researchers.

Data Collection
At the end of the PC4G event, participants were given an envelope containing the survey and a reply paid envelope to return their completed survey. There were no instances of missing data among the surveys returned; therefore no participants were excluded. Two girls were randomly selected to receive a small gift.

Data concerning the ICT-Connect programme were collected from two sources, namely the Deputy CE (Operations) of the IITP and the ICT-Connect website. Data concerning the Careers New Zealand website were collected directly from the website.

Analysis
To analyse the quantitative data from Survey Question 1, we calculated frequency distributions of responses in percentage format, despite the sample size being small, in order to facilitate reading.

In preparation for analysing the qualitative data resulting from Survey Questions 2 and 3, we transcribed the responses into a table consisting of 23 rows (one for each participant) and six columns (each response was placed in a different column; no participant identified more than six factors). This table presented the data set in a clear format that we could work with manually.

We then undertook an inductive thematic analysis of the girls' responses using the process outlined by Braun & Clarke (2006). This involved several steps.

Our first step was to independently examine the data set and generate initial codes. We then compared our provisional decisions and discussed all our coding decisions (the small data set made this possible). We adjusted some codes by mutual agreement. The second step, undertaken together, was to collate related codes into themes (Braun & Clarke, 2006, p. 87). When there was little need for interpretation, we identified themes semantically. For example, our code "work hours", assigned to data items such as "*what hours of the day I'll be working*", we translated directly to a theme HOURS. Identifying other themes did require interpretation. For example, we decided that our code "job location", assigned to data items such as "*how close to home the job is*", could be collated with another code "travel time", assigned to data items such as "*travelling*". Codes "job location" and "travel time", we agreed, reflected the girls' concerns regarding the distance they may have to travel to work; we therefore named the theme LOCATION. Some decisions required more interpretation. For example, we decided that one group of

codes, namely "right qualification", "own ability", and "right qualities", reflected a concern regarding capability to perform in the job. The appropriate theme, we decided, was CONFIDENCE. The third step was to review our themes. We concluded that our theme ENVIRONMENT ideally required more interpretation than the limited data set allowed. For example, we were not able to explore the girls' use of the word "cool" (e.g., "*a cool environment*" and "*a workplace that is cool*"). Aside from this limitation, we believed we had achieved an acceptable level of rigour and transparency.

Analysis of the Careers New Zealand and ICT-Connect websites involved both researchers accessing all web pages on the sites, reviewing the content, and watching all video clips. We documented the gender of people profiled, the degree of gender inclusivity, and the descriptions of IT work. We noted the technical skills, social skills, and knowledge that were stated as requirements to work as programmers in the IT industry.

RESULTS AND DISCUSSION

1. Factors (excluding money) Important to Teenage Girls when Choosing a Career

Eight major factors were identified as being important to the girls when choosing a career. These are shown in Table 1 (in no particular order):

Table 1
Factors that would Differentiate between Job Offers

Factor	Explanation
Location	Closeness to home, the amount and ease of travelling required
Hours	The hours they would be required to work
Rewards	How they might benefit in the future (e.g., promotions)
Challenge	That the work provided challenge
Confidence	That they would know they could do the work
Environment	Whether the work environment was 'cool'
Fun	That the work would provide fun and enjoyment.
Interaction	There would be friendly interaction with others in the workplace.

These factors can be considered in three groupings. The first group, Location and Hours, showed that the girls were practical about where they will work and the work-day hours. For example, a response "*will I have time to be with the people I love*" reflected a concern about a career that demands long working hours. These pragmatic considerations are likely associated with the family socialisation influences identified by Adya & Kaiser (2005). Programming career information therefore needs to make these matters clear.

The second group, Rewards, Challenge and Confidence, revealed a tension for the girls. They wanted a job which will challenge them and provide future opportunities, but they also appeared to be anxious about their ability to cope with challenges. Responses such as "*challenging"*, "*problem solving*", and "*not the exact same thing every day*" indicated that the girls would like an intellectually stimulating career and responses such as "*will there be promotions*" and "*is [sic] there different levels of experience*" suggested that the girls have ambitions to advance in their careers. If the girls are seeking challenge, variety, and advancement, then it would seem that programming career information should emphasise these opportunities. However, comments such as "*if I would have the right qualities*" and "*the one [job] I am more familiar with*" suggested that the girls want to have all the necessary skills before starting a job, rather than believing they could have most of the skills and then develop the remaining skills once they commence work. This finding matches observations of women's low self-confidence generally in the workplace (Kay & Shipman, 2014; Varma et al., 2016).

The third group of themes, Environment, Fun, and Interaction, demonstrated a range of social factors that were highly valued by the girls, including how friendly people are, the attractiveness of the work environment, the sense of fun, and the amount of interaction they would have with others. For example, girls' responses included "*interaction", "friendly workmates*", "*freedom and relaxed environment*", and "*cool workspace"*. These factors are likely to be associated with a gender identity common to Gen-Z girls.

We identified a few instances of some other themes, two of which were particularly relevant to programming; as Braun and Clarke (2006) noted, the prevalence of a theme across a data set does not necessarily reflect its importance. One theme, CREATIVITY, we attributed to a response "*opportunities to show my creative side*". The creative aspect of programming is an important feature which may not be widely recognised, but if emphasised, is likely to be seen as a positive feature of programming (Forssen, Lauriski-Karriker, Harriger, and Moskal, 2011). The second theme, ALTRUISM, reflected a response "*what will help people more*", a comment which indicated altruistic motivation. Several scholars (e.g., Eccles, 2013; Klawe et al., 2009) have noted that women are often motivated by opportunities to contribute socially; therefore it would make sense to also emphasise this aspect of programming.

Two distinctive responses within the data set appeared to indicate a theme INDIVIDUALISTIC. One girl wanted a "*career which is different*" and another wanted to "*work independently*". These responses are suggestive of the individual characteristics proposed by Trauth (2002).

Having identified attractive career factors, the girls were then asked to rank their top three factors. The most commonly top-ranked factors are listed in Table 2:

Table 2
The Top Three Factors that would Differentiate between Job Offers

Rank	Factor
1	Fun: That the work would provide fun and enjoyment
2	Interaction: There would be friendly interaction with others in the workplace
3	Environment: Whether the work environment was "cool"

These data indicated that fun, sociability, and a cool environment were more important to the girls than the pragmatic aspects of work; the girls were people-oriented rather than task-oriented. Further, this was true regardless of the decile rating of the girls' schools, suggesting that socio-economic background was not a significant determinant in shaping these girls' career preferences, contrary to claims by Trauth (2002) and Clayton and colleagues (2012).
Although a career in programming does offer many of the features the girls were seeking, those who wish to promote programming as a desirable career choice to teenage girls may not be aware of this. The amount of people interaction, fun aspects, and the attractiveness of work environments all need to be emphasised over more practical issues. In particular, the sociability factor of programming needs to be highlighted in programming career information in order to appeal to Gen-Z girls.

There have been suggestions that more girls will be attracted to IT work if the variety of people-oriented roles in IT is emphasised. For example, Snell and Snell-Siddle (2006, p. 105) suggested that girls should be made aware that IT work is not "just programming". This suggestion could imply that programming is not suitable for girls, a point also noted by Clayton and colleagues (2012). Rather we propose that the social aspects of programming should be promoted more clearly.

2. Adequacy of Girls' Sources of Information about Programming Careers

Survey Question 1 was answered by 83% of our respondents (those who might consider a programming career). Results are shown in Table 3. These data indicated that girls who might consider a programming career could have difficulty finding appropriate information. More than half the girls did not know where they could find out how to become a programmer and over half the girls were either unsure of their parents' knowledge about computing careers or perceived their parents as not knowing much. This finding was consistent with reports (e.g., Hunter, 2012) of a widespread lack of understanding of IT work among the general public. There is an opportunity therefore to target parents with computing career information. Only a slight majority of the girls agreed that their careers advisor "knows a lot" about computing careers (this is discussed in more detail below). Given that these girls mostly had some previous programming experience, the data

in Table 3 were disappointing, as the girls appeared to not know how to find out what a programming career would entail.

Table 3
Sources of Information about Computing Careers

Survey Question/Statement	Yes	No	Don't know
I know where to go if I want to find out how to become a programmer	44%	56%	N/A
My parents/guardians know a lot about careers in computing	37%	26%	37%
The careers advisor at school knows a lot about careers in computing	53%	11%	37%

Careers Education in High Schools

As seen in Table 3, confidence among the girls that their careers advisors are well informed about computing careers varied. Just over half the girls believed their careers advisor "knows a lot" but one third indicated they "don't know" how knowledgeable their careers advisors are.

Reports (e.g., Bell, 2014; Bell et al., 2014) that school careers advisors are not widely knowledgeable about computing work are concerning. For many years New Zealand's ICT industry has been experiencing a serious skills shortage (Institute of IT Professionals New Zealand, 2015) and it would clearly be desirable for schools to help reduce this shortage. We have been unable to locate any studies of New Zealand high school students' perceptions of their careers advisors' knowledge of IT careers. A study similar to that conducted in Australia by Rothman and Hillman (2008) would usefully fill this gap.

We did not ask our participants about their teachers' knowledge of computing careers, an oversight we will address in the next iteration of the research. But as noted earlier, others have found that many teachers are ill-equipped to provide adequate information about programming careers.

Thus, it appears that teachers and school careers advisors are in need of resources and training to address this lack of knowledge and skills. The PC4G and the ICT-Connect programme help provide this support.

Careers New Zealand Website

Having found that the girls wanted careers that are fun, provide ample social interaction, and take place in a 'cool' environment, we investigated (in 2014) the Careers New Zealand website (http://www.careers.govt.nz) to assess the programming career information provided against these criteria.

When given 'computer programmer' as a keyword in the Jobs Database section of the website, four pages of information were displayed. A *Summary* page stated pay, the number of programmers in New Zealand, and job opportunities. An *About the Job* page described programming work: the pay, what programmers do, skills and knowledge required, and typical working conditions. It also included two case study vignettes of young programmers. This page provided the most information about programming work and was therefore most relevant to the current study.

A *How to Enter the Job* page listed secondary education and other entry requirements. The final page, *Job Opportunities*, gave links to current vacancies.

If we wish to attract girls into programming careers, the *About the Job* page was disappointing. The page showcased five programmers, all males, a feature not welcoming to teenage girls. Further, all five males appeared to be of Caucasian ethnicity, another inappropriate aspect given New Zealand's diverse ethnic mix. The detailed information about what programmers do was very task-oriented and only two of the nine tasks listed referred to working with people. The creative aspect of programming was not mentioned. One case study did mention a balance between technical work and interaction with people; however the skills and knowledge section did not mention people skills being required. The video case study referred extensively to problem solving, and briefly mentioned helping people but gave the impression that communication is via email rather than face-to-face. The task-oriented view promoted on the website was also unlikely to appeal to teenage girls. Similarly the working conditions listed, for example the likelihood of evening and weekend work, although realistic, did not correspond well with the girls' career preferences.

Secondary education requirements identified on the *How to Enter the Job* page included "Computer Studies" rather than "Programming and Computer Science" or "Digital Technology", subjects that have been available since 2011. Ability to work in a team, and good communication skills were mentioned as personal requirements, but the need for these qualities was not evident in the *About the Job* section. The website could have stated that teamwork is integral to most programming work and that high level soft skills are required.

Our final concern was the website's mainly static presentation of information. Although there was an interactive Question and Answer section, Gen-Z girls require more emphasis on short video clips, blogs and other social media that will engage them and fit within their short attention span. The importance of promoting IT work to today's young people via social media rather than traditional media was also noted by Genrich and colleagues (2014).

So although there was much information provided on this website, it was not focussed in terms of the girls' most important career decision-making factors; nor was it gender inclusive. It was unlikely, therefore, to meet the needs of a teenage female audience.

ICT-Connect

The ICT-Connect programme commenced in 2012 and was delivered that year into 21 schools in Auckland, Wellington, Christchurch, and Dunedin. Since then the programme has grown rapidly, having now delivered over 550 presentations to 147 schools with a total audience size of well over 100,000 students (Cottle, 2015).

Although the programme targeted high school students of both genders, the programme organisers have actively recruited female IT professionals to join the pool of presenters. Single-sex girls' schools in particular were targeted and when arranging presenters, care was taken to ensure that female role models presented to the girls in these schools (Cottle, 2015). In addition, the formal communication on the ICT-Connect website in 2015 included a video that clearly demonstrated women succeeding in the IT industry. For example there was reference to Ada Lovelace, a woman often referred to as the first computer programmer. The video also featured female narrators and included several interviews with successful young female IT professionals likely to appeal to teenage girls.

The success of the programme was difficult to determine, given that students who participated in 2012 or 2013 will not enter the industry until 2017-2018 and feedback had only been collected informally at this stage. Anecdotal reports from schools involved with the programme suggested that subsequent to participation in ICT-Connect, more girls were choosing to take Digital Technology subjects and they no longer viewed the IT industry as a males-only "super geek" field (Cottle, 2015). However these accounts conflict with the reports noted earlier of a decreasing number and proportion of high school girls studying Programming and Computer Science.

The ICT-Connect programme appeared to have several positive aspects. Content was gender inclusive, girls' schools were actively targeted and female role models were used where possible. While not explicitly focussing on girls and girls' career criteria of fun, social interaction and a "cool environment", these factors may have been communicated implicitly through the presentation sessions. Moreover, the programme provided useful support for teachers, and helped schools meet their CIAGE responsibilities.

LIMITATIONS OF THE PILOT AND FUTURE WORK

This pilot study was intentionally kept small. Restricting the research to one site allowed us to trial both the survey and our procedures, with a view to refining these before extending the research. Procedures will be redesigned to be more scalable, and the survey will be automated with questions reviewed and expanded. For example, other potentially useful demographic information such as the gender of the girls' computing teachers could be included to allow for more granular analysis. Similarly it would be useful to know if a school participates in the ICT-Connect programme and whether it offers the Programming and Computer Science strand of the Digital Technology curriculum.

We recognise that socio-economic background, ethnicity, and culture are important factors when trying to understand girls' career choices and they are of growing

significance in the context of New Zealand society's increasing diversity. But they are also complex issues that cannot be taken lightly. First steps towards including these influences are being considered.

CONCLUSIONS

Our first conclusion is that Adya & Kaiser's (2005) model of factors influencing girls' career choices can be improved. We have discussed programming career information provided by the New Zealand government, the IT professional body, and schools. We described these as "formal" sources of career information and argued that these organisations have a specific responsibility to provide accurate and suitably presented information to teenage girls, in contrast to informal sources such as parents and peers for whom the same degree of accuracy and suitability cannot be expected. We therefore propose a modification to Figure 1 of Adya & Kaiser's (2005, p. 233) model as follows: (1) that the model's "Social Factors"be renamed 'Social Factors – Informal', and (2) that within the model's Structural Factors section, a group of factors named "Formal" is defined to include teacher/counselor, government, professional bodies, and industry associations. A further paper exploring these ideas from a theoretical perspective is planned.

Our remaining conclusions relate to the stated aims of this research.

Factors these girls rated highly in a desirable career were how much people interaction there was, whether there was a sense of fun, and whether the work environment was "cool". In other words, people-orientation took preference over task-orientation. Practical issues such as job location, travel time, and hours of work were also identified but were seen as less important. Therefore, if sociability factors are emphasised when promoting programming as a career option, this may contribute to reducing the under-representation of women in programming. The girls also wanted a career that challenges them but they revealed a lack of confidence to confront these challenges. Employers therefore need to be initially supportive to build self-confidence and then be willing to provide on-going professional development. There was no discernible difference in career preferences among girls from schools in vastly different socio-economic communities.

Almost all participants indicated they wanted to know more about programming and 61% said they would consider it as a career, but the majority of these did not know where they could obtain more information. Only 37% of participants thought their parents were knowledgeable about computing careers.

Appraisal of the three formal sources of programming career information produced mixed results. Predictably, careers advisors were thought to be somewhat better informed than parents, with 53% of the girls judging them to "know a lot" about computing careers. Providing career information to students, parents and schools would raise awareness of career possibilities and might result in more girls choosing a programming career, thereby beginning to address the under-representation of women in this field.

The information about programming careers available via the Careers New Zealand website was comprehensive in respect to roles and tasks, but was unlikely to entice today's teenage girls. The website was biased towards males, and the majority of information was static, which was contrary to the Gen-Z girls' need for interaction, and socially focussed, visually presented communication. This website was unlikely to address the under-representation of women in IT.

The ICT-Connect programme took several measures to attract girls into ICT work, without specifically promoting programming careers. The programme also appeared to be an effective step towards improving teachers' understanding of ICT careers. If the students were given materials and a task to be completed at home, something requiring parental input, then this could also improve parents' knowledge about careers available in IT.

The PC4G experience offers a model of programming that provides fun and social interaction, and may steer some girls towards a programming career. But the IT career information gap for parents, teachers, and careers advisors needs to be addressed so that these individuals are able to guide girls appropriately into the field. The government, the IT professional body, and IT industry representatives need to urgently address this issue, bearing in mind that the information provided, as well as the delivery method, needs to appeal to todays' teenage girls in addition to other audiences.

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