

Understanding the Relationships between Resilience, Work Stress and Information Security Awareness

A. McCormac¹, D. Calic¹, M. Butavicius¹, K. Parsons¹, M. Pattinson² and M. Lillie²

¹Defence Science and Technology Group, Edinburgh, South Australia

²Adelaide Business School, University of Adelaide, South Australia

e-mail: { agata.mccormac dragana.calic marcus.butavicius; kathryn.parsons; }

@dst.defence.gov.au;

malcolm.pattinson@adelaide.edu.au; Meredith.lillie@student.adelaide.edu.au

Abstract

This study examined the relationship between Information Security Awareness (ISA), resilience and work stress. Data was collected using an online questionnaire design, completed by 1,048 working Australians. The online survey included the Human Aspects of Information Security Questionnaire (HAIS-Q) (Parsons *et al.* 2017), which is a measure of ISA, the Brief Resilience Scale (Smith *et al.* 2008) and the Job Stress Scale (Lambert *et al.* 2006). It was found that participants with greater resilience also had higher ISA and experienced lower levels of work stress. Results of this study add to the body of knowledge emphasising the positive effects of resilience in the workplace. This research suggests that resilience also appears to have an association with improved ISA and reduced workplace stress. Future research may focus on assessing the impact of resilience training in the workplace, and its effect on ISA and job stress.

Keywords

Information security awareness (ISA); resilience; work stress; information security (InfoSec); cyber security

1. Introduction

It is well documented that cyber security breaches cannot be prevented through the implementation of solely technical solutions (Furnell *et al.* 2006; Parsons *et al.* 2014; Schulz, 2005). It is the human factor that is often the weakest link in a security system (Schneier, 2004). This has been supported by security and incident reports, international security standards, and peer reviewed literature. For example, IBM determined that breaches were often unintentional and that over 95% were the result of human error (IBM, 2015). Standards Australia Limited (2015) released a code of practice outlining information security controls, which recommends an emphasis on human resource security, thereby recognising the vulnerability that the human plays in information security.

There is a plethora of academic literature that focuses on individual characteristics and how they impact on information security (InfoSec) behaviours (McCormac *et al.* 2017; Shropshire *et al.* 2006). Research has shown that by improving employee behaviour organisations may reduce the risk of a security breach by 45% to 70%

(Wombat Security Technologies and Aberdeen Group, 2015). The focus of this study is to examine the relationship between resilience and work stress and Information Security Awareness (ISA). The following sections will introduce the main constructs considered in this study, namely, workplace resilience, work stress and ISA.

1.1. Resilience

Resilience has been researched in a variety of disciplines, ranging from psychology, sociology, anthropology, biology, medicine, education and management, and there is no consensus regarding its definition. Resilience has been described as a trait, process, capacity or outcome (Kossek *et al.* 2016; Southwick *et al.* 2014). For the purposes of the current study, we use the definition of the American Psychological Association (2014), which states that resilience is “the process of adapting well in the face of adversity, trauma, tragedy, threats or even significant sources of stress” (p.2). This definition suggests that resilience, as a process, is strongly influenced by our interactions within our environments. This means that resilience is not stable over adult life; rather it can be learned and developed, as it involves thoughts, behaviours and actions (American Psychological Association, 2014). Resilience is also commonly described as an individual’s ability to recover, or bounce back, from stressful situations (Smith *et al.* 2008).

The level of resilience of an individual is dependent on numerous interacting variables, including psychological, social, cultural and biological factors. Resilience also manifests itself differently in different environmental settings. These settings can range from individual, family, and organisational settings to societal and cultural settings. An individual may be resilient within their family environment; however, this might not translate to their workplace setting. Not only is resilience affected by the environment individuals are in but it can also change over time (Kim-Cohen *et al.* 2012; Southwick *et al.* 2014).

Resilience in a work environment reflects an individual’s capacity to adapt to adversity and withstand job demands (Kossek *et al.* 2016). Resilience research is particularly relevant to organisations, given the constantly changing nature of both work and the workforce, across a variety of employment contexts (Kossek *et al.* 2016). Employees need to become more resilient to successfully deal with heightened work demands, the blurring of work and non-work boundaries, and constant technological advancements (Kossek *et al.* 2012; Kossek *et al.* 2009).

Research has revealed a multitude of benefits associated with resilience. For example, resilient individuals are generally physically healthier, have better mental health outcomes, happier relationships, are more independent, they are better equipped to manage stressful situations, and are also more successful in work contexts (Siebert, 2005). Resilience has been researched in specific workplace settings with a variety of occupational groups (Kossek *et al.* 2016; Rees *et al.* 2015). However, our extensive literature review could find no previous research specifically exploring the relationship between the resilience and ISA of employees.

1.2. Work Stress

Organisational resilience cannot be considered independently of work or job stress, because, resilience is how an individual manages and copes with stress. Work stress is specifically related to an individual's job. It occurs when work demands and pressures do not match an individual's knowledge and abilities, which in turn affects their ability to cope (Leka *et al.* 2003).

It has been long established that work stress has a negative impact on both physical and psychological health. It can result in social problems, decreased job motivation and decreased job performance (Johnson, *et al.* 2005; Leka *et al.* 2003). Along with those negative impacts experienced by the individual, organisations experience increased absenteeism and turnover and decreased staff performance, resulting in a direct economic cost (Leka *et al.* 2003). Organisational culture has been identified as a key factor in understanding how well an organisation is able to manage work stress (Leka *et al.* 2003).

Similar to resilience, work related stress has been extensively researched across occupations (Johnson, *et al.* 2005). Research has been conducted investigating technology related stress (Al-Fudail *et al.* 2008; Rangarajan *et al.* 2005); however, no research has specifically explored co-occurrence of stress and ISA, within organisations.

1.3. ISA and Individual Differences

ISA refers to the extent to which employees understand the significance of information security policies, rules and guidelines in their organisation and the extent to which their behaviour is congruent with these policies, rules and guidelines (Kruger *et al.* 2006; Siponen, 2000).

Previous research has explored the interactions between ISA and individual differences. For example, it has been shown that behavioural responses to security related situations differ between individuals and are influenced by dispositional factors, including individual differences (Johnston *et al.* 2016). Two recent studies explored the relationship with age, gender and personality. They found that older adults had higher ISA scores when compared to younger adults (McCormac *et al.* 2017; Pattinson *et al.* 2015). Although McCormac *et al.* (2017) found a small significant gender difference, with females obtaining higher ISA scores compared to males, the findings related to gender were not consistent (McCormac *et al.* 2017; Pattinson *et al.* 2015). In the exploration of personality variables both studies concluded that individuals who were more conscientious and agreeable had higher scores on ISA (McCormac *et al.* 2017; Pattinson *et al.* 2015). Similarly, conscientiousness and agreeableness have been shown to moderate the relationship between behavioural intent and security software usage (Shropshire *et al.* 2015). In addition it was found that those with a propensity to take fewer risks also had higher scores on ISA (McCormac *et al.* 2017).

1.4. Study Aims

As noted above, this study aims to investigate the relationship between an individual's ISA and their reported resilience and work stress. Given previous findings relating to age and gender (McCormac *et al.* 2017; Pattinson *et al.* 2015), and their relationship to ISA, the influence of these variables will also be analysed.

2. Methodology

Data collection involved the completion of an online survey, administered through the web-based survey software Qualtrics. Ethics approval was granted by the Human Research Ethics Subcommittee of the University of Adelaide, School of Psychology. The data collected for this paper was part of a larger project. For the purposes of this paper, data analysis will focus on responses obtained from the demographic questions (age and gender), the HAIS-Q results, and responses to the Brief Resilience Scale and the Job Stress Scale.

2.1. Participants

A total of 1048 (535 females, 512 males and 1 gender unspecified) working Australians completed an online questionnaire. To take part in this study, participants were required to be over the age of 18, currently employed, and working in Australia. Participants were well distributed across age categories. Approximately 12% of participants were between 18 and 29 years of age, 24% were 30 to 39 year of age. This left approximately 22% in the 40 to 49 age category, 23% in the 50 to 59 age category, and 19% aged 60 and over. Participants represented over 15 sectors and 8 job areas, including sales workers, clerical and administrative workers, professionals, management, labourers and technicians/trade workers.

2.2. Materials

2.2.1. The Human Aspects of Information Security Questionnaire (HAIS-Q)

The HAIS-Q was used to measure individual knowledge, attitude and behaviour relating to ISA (Parsons *et al.* 2017). The tool consists of 63 statements which are answered on a five-point Likert scale (ranging from 1 = 'Strongly Disagree' to 5 = 'Strongly Agree'). In this study, Cronbach's alpha scores were above the recommended level of .70 for knowledge (.83), attitude (.92) and behaviour (.90), with a Cronbach's alpha of .96 for ISA. These are consistent with alpha levels reported in previous studies (McCormac *et al.* 2017 & McCormac *et al.* 2016). For detailed validity and reliability assessments of the HAIS-Q please refer to Parsons *et al.* (2017) and McCormac *et al.* (2016).

2.2.2. Brief Resilience Scale

The Brief Resilience Scale (BRS), developed by Smith *et al.* (2008), assesses an individual's ability to recover, or bounce back, from stressful situations. The scale consists of six items, and responses are obtained using a five-point Likert Scale (ranging from 1 = 'Strongly Disagree' to 5 = 'Strongly Agree'). A higher score on the scale reflects a higher degree of resilience (Smith *et al.* 2008). The scale has been shown to possess good internal consistency and test retest reliability. Analysis of the BRS in this study yielded a Cronbach's alpha of .86, which is considered reliable and consistent with previous studies (Rodriguez-Rey *et al.* 2016).

2.2.3. Job Stress Scale

The Job Stress Scale was developed by Lambert *et al.* (2006), adapted from early work conducted by Crank *et al.* (1995). The scale contains five items, also measured on a five-point Likert Scale (1 = 'Strongly Disagree' to 5 = 'Strongly Agree'). Higher scores correspond with higher levels of stress. An alpha level, of .82, has been previously reported (Shea *et al.* 2011). The results of this study found the measure to have an alpha value of .87.

3. Results

Table 1 presents a correlation matrix, including mean and standard deviation scores, to examine the relationship between ISA, gender, age, resilience and job stress.

Variables	Gender	Age	ISA	Resilience	Job Stress
Age	-.18*				
ISA	.08*	.27**			
Resilience	-.09**	-.19**	.25**		
Job Stress	-.03	-.18**	-.22**	-.45**	
Mean		***	257.1	63.0	38.5
SD		***	32.1	4.4	4.3

* $p < .05$ (2-tailed) ** $p < .01$ (2-tailed) *** Mean and SD scores for actual age are unavailable, as age range, rather than exact ages were provided by participants.

Table 1: Correlations, means and standard deviations between ISA, Age, Gender, Resilience and Job Stress (N = 1,048)

In addition collinearity diagnostics analysis revealed that Tolerance values were all greater than .10 and the Variance Inflation Factor (VIF) values were all well below 10, suggesting that multi-collinearity had not been violated.

3.1. ISA, Age and Gender

A two-way, between subjects ANOVA, with two levels for gender (female and male) and five levels for age ('18-29', '30-39', '40-49', '50-59' and '60 years and over'), was conducted to examine the effect of age and gender on ISA. This analysis

revealed a statistically significant effect for both age, $F(4, 1047) = 28.54, p < .001, \eta_p^2 = .099$, and gender, $F(2, 1047) = 12.35, p < .001, \eta_p^2 = .023$. There was also a statistically significant interaction between the effect of age and gender on ISA, $F(4, 1047) = 3.38, p = .009, \eta_p^2 = .013$.

Bonferroni post hoc comparisons found significant differences between the 18-29 age group ($M = 242.6, SD = 35.6$) and the following three age categories: 40-49 ($M = 262.2, SD = 28.4$) ($p < .001, d = .61$); 50 – 59 ($M = 263.5, SD = 28.5$) ($p < .001, d = .65$); and, those over 60 years of age ($M = 266.5, SD = 26.3$) ($p < .001, d = .76$). Significant differences were also reported between participants in the age category of 30-39 ($M = 245.9, SD = 35.3$) compared to the 40-49 age group ($p < .001, d = 0.51$), the 50-59 age bracket ($p < .001, d = .55$), and participants 60 years and over ($p < .001, d = .66$). There was a trend for ISA scores to be higher for participants in older age brackets, when compared to participants in younger age brackets.

Gender differences revealed that female participants ($M = 259.8, SD = 30.0$) had significantly higher ISA scores than their male counterparts ($M = 254.5, SD = 33.9$), although the effect size was small, $d = .17$. While men had lower ISA scores than women; the difference between genders was not as large after the age of 39. Therefore, younger males had particularly low levels of ISA when compared to both older males and females. This demographic finding warrants further investigation.

3.2. ISA, Resilience and Job Stress

A two-stage hierarchical multiple regression was used to investigate the extent to which independent variables predicted ISA. As shown in Table 2, to control for the effects of age and gender, these variables were entered at Stage 1. Both age and gender were significant, accounting for 9% of the variance. At Stage 2, resilience and job stress were added to the model, the total variance explained was 14%. The highest predictor was age, followed by resilience, then gender and job stress.

Variable	$\beta(\text{standardised})$	t	p
Stage 1	$F(2, 1047) = 49.85$, adjusted $R^2 = .085^{**}$		
Age	.29	9.63**	<.001
Gender	.13	4.31**	<.001
Stage 2	$F(4, 1047) = 42.05$, adjusted $R^2 = .136^{**}$		
Age	.24	8.04**	<.001
Gender	.14	4.75**	<.001
Resilience	.17	5.23**	<.001
Job Stress	-.10	-3.13*	.002

Table 2: Summary of the hierarchical regression analysis for age, gender, resilience and job stress predicting ISA (N = 1048)

4. Discussion

4.1. Overview and Contribution

This study aimed to examine the relationship between ISA, resilience, and job stress. Although there is a broad range of literature exploring a variety of aspects relating to both resilience and job stress, their relationship with ISA has not been previously researched. Therefore, this research provided an opportunity to empirically evaluate the relationship between resilience and job stress and ISA.

The analysis revealed that participants who were more resilient had higher scores on ISA, whereas participants who experienced greater job stress had lower ISA scores. Resilient individuals reported lower levels of work stress. The following sections will discuss these findings in more detail, and will outline the limitations of the current work and possible future directions.

4.2. Findings

Analysis of the data revealed an increasing relationship between age and ISA. Older adults had higher ISA scores than younger adults. In relation to gender, females had higher ISA scores than male participants. Both of these findings align with previous research conducted by Pattinson *et al.* (2015) and McCormac *et al.* (2017). The interaction effect between age and gender is important as it revealed that young males had lower levels of ISA. These findings may have implications for targeted training. Awareness of the effect of age and gender on ISA may assist organisations when preparing training programs. In addition, regression analyses showed that age and gender, in conjunction with resilience and job stress, significantly explained 14% variance in ISA. In some fields of research this may be deemed to be a modest portion of variance, however, in the field of psychological research, particularly given the number of potential variables involved, this represents a meaningful finding.

Previous research has shown that resilient individuals are more successful in work environments and are better able to manage stressful situations (Siebert, 2005). Resilient employees are also better able to cope with increased work demands and technological changes (Kossek *et al.* 2012; Kossek *et al.* 2009). This research supports the positive effect of resilience, showing that resilient individuals have better ISA.

Conversely, previous research has indicated that individuals experiencing job stress have poorer work performance (Johnson, *et al.* 2005; Leka *et al.* 2003). Our study revealed that those who reported higher job stress also had lower levels of ISA. This could be because individuals who are experiencing higher levels of work stress, due to various work demands, may also have less time to focus on other organisational demands, such as understanding and complying with organisational InfoSec policy, resulting in poorer ISA. Likewise, under stressful situations individuals are more likely to take 'short cuts' to get the job completed. This may be particularly true for

overload scenarios and these ‘short cuts’ may include their level of compliance to InfoSec policy. Another possible interpretation may relate to cultural factors. For example, perhaps an organisation that is responsive to employees’ needs and abilities is also more likely to provide employees with better ISA training. Ultimately making staff feel valued and less stressed.

Previous research has shown that resilience can be learnt and developed (American Psychological Association, 2014). Therefore, by helping individuals to become more resilient, they will become better equipped to cope with job stress. This has implications for training programs. Organisations have the opportunity to teach their employees strategies and skills to increase their resilience and decrease their work stress, and thereby improve the ISA of their employees.

4.3. Limitations and future directions

The data collected in this study relied on self-report. Although self-report data collection does provide valuable data, it can be affected by self-report biases, including social desirability bias (Spector, 1994). This may result in measurement error. In order to reduce the effect of such biases, this study guaranteed confidentiality and anonymity of participant responses.

This study also relied on brief measures of both resilience (Smith *et al.* 2008) and job stress (Lambert *et al.* 2006), consisting of six and five items, respectively. Although both measures have been shown to be reliable, future research could use more comprehensive measures of both resilience and job stress. This would provide a more robust measure of these variables and their impact on ISA.

Building on the present study, it is recommended that future research examine the relationship between ISA, resilience, and job stress, with an emphasis on exploring the direction of causality. There is also an opportunity to examine additional variables relating to organisational culture and security culture. This seems pertinent given that previous research has shown that organisational culture can have a significant impact on the management of work stress (Leka *et al.* 2003).

5. Conclusion

This study provided a preliminary examination of the relationship between ISA, resilience and job stress. It was found that individuals who were more resilient also experienced less job stress, and possessed higher levels of ISA. Our findings have important theoretical and applied implications. From a practical perspective, organisations may benefit from incorporating training programs that focus on resilience training, in an effort to create a more resilient workforce. There are numerous benefits associated with having resilient employees, these benefits may extend to improvements in ISA and levels of job stress. Theoretically, these initial findings can be used as a foundation for future research to investigate, more comprehensively, the impact of resilience and job stress in an effort to empirically ascertain causation.

6. References

- Al-Fudail, M., & Mellor, H. (2008). Investigating teacher stress when using technology. *Computers & Education*, 51(3), 1103-1110.
- American Psychological Association. (2014). The road to resilience. Retrieved from <http://www.apa.org/helpcenter/road-resilience.aspx>
- Crank, J., Regoli, R., Hewitt, J., & Culbertson, R. (1995). Institutional and Organizational Antecedents of Role Stress, Work Alienation, and Anomie among Police Executives. *Criminal Justice and Behavior*, 22(2), 152-171.
- Furnell, S. M., Jusoh, A., & Katsabas, D. (2006). The challenges of understanding and using security: A survey of end-users. *Computers & Security*, 25(1), 27-35.
- IBM Global Technology Services. (2015). *Cyber Security Intelligence Index*. Retrieved from <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=SEW03073USEN>
- Johnson, S., Cooper, C., Cartwright, S., Donald, I., Taylor, P., & Millet, C. (2005). The experience of work-related stress across occupations. *Journal of Managerial Psychology*, 20(2), 178-187.
- Johnston, A., Warkentin, M., McBride, M., & Carter, L. (2016). Dispositional and Situational Factors: Influences on IS Security Policy Violations. *European Journal of Information Systems*, 25(3), 231-251.
- Kim-Cohen, J., & Turkewitz, R. (2012). Resilience and measured gene-environment interactions. *Development and psychopathology*, 24(4), 1297-1306.
- Kossek, E., & Distelberg, B. (2009). Work and family employment policy for a transformed work force: Current trends and themes. In A. C. Crouter & A. Booth (Eds.), *Work-Life Policies* (pp. 3-51). Washington, DC: Urban Institute Press.
- Kossek, E., & Lautsch, B. A. (2012). Work-family boundary management styles in organizations: A cross-level model. *Organizational Psychology Review*, 2(2), 152-171.
- Kossek, E., & Perrigino, M. B. (2016). Resilience: A review using a grounded integrated occupational approach. *Academy of Management Annals*, 10(1), 729-797.
- Kruger, H., & Kearney, W. (2006). A prototype for assessing information security awareness. *Computers & Security*, 25(4), 289-296.
- Lambert, E. G., Hogan, N. L., Camp, S. D., & Ventura, L. A. (2006). The impact of work-family conflict on correctional staff: A preliminary study. *Criminology and Criminal Justice*, 6, 371-387.
- Leka, S., Griffiths, A., & Cox, T. (2003). *Work Organisation & Stress: Systematic Problem Approaches for Employers, Managers and Trade Union Representatives*. Geneva, Switzerland:
- McCormac, A., Calic, D., Parsons, K., Zwaans, T., Butavicius, M., & Pattinson, M. (2016). Test-retest reliability and internal consistency of the Human Aspects of Information Security Questionnaire (HAIS-Q). Australasian Conference on Information Systems (ACIS): Wollongong.

- McCormac, A., Zwaans, T., Parsons, K., Calic, D., Butavicius, M., & Pattinson, M. (2017). Individual Differences and Information Security Awareness. *Computers in Human Behavior*, 69, 151-156.
- Parsons, K., Calic, D., Pattinson, M., Butavicius, M., McCormac, A., & Zwaans, T. (2017). The Human Aspects of Information Security Questionnaire (HAIS-Q): Two further validation studies. *Computers & Security*, 66, 40-51.
- Parsons, K., McCormac, A., Butavicius, M., Pattinson, M., & Jerram, C. (2014). Determining employee awareness using the Human Aspects of Information Security Questionnaire (HAIS-Q). *Computers & Security*, 42, 165-176.
- Pattinson, M., Butavicius, M., Parsons, K., McCormac, A., & Calic, D. (2015). Factors that Influence Information Security Behaviour: An Australian Web-based Study. In T. Tryfonas & I. Askoxylakis (Eds.), *Proceedings of Human Aspects of Information Security, Privacy, & Trust (HCI 2015)* (pp. 231-241). Los Angeles: Springer International, LNCS 9190.
- Rangarajan, D., Jones, E., & Chin, W. (2005). Impact of sales force automation on technology-related stress, effort, and technology usage among salespeople. *Industrial Marketing Management*, 34(4), 345-354.
- Rees, C., Breen, L., Cusack, L., & Hegney, D. (2015). Understanding individual resilience in the workplace: the international collaboration of workforce resilience model. *Frontiers in Psychology*, 6(73).
- Rodriguez-Rey, R., Alonso-Tapia, J., & Hernansaiz-Garrido. (2016). Reliability and Validity of the Brief Resilience Scale (BRS) Spanish Version. *Psychological Assessment*, 28(5), 101-110.
- Schneier, B. (2004). *Secrets and lies: digital security in a networked world*: Wiley.
- Schultz, E. (2005). The human factor in security. *Computers & Security*, 24(6), 425-426.
- Shea, T., & De Cieri, H. (2011). *Workplace stress evaluation tools: A Snapshot Review*. Australian Centre for Research in Employment and Work (ACREW).
- Shropshire, J., Warkentin, M., & Sharma, S. (2015). Personality, attitudes, and intentions: Predicting initial adoption of information security behavior. *Computers & Security*, 49, 177-191.
- Shropshire, J., Warkentin, M., Johnston, A., & Schmidt, M. (2006). *Personality and IT security: An application of the five-factor model*. Paper presented at the Americas Conference on Information Systems.
- Siebert, A. (2005). *The resiliency advantage: Master change, thrives under pressure, and bounce back for setback*. San Francisco, CA: Berrett-Koehler Publishers, Inc.
- Siponen, M. T. (2000). A conceptual foundation for organizational information security awareness. *Information Management & Computer Security*, 8(1), 31-41.
- Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: assessing the ability to bounce back. *International journal of behavioral medicine*, 15(3), 194-200.

*Proceedings of the Eleventh International Symposium on
Human Aspects of Information Security & Assurance (HAISA 2017)*

Southwick, S. M., Bonanno, G. A., Masten, A. S., Panter-Brick, C., & Yehuda, R. (2014). Resilience definitions, theory, and challenges: interdisciplinary perspectives. *European Journal of Psychotraumatology*.

Spector, P. E. (1994). Using self-report questionnaires in OB research: A comment on the use of a controversial method. *Journal of Organizational Behavior*, 15(5), 385-392.

Standards Australia Limited. (2015). Information technology - security techniques - Code of practice for information security controls (AS ISO/IEC 27002:2015). Sydney, NSW 2001, Australia.

Wombat Security Technologies and Aberdeen Group. (2015). Retrieved from <https://www.wombatsecurity.com/press-releases/research-confirms-security-awareness-and-training-reduces-cyber-security-risk> (Accessed 1 July 2017).