Decision Making Style, Nicotine and Caffeine Use and Dependency.

James G. Phillips[a],[*] & Rowan P. Ogeil[b]

[a]Psychology Department, Auckland University of Technology, Akoranga Campus, Auckland

0627, New Zealand. Email: jphillip@aut.ac.nz

[b]Eastern Health Clinical School, Monash University, and Turning Point, Eastern Health,

Victoria, Australia.

[*]To whom correspondence should be addressed.

Running Head: Nicotine & Caffeine

CONFLICTS OF INTEREST - No conflicts of interest have been declared.

Abstract

Rationale: As therapeutic interventions are being developed utilising telehealth and mobile phones, it is important to understand how substance dependent individuals will respond to offers of online assistance.

Objectives: The present paper considered how decision making style: 1) is associated with use and dependence upon commonly used stimulants, and 2) influences behavioural responses to electronic offers of further information about these drugs.

Method: An online survey examined patterns of nicotine and caffeine use, administered Severity of Dependence Scales for caffeine and nicotine and assessed decision making style using the Melbourne Decision Making Questionnaire, and mood using the K-10. Upon completing these scales the 181 participants with a mean age of 28.14 were offered further information online.

Results: Stimulant dependence was associated with psychological distress. Caffeine dependency was linked to hypervigilance (panic). **Decisional self-esteem varied with stimulant dependency and K10 score.**   Participants with high decisional self-esteem declined electronic offers of further information.

Conclusion: Confidence rather than defensive avoidance was a factor in reducing information seeking behaviours on the internet.

Keywords: Nicotine, Caffeine, Withdrawal, Decision, Geolocation

INTRODUCTION

Nicotine and caffeine are widely available substances that are known to differ in their addictive potential (Benowitz, 2010; Nehlig, 1999; Satel, 2006). Nicotine poses appreciable health risks (U.S. Department of Health and Human Services, 2014), and DSM5 has recommended further consideration and research into the effects of caffeine (Meredith, Juliano, Hughes, & Griffiths, 2013). Both of these substances are Central Nervous System (CNS) stimulants, but vary in their mode of action. Consumers use these stimulants as cognitive enhancers to influence decision processes and well-being (Sahakian & Morein-Zamir, 2007; Smith, 2009a). However, both drugs are associated with dependence and withdrawal symptoms (Hughes, 2007; Strain et al, 1994), which also influence decision processes (Mitchell, 2004; Phillips-Bute & Lane, 1997). Given the emerging capacity of mobile technology to actually monitor behaviour and administer interventions (**Auer & Griffiths, 2014**; Heron & Smyth, 2010) it is important to **consider relationships between self-reported stimulant dependency and decision making style** and the processing of information.

Nicotine stimulates acetylcholine receptors in the brain, affecting the ventral tegmental area, that stimulate dopamine releasing neurones triggering reward pathways that contribute to repeated use of the substance (Benowitz, 2010; Craig & Stitzel, 2003). Nicotine also stimulates autonomic ganglia and adrenal glands, increasing heart rate and blood pressure and increases cerebral and peripheral blood flow (Craig & Stitzel, 2003).

Nicotine has been reported to improve attentional processes (Harrell & Juliano, 2012; Le Houezec et al., 1994). Although nicotine can cause improvements in information processing (Thompson et al, 2002), smoking is associated with higher levels of stress (Ansell, Gu, Tuit, & Sinha, 2012), and there is an abstinence syndrome involving symptoms of anger,

anxiety, depression, difficulty concentrating, impatience, insomnia, and restlessness (Hughes, 2007; Parrott & Murphy, 2012). These effects are somewhat in contrast to those of caffeine.

Caffeine either blocks the inhibitory effects of adenosine at the neurone, or antagonises a presynaptic inhibitory effect of adenosine on the release of neurotransmitters such as dopamine (Daly & Fredholm, 1998; Lorist & Tops, 2003). Although caffeine is generally considered benign (Freedman et al, 2012; Smith, 2009a), dosages in commercially available products have increased (Reissig et al, 2009), patterns of use have changed (Curry & Stasio, 2009), and individuals can vary in their susceptibility (James, 2012). Caffeine overdose can occur at doses over 600 mg (Pilette, 1983), and is associated with restlessness, anxiety and irritability (Hughes et al, 1998; Winston, Hardwick & Jaberi, 2005). Caffeine improves attentional processes (Hewlett & Smith, 2007; Lane & Bute-Phillips, 1998; Smith, 2009a,b; Warburton et al, 2001), but withdrawal from caffeine is associated with headaches, difficulty concentrating, fatigue, and drowsiness (James & Keane, 2007; Juliano et al, 2012; Strain et al, 1994).

People that report addiction to tobacco may also report addiction to caffeine (Greenberg et al, 1999; Rozin & Stoess, 1993). Indeed, Kozlowski (1976) noted that users titrate their dosages, increasing the levels of caffeine when not smoking or vice versa. As co-morbid substance dependencies and mental health problems are common (Crocq, 2003; Drake, 2007; Juliano et al, 2012; Kessler et al, 1996), there may be a trait that may predispose people to addiction (Ansell et al, 2012; Eysenck, 1997; Kotov et al, 2010; Shaffer et al, 2004). For instance Jacobs (1988) has proposed co-morbid addictions may arise from an avoidant trait. Others have suggested that impulsivity may predispose people to addictive behaviours (Ansell et al, 2012; Eysenck, 1997; Zuckerman, 1979). For instance, Friedel et al (2014) found smokers demonstrated an inability to wait (insensitivity to delayed

consequences) that extended to food, money and entertainment.   These traits could be important in understanding the likely response to electronic interventions.

Potential for Electronic Intervention

Hitherto therapeutic interventions tended to be by appointment in a health professional's office. This was not necessarily when a client was most "at risk". Nevertheless, the advent and uptake of smartphones, recommender technology, and location aware capability (Montaner et al, 2003), and targeted advertising (Chen & Stallaert, 2014) confers a capability to deliver interventions that are more convenient and less stigmatising (Dennison et al., 2013; Milward et al, in press). With this technology, there is an emerging capability to document and monitor a person's mental status and deliver timely and individualised interventions (e.g. Dennison et al., 2013; Gee et al, 2005; Shrier et al, 2014). From a therapeutic viewpoint, when a person indicates that they are at risk, there is then the possibility to send messages of therapeutic support "on site" in "real time" (**Auer & Griffiths, 2014;** Heron & Smyth, 2010; Oinas-Kukkonen, 2010; 2013). Thus when developing such systems it becomes important to consider: 1) a user's mobility (Song et al, 2010) as this has bearing on the number of times and places that the substance is used; 2) the likelihood that substance dependent individuals will respond to such information (Milward et al, in press; Prochaska & DiClemente, 1998).   For such reasons the present study employs a model of decision making that addresses adaptive, avoidant and maladaptive tendencies (Janis & Mann, 1977).

Decisions require the selection of a course of action from a range of options, and are thus a potential source of conflict (Janis & Mann, 1977). A consideration of responses to a variety of conflicts has identified a variety of coping patterns that tend to be a function of context (Janis & Mann, 1977), and Mann et al (1997) developed the Melbourne Decision

Making Questionnaire to address these tendencies. Radford et al (1986) found that patients hospitalised for depression were more likely to exhibit maladaptive **decision making styles**, and others have considered how decision making styles might influence the likelihood that people would read and respond to electronic messages (Baker & Phillips, 2007; Shirren & Phillips, 2011).

Under optimal conditions, with sufficient time to search and deliberate, it is possible for the decision maker to engage in considered (vigilant) decision making, canvassing relevant options and issues (Janis & Mann, 1977). Indeed, a diary study indicated that vigilant people were more likely to open electronic messages immediately (Shirren & Phillips, 2011). However, the action chosen likely depends on the consequences of inaction. For example, if the likely outcome is not serious if no action is taken, the decision maker may engage in procrastination (Janis & Mann, 1977), delaying any response (Beswick et al, 1988). Indeed, a tracking study indicated that procrastinators may be less likely to login (Phillips et al, 2007). Email diaries otherwise indicate that procrastinators tend to read electronic messages immediately, but delay their replies (Shirren & Phillips, 2011). If the outcome is serious, but it is unlikely that better options will be identified, the decision maker may engage in buck-passing (defensive avoidance). Buckpassers are less likely to respond to messages immediately (Shirren & Phillips, 2011). If there is insufficient time to search and deliberate, the decision maker may panic (be hypervigilant), engage in defective search (Mann & Tann, 1993) and select riskier options (Mann & Ball, 1994). Phillips et al (2007) found hypervigilance to be associated with defective search behaviour online. Hospitalised depressed patients were found to have less confidence in their abilities as a decision maker, and higher scores on defensive avoidance and hypervigilance scales (Radford et al, 1986).

If there is a general predisposition towards addiction (Ansell et al, 2012; Eysenck, 1997; Kotov et al, 2010; Shaffer et al., 2004; Zuckerman, 1979) that manifests in the form of

an addictive personality (Jacobs, 1988), the **decision making styles** of individuals that report dependence upon nicotine should be similar to the **decision making styles** of those reporting dependence upon caffeine. Alternatively, as there have been problems identifying any consistent personality trait associated with addiction (Kerr, 1996), differences on such scales may reflect the state and experience of substance abuse. There are indications that this might be the case as Phillips and Ogeil (2011) found problem drinkers had higher procrastination scores, while problem gamblers were hypervigilant and had lower decisional self-esteem. If addictive behaviour is more properly characterised by the substance being abused (Kerr, 1996) **the decision making styles** of users of caffeine and nicotine may vary.

According to Mann et al (1997), an avoidant style would be indicated by higher scores on the buckpassing and procrastination scales, while impulsivity and defective decision making might be indicated by higher hypervigilance scores (Mann, 1973), and lower decisional self-esteem (Radford et al., 1986). It was hypothesised that there would be relationships between dependence and patterns of substance use, **decision making style**, and more specifically the likelihood of seeking further information about a substance when provided with the opportunity to do so.

METHOD

Participants

The 181 participants (81 male, 99 female and 1 other) had a mean age of 28.14 years. After reading an explanatory statement, participants completed an online survey approved by institutional ethics committees in New Zealand and Australia, hosted on SurveyMonkey and promoted on online bulletin boards.

Materials

Participants were asked the numbers of times and places they smoked, and the number of times and places they consumed caffeine. Guidelines as to caffeine content were provided to assist participants in estimating their daily dose of caffeine in mg. As the number of instruments devoted to caffeine is limited, the Severity of Dependence Scale (Gossop et al, 1995) was adapted for use with caffeine (obtained Cronbach's alpha = .827). For comparison purposes the same scale was used for nicotine (obtained Cronbach's alpha = .933). If a cutoff of '4' on this scale is used to separate "non-dependent" from "dependent" substance users (Martin et al, 2006; Topp & Mattick, 1997) only 12 respondents were dependent upon both caffeine and nicotine. As an index of health status, participants were also asked to complete the K-10 (Kessler et al, 2002). A Cronbach's alpha of .912 was obtained for the present sample.

The Melbourne Decision Making Questionnaire (MDMQ) was used to assess **decision making style** (Mann et al., 1997). It is a 22-item self-report inventory designed to measure four major coping patterns identified in the conflict theory of decision making (Janis & Mann, 1977): buck-passing, procrastination, vigilance, hypervigilance. It also contains a measure of decisional self-esteem. Participants indicated their agreement with statements on a 3 point Likert-type scale: (1) True for me, (2) Sometimes true, and (3) Not true for me. For the present sample the means were: Buck-passing 5.12 (SE=0.249), Procrastination 4.10 (SE=0.214), Hypervigilance 4.35 (SE=0.209), Vigilance 9.57 (SE=0.182), and Decisional Self Esteem 8.62 (SE=0.190). Reliability coefficients were 0.876 (buck-passing), 0.843 (procrastination), 0.800 (hypervigilance), 0.799 (vigilance), and 0.78 (decisional self-esteem scale).

Behavioural Measure

Upon completion of the questionnaire, participants were asked if they wanted further information on "caffeine", "nicotine", or "nothing", with these clicks tracked by the researchers. Participants' responses were considered as a function of their **decision making style**.

Data Screening and Analysis

Two separate MANOVAs were used to assess the effects of multiple Independent Variables (IVs) (caffeine dependence, nicotine dependence, psychological distress) on multiple Dependent Variables (DVs) (Field, 2005; Mayers, 2013). As IVs must be categorical to satisfy the assumptions of MANOVA, the total SDS scores for caffeine and nicotine for each participant were used to categorise participants into "dependent" and "non-dependent"; a score of 4 has commonly be used for this purpose with other substances (Martin et al, 2006; Topp & Mattick, 1997).   To categorise participants into groups that vary in their risk of a mood disorder, scores above 29 on the K10 were used to indicate a higher risk of anxiety and depression (Andrews & Slade, 2001; Chamberlain, Goldney, Delfabbro, Gil, & Dal Grande, 2009).

The first MANOVA examined use of stimulants (times and places smoked and times and places consumed caffeine). As the numbers of times and places people reported using nicotine and caffeine were positively skewed, the assumption of normality was violated and hence these variables were subjected to square root transforms.

The second MANOVA examined decision making style (Decisional Self Esteem, Vigilance, Procrastination, Buckpassing, Hypervigilance). The DVs are conceptually related as required by MANOVA given that they measured facets of decision making

behaviour, although the adaptive Vigilance scale is negatively correlated with the

maladaptive Procrastination and Buckpassing scales (Field, 2005; Mayers, 2013).

RESULTS

Substance use

Participants that made a greater use of stimulants were more likely to report dependence. There were significant correlations between reported dependence on caffeine and both the number of times caffeine was consumed (r=.339, n=165, p<.05) and the estimated daily dose of caffeine (r=.280, n=166, p<.001). There was also a significant correlation between reported dependence on nicotine and the number of times a person smoked (r=.639, n=166, p<.05).

Substance dependence was linked to poorer well-being. Nicotine dependence was associated with higher levels of psychological distress as measured by the K-10 (r=.223, n=181, p<.05). Caffeine dependence was also associated with higher levels of psychological distress (r=.273, n=181, p<.05). Although there have been prior concerns about co-morbidity, in the present sample participants that were dependent upon nicotine were if anything less likely to be dependent upon caffeine (r=-.137, n=181, p=.065).

A Manova was conducted to address the contribution of stimulant dependence to patterns of use, while examining interactions with levels of psychological distress. There were significant multivariate effects of caffeine dependence [V=.145, $F_{(4,154)}$=6.547, p<.001, partial η^2=.145] and nicotine dependence [V=.498, $F_{(4,154)}$=38.184, p=.003, partial η^2=.498] upon stimulant use. Univariate tests indicated that the caffeine dependent individuals consumed caffeine at more times ($F_{(1,157)}$=4.566, p=.034, partial η^2=.028) and places ($F_{(1,157)}$=6.745, p=.010, partial η^2=.041) (see Table 1). Univariate tests indicated that the nicotine dependent individuals smoked at more times ($F_{(1,157)}$=126.917, p<.001,

partial η^2=.447) and in more places (F(1,157)=144.225, p<.001, partial η^2=.479) (see Table 1).

INSERT TABLE 1 ABOUT HERE

Decision Making Style

A Manova was conducted to address the contribution of stimulant dependence to decision making style, while examining interactions with levels of psychological distress. There were significant multivariate effects of caffeine dependence [V=.076, F(5,154)=2.538, p=.031, partial η^2=.076] and psychological distress [V=.108, F(5,154)=3.712, p=.003, partial η^2=.108] upon decision making style. There was also a significant multivariate interaction between caffeine dependency, nicotine dependency and psychological distress [V=.072, F(5,154)=2.406, p=.039, partial η^2 = .072].

The univariate analyses indicated that the caffeine dependent group was more hypervigilant (M=5.819, SE=0.468) than the non-caffeine dependent group (M=4.576, SE=0.348) (F(1,158)=29.844, p=.035, partial η^2=.028). The group with higher K-10 scores and a greater risk of psychological distress had lower decisional self-esteem scores (F(1,158)=17.486, p<.001, partial η^2=.10) and higher scores on the procrastination (F(1,158)=9.516, p=.002, partial η^2=.057), buckpassing (F(1,158)=11.533, p=.001, partial η^2=.068) and hypervigilance scales (F(1,158)=12.988, p=.035, partial η^2=.076) (see Table 2).

INSERT TABLE 2 ABOUT HERE

Caffeine, nicotine dependence and psychological distress had interactive effects upon Decisional Self Esteem. As may be seen in Figure 1, decisional self-esteem tended to be lower in participants at a greater risk of psychological distress (higher K-10 scores). For participants at less risk of psychological distress (lower K-10 scores), dependence upon stimulants reduced decisional self-esteem. The interaction was decomposed using simple main effects, looking at the effect of psychological distress at each level of stimulant dependence. Compared to those at less risk of psychological distress, decisional self-esteem was lower in people at greater risk of psychological distress that were only dependent upon caffeine (F(1,158)=10.152, p<.005) or nicotine (F(1,158)=23.741, p<.001).

INSERT FIGURE 1 ABOUT HERE

Information Seeking

Decisional style (particularly avoidant styles) was expected to influence information seeking. Hence, upon completion of the questionnaire participants were asked whether they would like further information. The offer of further information seems to have been treated seriously. Participants that sought information on nicotine had higher Severity of Dependence Scale scores (M=7.00, SE=0.786) than those not seeking information on nicotine (M=1.79, DE=0.245) (t(177)=6.524, p<.001). Participants seeking information on caffeine had higher Severity of Dependence Scores (M=4.514, SE=0.526) than those not seeking information on caffeine (M=1.958, SE=0.205) (t(177)=5.225, p<.001).

However, participants that did not select a link for further information had significantly higher decisional self-esteem (M=9.05, SE=0.24) than those that did select further information (M=8.30, SE=0.28) (t(177)=1.985, p<.05). The tendency to avoid further

information was not linked to avoidant tendencies. There were no significant differences on the defensive avoidance scales (Procrastination, t(177)=0.163, p>.05) (Buckpassing, t(177)=0.044, p>.05) between those that sought information (Procrastination M=4.11, SE=0.28)(Buckpassing M=5.10, SE=0.33), and those that did not (Procrastination M=4.04, SE=0.33)(Buckpassing M=5.08, SE=0.38).

DISCUSSION

The present study considered the **decision making styles** associated with the use of two widely available and used stimulants (nicotine and caffeine), both associated with withdrawal syndromes. Dependence upon these CNS stimulants was associated with their greater use in more places, but there were fewer indications of comorbidity or commonalities in terms of the decisional processes affected. Given the emerging potential of technology to monitor behaviour and intervene on site and in real time, the behavioural response to an electronic offer of further information was documented. It was confidence rather than defensive avoidance that posed an obstacle to information seeking behaviour online.

Although acute use of these substances can improve information processing (Smith, 2009b; Thompson et al, 2002), the present study found evidence of a dependence syndrome that was associated with psychological distress (Ansell et al, 2012) that manifested somewhat differently for nicotine and caffeine. **At low risk of mental health problems, stimulant dependence was associated with low decisional self-esteem, but at higher risk of mental health problems it seems decisional self-esteem was just lower for people that were only dependent upon one stimulant, implying that the joint use of these stimulants might be occurring to relieve symptoms (Kozlowski, 1976).**

In the present study, caffeine dependent individuals were prone to hypervigilance (panic), while nicotine dependence seemed to influence decisional self-

esteem. Indeed, these differences in decisional processes only partly support suggestions of a common predisposition for addiction (Greenberg et al, 1999; Rozin & Stoess, 1993). Unlike our previous observations of avoidant styles in problem drinkers (Phillips & Ogeil, 2011), the present study suggests links between stimulant use and poor or hasty decision making (Ansell et al, 2012).

Some differences in the effects of these stimulants are to be expected, as nicotine acts on cholinergic systems, and caffeine acts on adenosine. Indeed, there are qualitative differences in their withdrawal syndromes, with nicotine withdrawal being associated with symptoms such as insomnia (Hughes, 2007; Parrott & Murphy, 2012), and caffeine withdrawal being associated with drowsiness (James & Keane, 2007; Juliano et al, 2012).

Addiction has been proposed to arise from failures in a range of elements of the decision making process (Redish, Jensen, & Johnson. 2008). The present paper seems to have identified two different failures. The more obvious problem associated with caffeine dependence is that of hypervigilance, a pressure to act, such that the person makes choices without thinking. The other problem associated with nicotine dependency is more complex as it involves decisional self-esteem. This problem can be explained by referring to models of decision making that make decisions on the balance of evidence that the decision maker receives (Brebner, 1998; Vickers, 1979). In such models the balance of evidence is not just used to make decisions, but the balance of evidence is also used as a basis for ascriptions of confidence (Brebner, 1998; Koriat, Lichtenstein, & Fischhoff, 1980). Confidence is then monitored and when confidence is low, this should normally be used to adjust the decision making criteria (Brebner, 1998; Vickers, 1979). However, in the case of nicotine dependent individuals at greater risk of psychological distress, their decisions are likely to be poor **(Radford, Mann, & Kalucy, 1986)**, but there appears to be a failure to adjust their decision making criteria. It is not clear whether this is a cause or consequence of nicotine dependency,

but in the present study nicotine dependency could be associated with a problem with the supervisory systems that adjust the criteria upon which decisions are made. **Conceivably in populations that are at risk of mental health problems, nicotine is used as part of a self-medication process to address symptoms.**

Potential for Electronic Intervention

Emerging technology can now deliver advertising and inducements as a function of consumers' prior interests and behaviours (Chen & Stallaert, 2014), or that of peers (Schafer et al, 2001), or as a function of consumer location (Montaner et al, 2003). As receptiveness to recommendations varies (Leskovec et al, 2007), any therapeutic interventions (**Auer & Griffiths, 2014;** Heron & Smyth, 2010) may need estimates of the times or locations at which a substance user is vulnerable. For instance, Leskovec et al (2007) found greater response to electronic commercial inducements at around 10 in the morning, with repeated recommendations losing efficacy. In addition, there may be resistance to the use of location aware capability (Milward et al, in press; Smith, Birnholtz, Reynolds, & Hancock, 2014). Hence an understanding of factors that can improve receptiveness to messages are important.

Although the attention of substance abusers may be biased towards addiction related stimuli (Field & Cox, 2008), it is generally accepted that substance users are precontemplative before they engage in attempts to reduce substance abuse (Prochaska & DiClemente, 1998) and avoid warning information (Maynard et al, 2014). The present study indicates that a failure to seek electronic information about substance abuse is not necessarily due to defensive avoidance, but could be due to a higher level of confidence in one's decision making.

Decision making has been likened to a search through a range of options (Koehler, 1991). Unfortunately confidence can be unrealistic (Koriat et al, 1980), and this search

process can be faulty if people stop at the first option that seems appropriate rather than considering why a specific choice might be inappropriate (Koehler, 1991), and there are hints that this is occurring for stimulant users in the present data. Instead online information seeking seems to occur when symptoms are more salient.

Given the potential for interventions to be planned for specific times or locations where the stimulant dependent is more vulnerable (**Auer & Griffiths, 2014**; Heron & Smyth, 2010), it could be important to obtain estimates of stimulant users' mobility (Song et al, 2010). Interventions could then be triggered at point of purchase, as the converse of "location aware advertising". However the symptoms of impaired decision making observed in the present study suggest that the stimulus dependent might have difficulty responding to such information: feeling pressured to act; or failing to adjust their decision making criteria. Instead participants sought further information as a function of symptom severity. Hence there could be benefits in interventions that draw attention to a person's immediate symptoms. Alternatively there could be advantages in affective computing systems currently under development that monitor emotional status (e.g. Nazmul Haque Nahin, Alam, Mahmud & Hasan, 2014; **Ortigosa, Martin, & Carro, 2014**) and tailor system responses to user status.

Limitations

As the variables and populations under consideration were skewed, data were transformed. However the assumptions of Manova were sometimes not met, and this can influence significance tests. To address such concerns we took a conservative approach and only reported effects that were both significant on multivariate and univariate tests.

The present study observed relationships between stimulant use and symptoms of defective decision making. We doubt that this a peculiarity of an online sample, as online samples can actually be more representative of the general population (Gosling et al, 2004), and otherwise represent the population for which putative electronic interventions would be developed. **Although these effects are likely to be due to stimulant use, it is possible that they occur because stimulants are chosen by a cross-section of the community who are already under stress (Ansell et al, 2012).** Conceivably avoidance may play a role in a person's general responses towards stimulant dependency (Prochaska & DiClemente, 1998), but in the present study the stronger predictor of specific online information seeking behaviour seemed situational (Mischel, 2004), namely self-reported symptom severity.

CONCLUSION

Nicotine and caffeine dependency was linked to the number of times and places these stimulants were used. In addition, stimulant use was correlated with symptoms of defective decision making. **Nicotine or caffeine dependency was associated with low decisional self-esteem in patients at higher risk of psychological distress**. Caffeine use was associated with hypervigilance. Confidence rather than defensive avoidance was a factor in reducing information seeking behaviours online.

REFERENCES

Andrews G, Slade T. 2001. Interpreting scores on the Kessler Distress Scale (K10). *Aus NZ J Public Health* **25**: 494–497

Ansell EB, Gu P, Tuit K, Sinha R. 2012. Effects of cumulative stress and impulsivity on smoking status. *Human Psychopharmacol* **27**: 200–208.

Auer M, Griffiths MD. 2014. Personalised feedback in the promotion of responsible gambling: A brief overview. *Responsible Gambling Review* 1: 27-36.

Baker JR, Phillips JG. 2007. Email, decisional styles and rest breaks. *CyberPsychol Behav* **10:** 705-708.

Benowitz NL. 2010. Nicotine addiction. *New England J Med* **362**: 2295-2303.

Beswick G, Rothblum ED, Mann L. 1988. Psychological antecedents of student procrastination. *Aust Psychol* **23**: 207–217.

Brebner J. 1998. Happiness and personality. *Personal Individ Diff* **25:** 279-296.

Chamberlain P, Goldney R, Delfabbro P, Gil T, & Dal Grande L. 2009. Suicidal ideation: The clinical utility of the K10. *Crisis* **30**: 39-42.

Chen J, Stallaert J. 2014. An economic analysis of online advertising using behavioural targeting. *MIS Quarterly* **38**: 429-449.

Craig CR, Stitzel RE. 2003. Modern pharmacology with clinical applications. Lippincott Williams Wilkins, Philadelphia.

Crocq M-A. 2003. Alcohol, nicotine, caffeine, and mental disorders. *Dialog Clinical Neurosci* **5**: 175-185.

Curry K., Stasio MJ. 2009. The effects of energy drinks alone and with alcohol on neuropsychological functioning. *Human Psychopharmacol* **24**: 473–481.

Daly JW, Fredholm BB. 1998. Caffeine – an atypical drug of dependence. *Drug Alcohol Depend* **51**: 199–206.

Dager SR, Friedman SD. 2000. Brain imaging and the effects of caffeine and nicotine. *Ann Med* **32**: 592-599.

Dennison L, Morrison L, Conway G, Yardley L. 2013. Opportunities and challenges for smartphone applications in supporting health behavior change: Qualitative study. *J Med Internet Res* **15**: e86. doi:10.2196/jmir.2583. Accessed 3rd December 2014.

Drake RE. 2007. Dual diagnosis. *Psychiatry* **6**: 381-384.

Eysenck HJ. 1997. Addiction, personality and motivation. *Human Psychopharm* **12**: S79–S87.

Field A. 2005. Discovering statistics using SPSS.

Field M, Cox WM. 2008. Attentional bias in addictive behaviors: A review of its development, causes, and consequences. *Drug Alcohol Depend* **97**: 1–20.

Freedman ND, Park Y, Abnet CC, Hollenbeck AR, Sinha R. 2012. Association of coffee drinking with total and cause-specific mortality. *New Eng J Med* **366**: 1891-1904.

Friedel JE, DeHart WB, Madden GJ, Odum AL. 2014. Impulsivity and cigarette smoking: discounting of monetary and consumable outcomes in current and non-smokers. *Psychopharmacology* **231**: 4517–4526.

Gee P, Coventry KR, Birkenhead D. 2005. Mood state and gambling: Using mobile telephones to track emotions. *Brit J Psychol* **96**: 53-66.

Gosling SD, Vazire S, Srivastava S, John OP. 2004. Should we trust web-based studies? A comparative analysis of six preconceptions about internet questionnaires. *Am Psychol* **59:** 93-104.

Gossop M, Darke S, Griffiths P, Hando J, Powis B, Hall W, Strang J. 1995. The Severity of Dependence Scale (SDS): psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction* **90**: 605-614.

Greenberg JL, Lewis SE, Dodd DK. 1999. Overlapping addictions and self-esteem among college men and women. *Addict Behav* **24**: 565-571.

Harrell PT, Juliano LM. 2012. A direct test of the influence of nicotine response expectancies on the subjective and cognitive effects of smoking. *Exp Clin Psychopharm* **20**: 278 –286.

Heron KE, Smyth JM. 2010. Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behaviour treatments. *Brit J Health Psychol* **15**: 1-39.

Hewlett P, Smith A. 2007. Effects of repeated doses of caffeine on performance and alertness: new data and secondary analyses. *Human Psychopharmacol* **22:** 339–350.

Hughes JR. 2007. Effects of abstinence from tobacco: valid symptoms and time course. *Nicotine Tobacco Res* **9**: 315-327.

Hughes JR, Oliveto AH, Liguori A, Carpenter J, Howard T. 1998. Endorsement of DSM-IV dependence criteria among caffeine users. *Drug Alcohol Depend* **52**: 99–107.

Jacobs DF. 1988. Evidence for a common dissociative-like reaction among addicts. *J Gamb Behav* **4**: 27–37.

James JE. 2012. Death by caffeine: How many caffeine-related fatalities and near-misses must there be before we regulate. *J Caffeine Res* **2**: 149-152.

James JE, Keane MA. 2007. Caffeine, sleep and wakefulness: implications of new understanding about withdrawal reversal. *Human Psychopharmacol* **22**: 549–558.

Janis IL, Mann L. 1977. Emergency decision making: A theoretical analysis of responses to disaster warnings. *J Human Stress* **3**: 35-48.

Juliano LM, Evatt DP, Richards BD, Griffiths RR. 2012. Characterization of individuals seeking treatment for caffeine dependence. *Psychol Addictive Behav* **26**: 948–954.

Kerr JS. 1996. Two myths of addiction: The addictive personality and the issue of free choice. *Human Psychopharmacol* **11**: S9–S13.

Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, Walters EE, Zaslavsky AM. 2002. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med* **32**: 959-956.

Kessler RC, Nelson CB, McGonagle KA, Edlund MJ, Frank RG, Leaf PJ. 1996. The epidemiology of co-occurring addictive and mental disorders: Implications for prevention and service utilization. *Am J Orthopsychiatry* **66**: 17-31.

Koehler DJ. 1991. Explanation, imagination, and confidence in judgement. *Psychol Bull* **110**: 499–519.

Koriat A, Lichtenstein S, Fischhoff B. 1980. Reasons for confidence. *J Exp Psychol Hum Learn Mem* **6**: 107–118.

Kotov R, Gamez W, Schmidt F, Watson D, 2010. Linking "big" personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychol Bull* **136**: 768-821.

Kozlowski LT, 1976. Effects of caffeine consumption on nicotine consumption. *Psychopharmacology* **47**: 165-8.

Lane JD, Phillips-Bute BG. 1998. Caffeine deprivation affects vigilance performance and mood. *Physiol Behav* **65**: 171-175.

Le Houezec J, Halliday R, Benowitz NL, Callaway E, Naylor H, Herzig K. 1994. A low dose of subcutaneous nicotine improves information processing in non-smokers. *Psychopharmacology* **114**: 628-34.

Leskovec J, Adamic LA, Huberman BA. 2007. The dynamics of viral marketing. *ACM Trans Web* **1**: 1-39.

Lorist MM, Tops M. 2003. Caffeine, fatigue, and cognition. *Brain Cogn* **53**: 82–94.

Mann L. 1973. Differences between reflective and impulsive children in tempo and quality of decision making. *Child Dev* **44**: 274–279.

Mann L, Ball C. 1994. The relationship between search strategy and risk choice. *Aust Psychol* **46:** 131-136.

Mann L, Burnett P, Radford M, Ford S. 1997. The Melbourne Decision Making Questionnaire: An instrument for measuring patterns of coping with decisional conflict. *J Behav Decis Making* **10**: 1–19.

Mann L, Tan C. 1993. The hassled decision maker: The effects of perceived time pressure on information processing in decision making. *Aust J Manage* **18**: 197–209.

Martin G, Copeland J, Gates P, Gilmour S. 2006. The Severity of Dependence Scale (SDS) in an adolescent population of cannabis users: Reliability, validity and diagnostic cut-off. *Drug Alcohol Depend* **83**: 90–93.

Mayers A. 2013. Introduction to Statistics and SPSS in Psychology. Pearson: UK.

Maynard OM, Attwood A, O'Brien L, Brooks S, Hedge C, Leonards U, Munafò MR. 2014. Avoidance of cigarette pack health warnings among regular cigarette smokers. *Drug Alcohol Depend* **136**: 170–174.

Meredith SE, Juliano LM, Hughes JR, Griffiths RR. 2013. Caffeine use disorder: A comprehensive review and research agenda. *J Caffeine Res* **3**: 114-130.

Milward J, Day E, Wadsworth E, Strang J, Lynskey M. in press. Mobile phone ownership, usage and readiness to use by patients in drug treatment. *Drug Alcohol Depend* doi:10.1016/j.drugalcdep.2014.11.001. Accessed on 3rd December 2014.

Mischel W. 2004. Toward an integrative science of the person. *Ann Rev Psychol* **55**: 1-22.

Mitchell SH. 2004. Effects of short-term nicotine deprivation on decision-making: Delay, uncertainty and effort discounting. *Nicotine Tobacco Res* **6**: 819-828.

Montaner M, Lopez B, de la Rosa JL. 2003. A taxonomy of recommender agents on the internet. *Artific Intell Rev* **19**: 285–330.

Nazmul Haque Nahin AFM, Alam JM, Mahmud H, Hasan K. 2014. Identifying emotion by keystroke dynamics and text pattern analysis. *Behav Info Tech* **33**: 987–996.

Nehlig A. 1999. Are we dependent upon coffee and caffeine? A review on human and animal data. *Neurosci Biobehav Rev* **23**: 563–576.

Oinas-Kukkonen H. 2010. Behavior Change Support Systems: A research model and agenda. *Lecture Notes Comp Sci* **6137**: 4-14.

Oinas-Kukkonen H. 2013. A foundation for the study of behavior change support systems. *Pers Ubiq Comput* **17**: 1223-1235.

Ortigosa A, Martin JM, Carro RM. 2014. Sentiment analysis in Facebook and its application to e-Learning. *Comp Hum Behav* 31: 527-541.

Parrott AC, Murphy RS. 2012. Explaining the stress-inducing effects of nicotine to cigarette smokers. *Human Psychopharmacol* **27**: 150–155.

Phillips-Bute BG, Lane JD. 1997. Caffeine withdrawal symptoms following brief caffeine deprivation. *Physiol Behav* **63**: 35-39.

Phillips JG, Jory M, Mogford N. 2007. Decisional style and eParticipation. Proceedings of OZCHI2007, pp. 139-141. http://dl.acm.org/citation.cfm?id=1324892.1324917&coll=DL&dl=ACM&CFID=460 532423&CFTOKEN=19927600. Accessed 3rd December 2014

Phillips JG, Ogeil RP. 2011. Decisional styles and risk of problem drinking or gambling. *Personality Individ Diff* **51**: 521–526.

Pilette WL.1983. Caffeine: Psychiatric grounds for concern. *J Psychosoc Nurs Mental Health Serv* **21**: 19-24.

Prochaska, JO, DiClemente, CC. 1998. Toward a comprehensive transtheoretical model of change: Stages of change and addictive behaviors. In: Miller, W.R, Heather, N. (Eds.), Treating addictive behaviors. Plenum Press, New York, pp. 3-24.

Radford MH, Mann L, Kalucy RS. 1986. Psychiatric disturbance and decision-making. *Aust NZ J Psychiatry* **20**: 210–217.

Redish AD, Jensen S, Johnson A. 2008. A unified framework for addiction: Vulnerabilities in the decision process. *Behav Brain Sci* **31**: 415-437.

Reissig CJ, Strain EC, Griffiths RR. 2009. Caffeinated energy drinks-A growing problem. *Drug Alcohol Depend* **99**: 1-10.

Rozin P, Stoess C. 1993. Is there a general tendency to become addicted? *Addict Behav* **18**: 81-87.

Sahakian B, Morein-Zamir S. 2007. Professor's little helper. *Nature* **450**: 1157-1159.

Satel S. 2006. Is caffeine addictive?—A review of the literature. *Am J Drug Alcohol Abuse* **32**: 493–502.

Schafer JB, Konstan JA, Riedl J. 2001. E-commerce recommendation applications. *Data Mining Know Discovery* **5**: 115-153.

Shaffer HJ, LaPlante DA, LaBrie RA, Kidman RC, Donato AN, Stanton MV. 2004. Toward a syndrome model of addiction: Multiple expressions, common etiology. *Harvard Rev Psychiatry* **12**: 367–374.

Shirren S, Phillips JG. 2011. Decisional style, mood and work communication: Email diaries. *Ergonomics* **54**: 891-903.

Shrier LA, Rhoads A, Burke P, Walls C, Blood EA. 2014. Real-time, contextual intervention using mobile technology to reduce marijuana use among youth: A pilot study. *Addict Behav* **39**: 173-180.

Smith AP. 2009a. Caffeine, cognitive failures and health in a non-working community sample. *Human Psychopharmacol* **24**: 29-34.

Smith AP. 2009b. Effects of caffeine in chewing gum on mood and attention. *Human Psychopharmacol* **24**: 239–247.

Smith ME, Birnholtz J, Reynolds L, Hancock J. 2013. People, place and time: the daily rhythms of deception in interpersonal text messaging. International Communication Association 63rd Annual Conference, London, UK. http://socialmedia.northwestern.edu/files/2013/04/android_ica2013_preprint.pdf (accessed Sept. 16, 2014).

Song C, Qu Z, Blumm N, Barabási A-L. 2010. Limits of predictability in human mobility. *Science* **327**:1018-1021.

Strain EC, Mumford GK, Silverman K, Griffiths RR. 1994. Caffeine dependence syndrome evidence from case histories and experimental evaluations. *JAMA* **272**: 1043-1048.

Thompson JC, Wilby G, Stough C. 2002. The effects of transdermal nicotine on inspection time. *Human Psychopharm* **17**: 157–161.

Topp L, Mattick RP. 1997. Choosing a cut-off on the Severity of Dependence Scale (SDS) for amphetamine users. *Addiction* **92**: 839-845.

U.S. Department of Health and Human Services. 2014. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

Vickers, D. 1979. Decision processes in visual perception. London: Academic Press.

Warburton DM, Bersellini E, Sweeney E. 2001. An evaluation of a caffeinated taurine drink on mood, memory and information processing in healthy volunteers without caffeine abstinence. *Psychopharmacology* **158**: 322–328.

Winston AP, Hardwick E, Jaberi N. 2005. Neuropsychiatric effects of caffeine. *Adv Psychiatric Treat* **11**: 432–439.

Zuckerman M. 1979. Sensation seeking: beyond the optimal level of arousal. Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Table 1. Mean use of stimulants as a function of dependence (SE in brackets). Bolded

dependent values are significantly different from non-dependent levels.

	Times Caffeine Consumed	Places Caffeine Consumed	Times Nicotine Smoked	Places Nicotine Smoked
Non-Caffeine Dependent	2.695 (0.286)	1.593 (0.126)	7.692 (0.744)	2.018 (0.158)
Caffeine Dependent	**3.396 (0.383)**	**2.159 (0.169)**	2.973 (0.997)	0.986 (0.212)
Non-Nicotine Dependent	2.882 (0.305)	1.852 (0.135)	0.874 (0.795)	0.408 (0.169)
Nicotine Dependent	**3.209 (0.367)**	**1.901 (0.162)**	**9.791 (0.958)**	**2.597 (0.203)**

Table 2. Mean decisional styles as a function of psychological distress (SE in brackets).

Bolded risk values are significantly different from no risk values.

	Vigilance	Buckpassing	Procrastination	Hypervigilance	Decisional Self-Esteem
Low K10	9.304 (0.284)	4.503 (0.368)	3.780 (0.327)	4.146 (0.297)	8.696 (0.266)
High K10	9.211 (0.480)	**6.954 (0.621)**	**5.756 (0.551)**	**6.249 (0.502)**	**6.513 (0.449)**

Figure 1. The significant interaction of Caffeine Dependence, Nicotine Dependence and K10 Score upon mean decisional self-esteem.