The RT-18

A new instrument to assess adolescent and young adult risk-taking behavior

Cover illustration: Paul J.M. Keulen
Lay-out: Jasper Stamm
Printed by: Gildeprint, Enschede

The RT-18

A new instrument to assess adolescent and young adult risk-taking behavior

De RT-18

Een nieuw instrument om risicogedrag te meten bij adolescenten en jong volwassenen

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht
op gezag van de rector magnificus, prof. dr. G.J. van der Zwaan,
ingevolge het besluit van het college voor promoties
in het openbaar te verdedigen op woensdag 16 december 2015
des middags te 2.30 uur

door

Lydia de Haan

geboren op 27 juli 1986 te Amsterdam

Promotor: Prof. dr. A.C.G. Egberts

Copromotor: Dr. E.R. Heerdink

…I walk to the horizon

And there I find another

It all seems so surprising

And then I find that I know…

From Enya – Anywhere is

Voor Papa en Mama

Voor Yvo

TABLE OF CONTENTS

Chapter 1. General Introduction 9

PART 1. DEVELOPMENT AND PSYCHOMETRICAL VALIDATION OF THE RT-18

Chapter 2. The RT-18: a new screening tool to assess young adult risk-taking behavior 25

Chapter 3. Reliability of the risk-taking questionnaire 18 items (RT-18); internal consistency, measurement error, and retest reliability in two samples of young adults 43

Chapter 4. The RT-18 compared to self-report questionnaires and behavioral tasks 59

PART 2. ASSESSMENT OF THE ASSOCIATION BETWEEN RT-18 AND VARIOUS EXPRESSIONS OF RISK-TAKING BEHAVIOR

Chapter 5. The relation between risk-taking behavior and alcohol use in young adults is different for men and women 83

Chapter 6. The association between risk-taking behavior and substance use: results from a diary study 99

Chapter 7. The association between risk-taking behavior and beliefs about medicines in adolescents 117

Chapter 8. Interpersonal relating, risk-taking behavior, and alcohol use in young adults 135

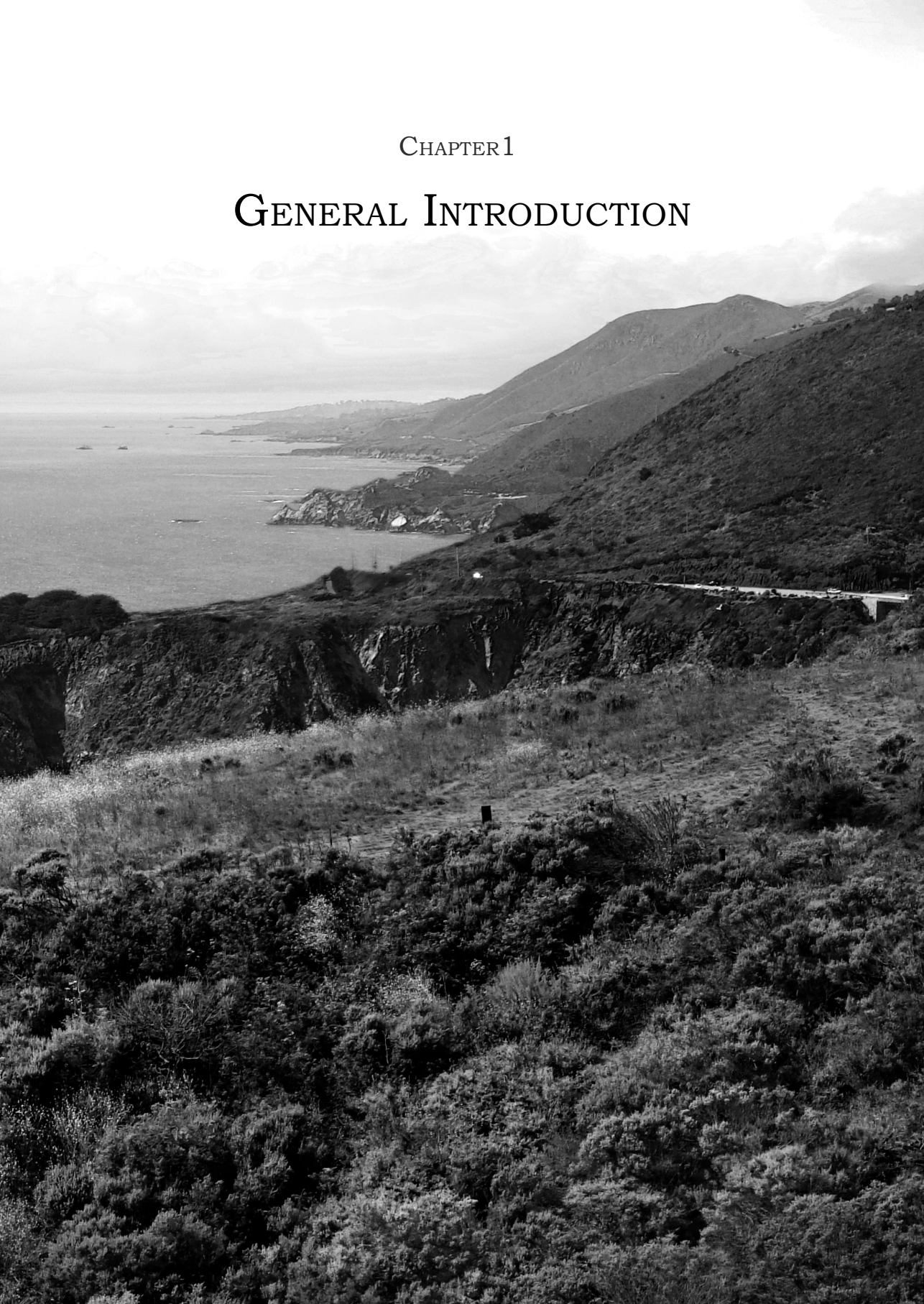
Chapter 9. Summary & General Discussion 155

APPENDICES

Nederlandse Samenvatting 178
Acknowledgements 182
List of co-authors 183
The CNS Clinical Pharmaco-epidemiology Research Group 184
About the author 187
List of publications 188

Chapter 1

General Introduction



Background

Case: Risk-taking behavior in healthcare

Tom is a 24-year-old man with a history of cannabis and cocaine dependence. He can become extremely aggressive when under the influence of cocaine and has built a considerable criminal record. Tom has read that cocaine use is in some cases considered to be self-medication for ADHD. This has led him to believe that if he receives medication in the form of methylphenidate, this will solve all his problems at once, both the addiction and the aggression issues. When he meets a psychiatrist, he immediately demands to be put on methylphenidate.

The psychiatrist now has to make various risk assessments. First of all, he needs to assess his own safety and thus the risk of Tom getting aggressive towards him, in case the he refuses to prescribe methylphenidate. Assuming this can be safely discussed with Tom, he needs to assess the risk of Tom going to abuse the methylphenidate, considering his history of addiction. When making this assessment, not only Tom's history of addiction is a factor to keep in mind, also the level of impulsivity of the patient plays an important role in not adhering to the prescribed regiment; for instance upping the dose when the medication-effect is not sufficient. And how about the tendency of sensation seeking? Will Tom start to sniff the methylphenidate, a form of use with much higher risk of addiction, instead of the regular oral administration? On the other hand, although the evidence is limited in case of a co-occurring substance use disorder, the methylphenidate could also help Tom to improve his ADHD symptoms, making him less impulsive and hence reduce his cocaine use and the risk of aggressive outbursts.

As is evident from this case, a comprehensive assessment of possible patient risk behaviors and forming adequate treatment policy accordingly, is an essential element of healthcare.

Taking risks

Healthcare is built on decisions. Medical decisions are taken on the basis of probabilities (evidence), suspicion, experience, opinions and expectations (Mann, 1989). When deciding upon diagnosis, course of treatment and subsequent interventions to take, a balance is sought between expected benefits and acceptable risks. An example is the decision whether to treat a patient that shows symptoms of depression with an antidepressant, or to employ 'watchful waiting'. Medicine can thus be seen as calculated risk taking, a gamble which is expected to pay off (O'Brien, 1989). The potential negative outcome (or risk) usually involves a form of harm, loss or injury. In order to make a decision, the potential benefits and risks need to be weighed. In some situations decisions are made consciously and after careful consideration of potential positive and negative consequences, and in other circumstances decisions are made in a more subconscious manner.

Choices have to be made not only by the medical expert but by the patient himself as well, see Figure 1. Even more so, shared decision making (SDM) has become a recent point of focus within medical and pharmaceutical care. For many health situations in which there is no clearly superior treatment, shared decision making can ensure that medical care better aligns with patients' preferences and values (Oshima Lee & Emanuel, 2013). Some individuals, however, seem inclined to take more risk, where others come across as risk aversive. Such a general predisposition towards risky behavior (e.g. risk-taking or risk-avoiding) can have a great impact on the decisions made by that individual, whether it concerns a health care professional or a patient. The latter might overestimate the risks involved and adopt a risk averse attitude, thereby missing out on potential treatment benefits. The patient could also decide not to adhere to treatment by purposely not taking the prescribed medication. Besides patients, health care professionals might (consciously or unconsciously) express a certain preference for risk, for greater risks are sometimes accompanied with greater benefits. Such preferences could conflict with the Primum non nocere (first do no harm) principle.

As with all behaviors, a psychological or motivational component is hypothesized to lie at the basis of the expressed behavior (i.e.; risk behaviors like binge drinking, medication non-adherence etc.). This thesis will focus on individual differences in risk-taking behavior by assessing the underlying psychological component as well as the actual expressed risk behavior. A better understanding of this particular behavior in a medical setting could be beneficial. For instance, patients with a very high or very low preference for risk can be identified and (pharmacological) treatment and counselling can be adjusted accordingly to improve treatment-outcome.

Risk-taking behavior and health related risks

Risks in general can be categorized as either financial, social, legal, physical or psychological. This thesis will focus in particular on the physical and psychological risk domains. An individual's level of risk-preference plays a large role in all daily life decisions and activities. We assume that individuals with a preference for risk, are more likely to engage in risk behavior, and thus place themselves more at-risk for physical and or psychological harm.

Risk behavior like reckless driving, fighting, and practicing extreme sports increases the chance of injury (Turner, McClure, & Pirozzo, 2004). It has been estimated that world-wide 830,000 children under the age of 18 die every year as a result of unintentional injury either by unfortunate actions of themselves or inflicted by others (Harvey, Towner, Peden, Soori, & Bartolomeos, 2009). Practicing unsafe sex (with the risk of unwanted pregnancy or acquiring a sexually transmitted disease) (Cooper, Agocha, & Sheldon, 2000), unhealthy eating, not exercising enough, and not adhering to prescribed medication are other behaviors that can endanger a person's health and well-being in which risk-taking behavior plays a significant role (Bogg & Roberts, 2004). Moreover, risk-taking behavior exerts a clear influence on substance use and abuse (Ball, 2005; Dick et al., 2010a; Hittner & Swickert, 2006; Ibáñez et al., 2010; Sher, Bartholow, & Wood, 2000). Nearly eight percent of all male deaths and four percent of all female deaths worldwide in 2012 were attributed to alcohol abuse (World Health Organization, 2014). Associations have been found between risk-taking behavior and alcohol use across different populations of adolescents, university students, and (addicted) patients (Dom, Hulstijn, & Sabbe, 2006; Epstein, Griffin, & Botvin, 2001; Fernie, Cole, Goudie, & Field, 2010), but also for risk-taking behavior and illicit drug use (Chambers, Taylor, & Potenza, 2003; de Wit, 2009) as well as tobacco use (Dom et al., 2006). Sher, Bartholow, and Wood found that disinhibition and behavioral undercontrol were the most consistent predictors of substance abuse disorders (Sher et al., 2000). The association between risk-taking behavior and substance use is interesting for the level of individual risk-taking is positively related to substance use, and the consumption of substances increases in its turn the level of engagement in risk behaviors (de Wit, 2009; Dick et al., 2010b; Parent & Newman, 1999).

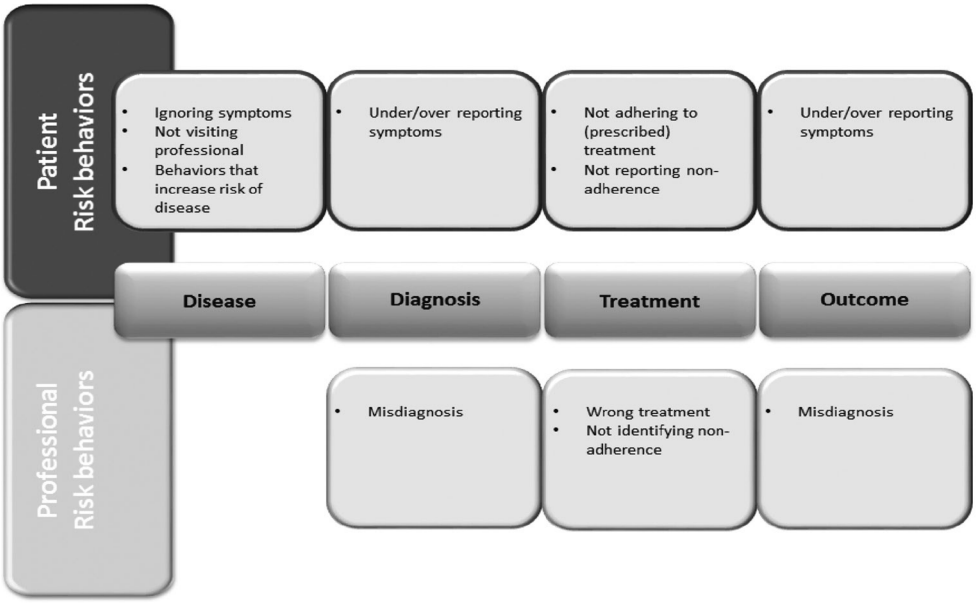


Figure 1: Examples of general patient and professional risk behaviors in healthcare

Besides risk behaviors that have the potential to directly influence an individual's health and well-being in general, the risk-taking behavior construct is also thought to exert a substantial influence on the behavior of patients. We will briefly discuss this, employing the example of medication non-adherence.

Non-adherence to medication is a global issue of major public health concern (ABC Project Team, 2013; Vermeire, Hearnshaw, Van Royen, & Denekens, 2001). It is a significant barrier to the safe, effective and cost-effective use of medicines (ABC Project Team, 2013). Adherence is commonly measured as an outcome; through direct methods such as blood and urine analyses, or by indirect measures such as tablet counts, prescription filling dates and therapeutic and preventive outcomes, or patient's self-report through interviews or diaries, none of which appears to be completely reliable and valid (Vermeire et al., 2001). At the basis of all these outcomes lies the behavioral construct of non-adherence, that involves complex actions, intentions, emotions, and phenomena that may not be directly observable (Kyngäs, Kroll, & Duffy, 2000).

Adherence outcomes are likely to be associated with this psychological component, but hardly equivalent (DiMatteo, Haskard-Zolnierek, & Martin, 2012). Patients can be perfectly adherent but still have a poor adherence outcome like blood pressure (DiMatteo et al., 2012). The quest to identify factors that predict non-adherence is ongoing. Since 1975, more than 200 variables have been studied, none of which consistently predicts adherence (Vermeire et al., 2001). We think risk-taking behavior might play an important role in non-adherence. As stated earlier, risk-taking behavior involves weighing risks and benefits, and a certain individual preference for risk in general. The

active decision to adhere to a prescribed medication regiment depends on the patient's beliefs, as in perceived risks and benefits. Hence non-adherence can be seen as a form for risk behavior, that gravely endangers a persons' treatment outcome, health and well-being.

Research perspectives on risk-taking behavior

There is a vast amount of literature on risk-taking behavior. Boyer (2006) identified four major perspectives on the development of risk-taking behavior; cognitive, emotional, psychobiological, and social. Within these research areas, specific theories about the nature of risk-taking behavior have been developed. A lot of conceptual overlap exists between theories, but also some clear discrepancies. And to somewhat convolute the matter, numerous definitions of risk and risk-taking, and a large diversity in nomenclatures of psychological dispositions underlying risk behaviors have been postulated (Arnett, 1992; Byrnes, Miller, & Schafer, 1999; Dick et al., 2010b; Evenden, 1999). We will shortly discuss the four different research perspectives on risk-taking behavior, to paint the background of our vision on the concept of risk-taking behavior.

From a social research perspective, risk-taking behavior is thought to be influenced by the social- cultural environment, which in its turn influences how an individual interacts and interprets this environment.

The cognitive research perspective places risk-taking behavior within a framework of decision-making, utilizing a mathematical approach, by modeling the probability of an individual engaging in risk-taking based on probable costs and perceived benefits. Therefore the focus lies on explaining the risk assessment process within individuals.

Within the emotional research perspective, two main focusses can be distinguished. The first focus uses mathematical frameworks similar to cognitive research, but costs and benefits are substituted by increased or decreased positive and negative emotions (i.e. affective decision-making). The second focus assumes risk-taking to be an expression of personality characteristics. Several personality constructs have been postulated as the psychological component underlying risk behaviors; impulsivity, sensation seeking, venturesomeness, novelty seeking, and thrill seeking.

The psychobiological research perspective on risk-taking behavior focuses on the specific brain structures involved in taking risks, but also other biological mechanisms such as hormones and specific genetic components. This can be done based on the cognitive or the affective frameworks, mentioned before.

Risk-taking behavior as a personality trait

The research presented in this thesis converges around the idea that risk-taking behavior is an expression of a personality construct as hypothesized by the emotional research field. Personality constructs like impulsivity, sensation seeking, venturesomeness, novelty seeking, and thrill seeking have a lot of conceptual overlap in that they all attempt to explain the psychological component that underlies risk-taking behavior, however, each of these constructs has a distinct definition.

Venturesomeness has been postulated by Eysenck and Eysenck and is described as "taking risks and seeking thrill and adventure". Individuals with a high level of venturesomeness are fully conscious of the particular risk at hand and consciously decide to take their chances (Eysenck & Eysenck, 1978).

Eysenck and Eysenck have also described impulsivity to be the tendency to make hasty rather than reflective decisions (Eysenck & Eysenck, 1978), and they feel impulsivity is in its turn a product of low self-control. However, most researchers argue impulsivity to be a multifaceted construct, with aspects related to the inability to stop initiated actions, intolerance to delay, reward sensitivity, and lack of consideration of consequences of actions (Dick et al., 2010b; Wiers, Ames, Hofmann, Krank, & Stacy, 2010).

Zuckerman postulated the impulsive-sensation-seeking trait, which comprises a more impulsive or "lack of planning and a tendency to act quickly on impulse without thinking" component and a sensation seeking component; "a general need for thrills and excitement, a preference for unpredictable situations and friends, and the need for novelty and change" (Zuckerman, 2002).

The novelty seeking construct was postulated by Cloninger, and differentiates between slow tempered, uninquiring, tolerant of monotony, orderly, reserved, rigid, frugal and stoic individuals on one hand and quick-tempered, exploratory, curious, impulsive, easily bored, extravagant, disorderly and irritable individuals on the other (Cloninger, Svrakic, & Przybeck, 1993).

As said before, these personality constructs have a lot of theoretical overlap. Therefore we argue that impulsivity, venturesomeness, novelty seeking and sensation seeking, can be combined into one overarching personality trait. We will refer to this trait as risk-taking behavior. The individual level of the personality trait risk-taking behavior will thus directly influence the engagement in risk behaviors (Figure 1). Although the engagement in risk behavior of an individual can differ between days and situations, we think risk-taking behavior to be a more general predisposition that is relatively stable over time (Dahlbäck, 1990). Moreover, risk-taking behavior is hypothesized to be a continuous personality trait with high levels of risk-taking at one end and risk averseness at the other.

High risk-taking groups

Certain groups of individuals have been identified, that display more risk behaviors than others. For instance, sex-differences in risk-taking behavior are well known; men typically are more likely to engage in risky behavior than women (Byrnes et al., 1999). The magnitude of this effect was found to be influenced by setting and age. In general, men score higher on measures of behavioral disinhibition, impulsivity and sensation seeking (Nolen-Hoeksema, 2004). Why would men take more risks than women? It has been argued that observed sex-differences in the Big Five traits neuroticism and agreeableness may help explain this phenomenon (Lauriola & Levin, 2001). Another explanation is that risk-taking is an evolutionary based behavior, which acts as a mating strategy, as males signal inclusive fitness to females and compete with male rivals.

Individuals practicing certain professions or sports that require a risk-accepting attitude are thought to express more risky behavior in general (Freixanet, 1991; Jack & Ronan, 1998). For instance, the most successful business executives are the biggest risk-takers whereas the most mature executives are the most risk averse (MacCrimmon & Wehrung, 1990). However, some researchers argue homogeneity in the level of risk-taking across different domains of risks should not be assumed based on risk-taking in one domain (i.e. financial or physical risk) (Llewellyn & Sanchez, 2008).

Adolescents and young adults are also known to take more risks (Arnett, 1992; Boyer, 2006). This is thought to be the product of increased reward seeking behavior on one hand and immature control systems of the prefrontal cortex on the other. Taking risks can be very functional in this age period, for it also educates the individual about the specific negative consequences that can be involved with taking a particular risk. Levels of risk-taking behavior usually decline after maturation of the prefrontal cortex around the age of 25 to 30.

After reaching adulthood, some differences in individual levels of risk-taking behavior remain. For some it can be functional adaptive behavior, whereas it might be inappropriate in certain situations and become dysfunctional behavior for others (Byrnes et al., 1999). Personality constructs related to risk-taking behavior like impulsivity and sensation seeking are (core) symptoms of certain psychiatric diseases, for instance ADHD, addictive behaviors, pathological gambling, childhood conduct disorder and adult antisocial personality disorder (Evenden, 1999; Fineberg et al., 2010; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001).

Ways to measure risk-taking behavior

At the moment, there is no gold standard for assessing the risk-taking behavior construct despite the plethora of available measures that range from gambling tasks to self-report measures (Appelt, Milch, Handgraaf, & Weber, 2011). Based on the before mentioned differences in research perspectives on risk-taking behavior, two major leagues in the assessment of risk-taking behavior can be distinguished, personality psychologists and decision-making researchers, who operationally define risk in quite different ways (Lauriola & Levin, 2001). Whereas hypothetical gambles or choice dilemmas are the favorite stimuli in experimental research, personality psychologists examine risk-taking behavior in applied settings, such as driving behavior, health behavior, pathological gambling, and high-risk or "thrill-seeking" sports (Lauriola & Levin, 2001). Appelt et al. reported seven categories of available instruments across all research fields involved; decision making measures, risk attitude measures, cognitive ability measures, motivation measures, personality inventories, personality construct measures, and miscellaneous measures (Appelt et al., 2011). In general, instruments assessing risk-taking behavior can be divided in two categories of methodology; questionnaires based on self-report (either pen and paper or computer-based versions) and laboratory tasks (i.e., performance based tasks that usually involve a computer-based testing design). Interestingly, there has been little empirical evidence examining the overlap in nomothetic span for self-report measures and construct representation for behavioral lab tasks (Cyders & Coskunpinar, 2011). Most of the relationships that have been studied between different kinds of risk-taking measures are weak or non-existent (Dahlbäck, 1990). Since it is difficult to compare between risk-taking measures, validation of these instruments depends largely on external validation with actual risk behaviors.

Taken together, one's specific constitution of risk-taking behavior lies at the basis of many health related decisions and risk behaviors. We feel it is therefore worthwhile to develop an instrument that evaluates risk-taking behavior at an individual level. Such an instrument could serve multiple purposes. First, the assessment of individual levels of risk-taking behavior aids gaining insight into one's personality and subsequent behavior and allows for comparison of individuals. Second, in case problematic risk-taking behavior is displayed (e.g.; substance abuse, non-adherence to medication), this assessment would be a potential point of action for therapy, practitioner-patient interactions or improvement of treatment. Third and final, a valid assessment of risk-taking behavior might help to identify at-risk individuals (i.e.; children, adolescents, and young adults) before they start to engage in health-risk behaviors, so that preventive actions can be taken.

Thesis objectives

The aim of this thesis is two-fold:

1. To develop and psychometrically validate a new instrument (RT-18) to assess risk-taking behavior
2. To assess the association between RT-18 and various expressions of risk-taking behavior

Thesis outline

The first half of this thesis focusses on the development and psychometric characteristics of the RT-18. Chapter 2 presents the development of the RT-18 and the first psychometric analyses. Chapter 3 evaluates the internal consistency, measurement error and temporal stability. In Chapter 4, the RT-18 is compared to other questionnaires measuring risk-taking to assess construct validity, and to laboratory based behavioral tasks assessing risk-taking.

The second half centers around risk-taking behavior and associations with risk behaviors. Chapter 5 describes the relation of risk-taking behavior and alcohol use. Chapter 6 assesses the association between the RT-18 and substance use in a longitudinal design. Chapter 7 reports the relation between risk-taking behavior and beliefs about medicine in adolescents. Chapter 8 explores the mediating role of risk-taking behavior on the relation of interpersonal relating and alcohol use.

In Chapter 9 the results, strengths and limitations are discussed and directions for future research are given.

References

ABC Project Team. (2013). Ascertaining barriers for compliance: Policies for safe, effective and cost-effective use of medicines in europe. final report of the ABC project. available from: Http. *Abcproject.Eu/Img/ABC% 20Final.Pdf.Accessed April, 11*

Appelt, K. C., Milch, K. F., Handgraaf, M. J., & Weber, E. U. (2011). The decision making individual differences inventory and guidelines for the study of individual differences in judgment and decision-making research. *Judgment and Decision Making, 6*(3), 252-262.

Arnett, J. (1992). Reckless behavior in adolescence: A developmental perspective. *Developmental Review, 12*(4), 339-373.

Ball, S. A. (2005). Personality traits, problems, and disorders: Clinical applications to substance use disorders. *Journal of Research in Personality, 39*(1), 84-102.

Bogg, T., & Roberts, B. W. (2004). Conscientiousness and health-related behaviors: A meta-analysis of the leading behavioral contributors to mortality. *Psychological Bulletin, 130*(6), 887.

Boyer, T. W. (2006). The development of risk-taking: A multi-perspective review. *Developmental Review, 26*(3), 291-345.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. *Psychological Bulletin, 125*(3), 367-383.

Chambers, R. A., Taylor, J. R., & Potenza, M. N. (2003). Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability. *Am J Psychiatry., 160*(6), 1041-1052.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*(12), 975.

Cooper, M. L., Agocha, V. B., & Sheldon, M. S. (2000). A motivational perspective on risky behaviors: The role of personality and affect regulatory processes. *Journal of Personality, 68*(6), 1059-1088.

Cyders, M. A., & Coskunpinar, A. (2011). Measurement of constructs using self-report and behavioral lab tasks: Is there overlap in nomothetic span and construct representation for impulsivity? *Clinical Psychology Review, 31*(6), 965-982.

Dahlbäck, O. (1990). Personality and risk-taking. *Personality and Individual Differences, 11*(12), 1235-1242.

de Wit, H. (2009). Impulsivity as a determinant and consequence of drug use: A review of underlying processes. *Addiction Biology, 14*(1), 22-31.

Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010a). Review: Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology, 15*(2), 217-226.

Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010b). Review: Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology, 15*(2), 217-226.

DiMatteo, M. R., Haskard-Zolnierek, K. B., & Martin, L. R. (2012). Improving patient adherence: A three-factor model to guide practice. *Health Psychology Review, 6*(1), 74-91.

Dom, G., Hulstijn, W., & Sabbe, B. (2006). Differences in impulsivity and sensation seeking between early-and late-onset alcoholics. *Addictive Behaviors, 31*(2), 298-308.

Epstein, J. A., Griffin, K. W., & Botvin, G. J. (2001). Risk taking and refusal assertiveness in a longitudinal model of alcohol use among inner-city adolescents. *Prevention Science, 2*(3), 193-200.

Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology, 146*(4), 348-361.

Eysenck, S. B., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. *Psychological Reports, 43*(3f), 1247-1255.

Fernie, G., Cole, J. C., Goudie, A. J., & Field, M. (2010). Risk-taking but not response inhibition or delay discounting predict alcohol consumption in social drinkers. *Drug and Alcohol Dependence, 112*(1), 54-61.

Fineberg, N. A., Potenza, M. N., Chamberlain, S. R., Berlin, H. A., Menzies, L., Bechara, A., . . . Hollander, E. (2010). Probing compulsive and impulsive behaviors, from animal models to endophenotypes: A narrative review. *Neuropsychopharmacology, 35*(3), 591-604.

Freixanet, M. G. (1991). Personality profile of subjects engaged in high physical risk sports. *Personality and Individual Differences, 12*(10), 1087-1093.

Harvey, A., Towner, E., Peden, M., Soori, H., & Bartolomeos, K. (2009). Injury prevention and the attainment of child and adolescent health. *Bulletin of the World Health Organization, 87*(5), 390-394.

Hittner, J. B., & Swickert, R. (2006). Sensation seeking and alcohol use: A meta-analytic review. *Addictive Behaviors, 31*(8), 1383-1401.

Ibáñez, M. I., Moya, J., Villa, H., Mezquita, L., Ruiperez, M., & Ortet, G. (2010). Basic personality dimensions and alcohol consumption in young adults. *Personality and Individual Differences, 48*(2), 171-176.

Jack, S., & Ronan, K. R. (1998). Sensation seeking among high-and low-risk sports participants. *Personality and Individual Differences, 25*(6), 1063-1083.

KyngÄs, H. A., Kroll, T., & Duffy, M. E. (2000). Compliance in adolescents with chronic diseases: A review. *Journal of Adolescent Health, 26*(6), 379-388.

Lauriola, M., & Levin, I. P. (2001). Personality traits and risky decision-making in a controlled experimental task: An exploratory study. *Personality and Individual Differences, 31*(2), 215-226.

Llewellyn, D. J., & Sanchez, X. (2008). Individual differences and risk taking in rock climbing. *Psychology of Sport and Exercise, 9*(4), 413-426.

MacCrimmon, K. R., & Wehrung, D. A. (1990). Characteristics of risk taking executives. *Management Science, 36*(4), 422-435.

Mann, R. D. (Ed.). (1989). *Risk and consent to risk in medicine: The proceedings of a conference organised by management forum limited and held in london, april 28 & 29, 1988*. Carnforth, UK: Parthenon Publishing.

Moeller, F. G., Barratt, E. S., Dougherty, D. M., Schmitz, J. M., & Swann, A. C. (2001). Psychiatric aspects of impulsivity. *American Journal of Psychiatry,*

Nolen-Hoeksema, S. (2004). Gender differences in risk factors and consequences for alcohol use and problems. *Clinical Psychology Review, 24*(8), 981-1010.

O'Brien, B. (1989). An overview of the estimation and evaluation of clinical risks. In R. D. Mann (Ed.), *Risk and consent to risk in medicine* (pp. 23-37)

Oshima Lee, E., & Emanuel, E. J. (2013). Shared decision making to improve care and reduce costs. *New England Journal of Medicine, 368*(1), 6-8.

Parent, E. C., & Newman, D. L. (1999). The role of sensation-seeking in alcohol use and risk-taking behavior among college women. *Journal of Alcohol and Drug Education, 44*(2), 12.

Sher, K. J., Bartholow, B. D., & Wood, M. D. (2000). Personality and substance use disorders: A prospective study. *Journal of Consulting and Clinical Psychology, 68*(5), 818.

Turner, C., McClure, R., & Pirozzo, S. (2004). Injury and risk-taking behavior—a systematic review. *Accident Analysis & Prevention, 36*(1), 93-101.

Vermeire, E., Hearnshaw, H., Van Royen, P., & Denekens, J. (2001). Patient adherence to treatment: Three decades of research. A comprehensive review. *Journal of Clinical Pharmacy and Therapeutics, 26*(5), 331-342.

Wiers, R., Ames, S. L., Hofmann, W., Krank, M., & Stacy, A. (2010). Impulsivity, impulsive and reflective processes and the development of alcohol use and misuse in adolescents and young adults. *Frontiers in Psychology, 1*, 144.

World Health Organization. (2014). *Global status report on alcohol and health-2014* World Health Organization.

Zuckerman, M. (2002). Zuckerman-kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model. *Big Five Assessment,* , 377-396.

Part 1

Development and psychometrical validation of the RT-18

Chapter 2

The RT-18:

A new screening tool to assess young adult risk-taking behavior

Lydia de Haan[1], Esther Kuipers[1], Yvanca Kuerten[1], Margriet van Laar[2], Berend Olivier[1], Joris Cornelis Verster[1]

[1] Division of Pharmacology, Utrecht Institute for Pharmaceutical Sciences, Utrecht University
[2] Trimbos Institute, Netherlands Institute of Mental Health and Addiction, Utrecht, The Netherlands

International Journal of General Medicine 2011:4 575–584

Abstract

Risk-taking behavior is a major determinant of health and plays a central role in various diseases. Therefore, a brief questionnaire was developed to assess risk-taking among young adults with known different levels of risk-taking behavior (social drinkers and recreational drug users). In Study 1, N = 522 university students completed the RT-18 risk taking questionnaire. N = 100 students were retested after 2 to 4 weeks and performed the Cambridge Gambling Task (CGT). Mean RT-18 score was 7.69 and Cronbach's alpha was 0.886. The test-retest reliability was r = 0.94. Significant correlation was found between the RT-18 score and CGT scores of risk-taking, bet proportion, and risk adjustment. In Study 2, N = 7834 young adult social drinkers, and recreational drug users, mean RT-18 score was 9.34 and Cronbach's alpha was 0.80. Factor analysis showed that the RT-18 comprises two factors assessing level of risk-taking behavior and risk assessment. Men scored significantly higher than women on the RT-18. Recreational drug users had significantly higher scores when compared to social drinkers. In Study 3 of N = 1000 students, construct validity was confirmed by showing that the RT-18 outcome correlates significantly with scores on the Stimulating-Instrumental Risk Inventory. In conclusion, the RT-18 is a valid and reliable screening tool to differentiate levels of risk-taking behavior. This short scale is quick and practical to administer, imposing minimal demands on participants. The RT-18 is able to differentiate risk taking and risk assessment which can help target appropriate intervention strategies.

Introduction

Risk taking can be defined as the intentional or unintentional exposure to the possibility of injury or loss. Risk-taking behavior is a major determinant of health, plays a central role in many diseases, and is related to several health risk factors listed in a 2006 World Bank report.[1] For example, risk-taking behavior may be the cause of injury (e.g., traffic accidents and self-inflicted injuries), is related to public health hazards (e.g., unsafe sex, smoking, alcohol, and recreational drug use),[2] and may be a dominant symptom in psychiatric disease such as attention-deficit hyperactivity disorder (ADHD).[3] These examples illustrate how some people show higher levels of risk-taking behavior than others. Adolescents and male young adults especially show higher levels of risk-taking behavior and related consequences.[4,5]

Risk-taking behavior can be functional, necessary, and appropriate in some situations, but can also be dangerous and inappropriate. There are different categories of risks, for example financial, social, legal, physical, and psychological. The outcome of risk-taking behavior is subjective and depends partly on individual circumstances; many decisions in life involve a balance between risk and anticipated reward. Thus, in many cases risk-taking behavior is goal-directed (i.e. , acquiring the reward) and related to perceived needs.[6] Risk-taking behavior has been associated with impulsivity and traits such as sensation seeking, novelty seeking, and venturesomeness.[4,7–10] Although closely related, these individual traits do not adequately cover all concepts of risk taking.[11] For example, high risk takers sometimes engage in behaviors that can be viewed as sensation seeking (e.g., bungee jumping). However, other risky behaviors are conducted in a more automatic and/or less conscious way and do not involve sensation or thrill seeking (e.g., crossing a road while not attending to the traffic). These two examples of risk taking behavior cannot be both defined as sensation seeking or impulsivity. Instead, sensation seeking, venturesomeness, and impulsivity must be viewed as different expressions of risk-taking behavior. Therefore, it is important to integrate these traits and develop a risk taking questionnaire that differentiates level of risk-taking behavior from level of risk assessment.

Current questionnaires that assess risk-taking behavior are limited by the fact that they are specifically designed to examine adolescents (12–18 years old) or include questions on a variety of risk-taking related daily activities.[12–15] The latter is problematic, because it cannot be assumed that everybody who completes the questionnaire is engaged in these activities. To complicate matters, these questionnaires all measure different components of risk-taking behavior, depending on the items that were included in the questionnaire. These studies illustrate that conceptualization of risk taking behavior differs greatly between researchers. It is of high importance that young adults who are high risk takers can be easily recognized, because early detection of high risk-taking individuals can help improve prevention, health promotion, and diagnosis. Therefore, the aim of our study was to develop a brief risk taking questionnaire in young adults that can be completed and analyzed in minimal time.

The new questionnaire was validated in a large sample of young adult social drinkers and recreational drug users,[16] i.e., two groups known to differ in levels of risk-taking behavior,[17–20] and in a sample of university students.

Materials and methods

Study 1 was conducted in a student population to develop a short risk-taking questionnaire (Risk Taking questionnaire 18 items; RT-18). As part of the Alcohol and Cocaine Impaired Driving survey (ACID survey),[16] the psychometric properties of the RT-18 were tested among social drinkers and recreational drug users (Study 2). To examine construct validity, Study 3 compared the RT-18 score with an existing risk-taking questionnaire. The studies were approved by the Institutional Review Board at Utrecht University and performed according to guidelines for Good Clinical Practice.

Development of the RT-18 (Study 1)

Subjects and procedure

N = 550 university and college students in Utrecht, The Netherlands were recruited between September 2008 and October 2008 to complete a two-page survey. To obtain a representative sample of the general student population of Utrecht, students were approached at various locations such as colleges, campuses, fraternities, and libraries. With few exceptions, almost all students agreed to participate (N = 522) and completed the survey at the location of recruitment. Subjects were invited to submit their contact details in order to participate in a follow up study. Of the subjects who were willing to participate, N = 100 were selected according to their scores on the 65-item questionnaire. We aimed at selecting an equal distribution of low-, medium-, and high-scoring subjects. The questionnaire was re-administered to these subjects after 2 to 4 weeks and they also performed the Cambridge Gambling Task (CGT).

The risk-taking questionnaire

The preliminary risk-taking questionnaire consisted of 65-items and was composed of subscales on impulsiveness and venturesomeness from the Impulsiveness Venturesomeness Empathy (IVE) questionnaire,[7,21] novelty seeking from the Temperament and Character Inventory (TCI),[9,22] and impulsive sensation seeking (ImpSS) from the Zuckerman Kuhlman Personality Questionnaire.[8] Existing Dutch versions of the IVE and TCI were used;[21,22] items of the ImpSS were translated from the English language version.[23] These subscales were chosen from a variety of scales and questionnaires, because they reflect traits associated with risk taking. In addition, the scales that were chosen comprise general items, not related to specific subtypes of risk-taking behavior that may not be relevant or apply to the whole population (e.g., gambling or drug use). Questions can be answered by “yes” and “no.” Scores are 0 or 1 point per question, adding up to a sum score ranging from 0 to 65.

The CGT

The CGT is part of the CANTAB test battery.[24] The test was developed to assess decision-making and risk-taking behavior. [25] On each trial, a row of ten boxes is presented across the top of the screen, some of which are red, others are blue. At the bottom of the screen two rectangles are presented, containing the words "red" and "blue." The subject must guess whether a yellow token is hidden in a red or in a blue box. Subjects start with a number of points which are displayed on the screen and they can select a proportion of these points (5%, 25%, 50%, 75%, or 95% of current points), displayed in either rising or falling order. If the subject chose the correct color the bet placed was added to the overall score; if the subject chose the wrong color the bet was subtracted. The task has two modes: ascending first or descending first. In the ascending mode the stakes rise, whereas in descending mode the stakes decrease. The CGT dissociates risk taking from impulsivity, because in the ascending mode the subject has to wait patiently for the appearance of a higher, more risky bet.

The subject must try to accumulate as many points as possible. The six outcome measures of the CGT are risk taking, quality of decision making, deliberation time, risk adjustment, delay aversion, and overall proportion bet. Of these, risk taking and overall proportion bet are most important predictors of risk-taking behavior. It takes about 30 minutes to complete the test.

Statistical analysis

Statistical analyses were performed using SPSS software (v 16; SPSS Inc., Chicago, IL). Based on N = 522 completed surveys, shortening the 65-item questionnaire into an 18-item questionnaire was done by applying a forward-step regression analysis. The aim was to develop a shortened questionnaire that includes sufficient questions to have a predictive validity of at least 90% of the 65-item questionnaire. Internal consistency (reliability) of the RT-18 was measured by Cronbach's alpha. Test-retest reliability was determined in N = 100 subjects by correlating RT-18 scores of the initial administration and those of retesting, 2 to 4 weeks thereafter. Validity of the RT-18 was determined by correlating the scores with those of the CGT parameters. In these analyses, data of subjects using psychoactive medication or drugs of abuse were omitted, because these can potentially affect performance on the CGT. Effects were considered significant if $P < 0.05$ (two-tailed).

Assessing the psychometric properties of the RT-18 (Study 2)

The ACID survey was conducted among a representative sample of Dutch partygoers (18–30 years old) to establish who will drive a car after using alcohol and/or cocaine and why.[16] This online survey comprised a large number of questions on demographics and respondent characteristics, alcohol and drug use, reasons for driving after using cocaine, and prevention methods. A total of N = 64,575 subjects read the invitation and N = 10,153 started the survey (15.7%). N = 7834 subjects completed the survey and were included in the analysis. The RT-18 was also completed as part of this survey. These subjects were deliberately chosen because alcohol and drug use is common among Dutch partygoers. A thorough discussion of the design, methodology, and sample of the ACID survey can be found elsewhere.[16]

Mean (standard deviation) and distribution of the RT-18 data were computed for all subjects and for men and women separately. Distributions of RT-18 scores were also computed individually for social drinkers (N = 2646) and recreational drug users (N = 4968). Differences were analyzed using ANOVA. Results were taken as significant if $P < 0.05$ (two-tailed). Internal consistency (reliability) of the RT-18 was measured by Cronbach's alpha and the Spearman–Brown split-half method. A principal component factor analysis was conducted using data from all subjects who completed the RT-18, applying an orthogonal rotation (Varimax with Kaizer Normalization) to check for interrelation between the items. A confirmatory factor analysis was performed to determine which model best fitted the data.

Examining the construct validity of the RT-18 (Study 3)

Among N = 1000 students, a survey was conducted comprising the RT-18 and the Stimulating-Instrumental Risk Inventory (SIRI).[26] The purpose of this survey was to compare the outcome of the RT-18 with the SIRI. The SIRI measures two kinds of risk taking. Instrumental risk taking is a form of controlled risk taking in which the magnitude of potential losses are important and reflective decision making (on long term gains and losses) plays an important role. In contrast, stimulating risk taking comprises uncontrolled impulsive decision making, concentrating on (short term) gains with much less consideration for potential losses. The SIRI consists of 17 items describing different attitudes towards risk. Items can be answered by selecting from "no for sure," "rather not," "rather yes," "yes for sure."

Statistical analyses were performed with SPSS software. In addition to characteristics of the RT-18 (e.g. mean, 95% confidence interval [CI], Cronbach's alpha), Pearson's r correlation between the RT-18, its two factors, and SIRI subscale scores were computed. A correlation was regarded as significant if $P < 0.05$ or better.

Results

Development of the RT-18 (Study 1)

Applying a forward-step regression analysis the 65-item questionnaire could be shortened to 18 items, while maintaining 91% of the predictive validity. Mean score of the RT-18 was 7.69 (95% confidence intervals [CI]: 7.33–8.05), Cronbach's alpha was 0.89, and the test-retest reliability was $r = 0.94$ ($P < 0.0001$). The correlation between the RT-18 scores and the 65-item questionnaire was significant ($r = 0.95$, $P < 0.0001$), as were the correlations between the RT-18 and subscales of impulsivity ($r = 0.72$, $P < 0.0001$), venturesomeness ($r = 0.63$, $P < 0.0001$), novelty seeking ($r = 0.85$, $P < 0.0001$), and impulsive sensation seeking ($r = 0.85$, $P < 0.0001$).

Table 1. RT-18 Items, endorsement and factor loadings

#	RT-18 Items	%	Factor 1	Factor 2	Source
16	I sometimes do "crazy" things just for fun	81.2	0.513		ImpSS
5	Would you enjoy parachute jumping?	75.7	0.472		IVE-V
6	Do you welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional?	73.2	0.639		IVE-V
15	I sometimes like to do things that are a little frightening	67.9	0.703		ImpSS
18	I like "wild" uninhibited parties	67.6	0.499		ImpSS
14	I enjoy getting into new situations where you can't predict how things will turn out	60.0	0.565		ImpSS
7	I often try new things just for fun or thrills, even if most people think it is a waste of time	57.5	0.606		TCI-NS
4	Do you enjoy taking risks?	53.4	0.619		IVE-V
17	I prefer friends who are excitingly unpredictable	44.7	0.458		ImpSS
12	I often follow my instincts, hunches, or intuition without thinking through all the details	60.4		0.552	TCI-NS
9	I like to think about things for a long time before I make a decision	50.8		0.610	TCI-NS
10	I usually think about all the facts in detail before I make a decision.	45.4		0.661	TCI-NS
13	I often do things on impulse	42.6		0.588	ImpSS
3	Do you mostly speak before thinking things out?	32.4		0.503	IVE-I
2	Do you usually think carefully before doing anything?	23.1		0.662	IVE-I
1	Do you often get into a jam because you do things without thinking?	12.9		0.513	IVE-I
11	I enjoy saving money more than spending it on entertainment or thrills.	63.4		0.430	TCINS
8	I often spend money until I run out of cash or get into debt from using too much credit.	22.1		0.433	TCI-NS

Note: Endorsement of RT-18 items (N=7825). % = percentage of subjects that endorsed the items. Factor loadings of the 2-factor model are included. ImpSS = Impulsive Sensation Seeking, IVE-V = venturesomeness, IVE-I = impulsivity, TCI-NS = Novelty Seeking

N = 100 students also performed the CGT. Data of subjects using psychoactive medication or drugs of abuse were omitted (N = 21). Data of N = 79 students revealed significant correlations between the RT-18 score and bet proportion ($r = 0.46$, $P < 0.0001$), risk taking ($r = 0.45$, $P < 0.0001$), and risk adjustment ($r = -0.29$, $P < 0.01$).

Psychometric properties of the RT-18 (Study 2)

Of the online survey, a total of N = 7834 completed surveys were eligible for the statistical analyses. Mean score on the RT-18 was 9.34 (95% CI: 9.26–9.43), Cronbach's alpha was 0.80, and the Spearman–Brown split-half reliability was 0.81. Figure 1 shows that the data follow a normal distribution. The endorsement of items is summarized in Table 1.

Best coverage of total variance (45.7%) is reached by a four-factor model, which resulted in factor 1 (22.6%, 9 items), factor 2 (10.9%, 3 items), factor 3 (6.4%, 4 items), and factor 4 (5.9%, 2 items). Unfortunately, these four factors do not provide a logical framework to explain the data. Therefore, a forced two- and three-factor analysis was conducted. Explained variance of the three models is shown in Table 2.

Confirmatory factor analysis was performed to examine the two-, three-, and four-factor models. Fit indices included the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), and the root mean square (RMS) of the standardized residuals. Results are summarized in Table 2. Models can be regarded as acceptable if GFI and AGFI values are higher than 0.9, and the RMS is lower than 0.05.[27,28] It is evident that the three models fit well with the data.

The two-factor model corresponds best with the theoretical framework of risk-taking behavior. These two factors together explain 33.4% of the total variance. The analysis yields factor 1 (22.5%) labeled "level of risk-taking behavior," and factor (10.9%) labeled "risk assessment." Factor 1 and factor 2 correlate significantly ($r = 0.312$, $P < 0.0001$).

Factor loadings of each item are summarized in Table 1. To explore the factor loadings we sorted subjects based on scores on each factor. Using quartile scores, scores were categorized as low, medium, or high. It is possible to distinguish nine groups of subjects that score low, medium, or high on factor 1, factor 2, or both. Table 3 and Figure 2 summarize risk-taking scores on these nine factor combinations.

Relationship with CGT performance

In Study 1, subjects performed the CGT. The relationship of performance on this test with the overall RT-18 score and its two factors is summarized in Table 4.

Men vs women

Figure 3 shows the distribution of RT-18 scores of men and women. Men 9.68, 95% CI: 9.57–9.79) score significantly higher ($F(1,7833) = 80.31$, $P < 0.0001$) on the RT-18 than women (8.88, 95% CI: 8.74–9.02). Men scored significantly higher on all individual items of the RT-18 ($P < 0.0001$), except for items 1, 9, and 12.

Table 2. Goodness-of-fit indices generated by the confirmatory factor analysis

	Explained variance	GFI	AGFI	RMS
2-factor	33.4%	0.955	0.942	0.0430
3-factor	39.8%	0.952	0.938	0.0474
4-factor	45.6%	0.968	0.957	0.0380

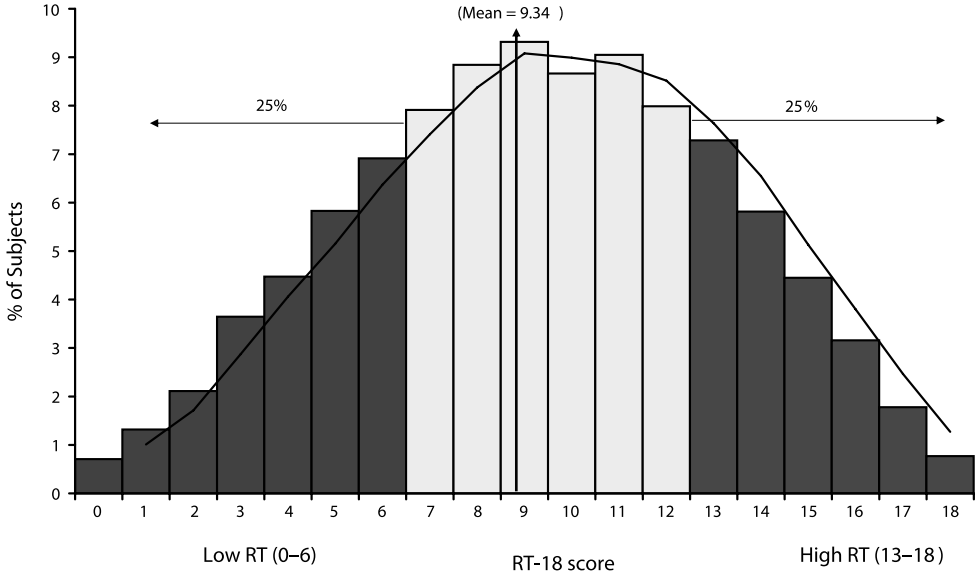
Note: GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, RMS = root mean square of the standardized residuals

Table 4. Relationship between RT-18 scores and performance on the Cambridge Gambling Task

Cambridge Gambling Task Parameters				
	Deliberation time	**Bet proportion**	**Risk adjustment**	**Risk taking**
RT-18 overall	NS	r =0.460**	r = -0.287*	r = 0.453**
RT-18 factor 1	r = 0.252*	r = 0.318**	r = -0.268*	r = 0.301**
RT-18 factor 2	NS	r = 0.440**	r = -0.204*	r = 0.446**

Note: Delayed aversion and Quality of decision making did not correlate significantly with any measure. * = Correlation is significant at the 0.05 level (2-tailed). ** = Correlation is significant at the 0.01 level (2-tailed). NS = not significant

Figure 1. Distribution of RT-18 scores of N = 7834 young adults



Note: Cut-off scores: 25% = 6, 50% = 9, 75% = 12

Table 3. RT-18 scores for the 9 different factor loading combinations for men, women, and overall

Factor 1	Men			Women			Overall			
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**%**
L1L2	2.00	1.01	276	1.76	1.06	308	1.87	1.05	584	6.2
L1M2	2.22	0.92	295	1.91	0.98	434	2.03	0.97	729	6.6
L1H2	2.33	0.88	48	1.94	1.01	76	2.09	0.98	124	1.1
M1L2	5.58	1.14	567	5.36	1.11	338	5.50	1.13	905	12.7
M1M2	5.79	1.08	1333	5.53	1.09	864	5.69	1.09	2197	29.9
M1H2	6.01	1.01	372	5.84	1.07	338	5.93	1.04	710	8.4
H1L2	8.32	0.47	178	8.38	0.48	63	8.34	0.47	241	4.0
H1M2	8.41	0.49	836	8.40	0.49	394	8.41	0.49	1230	18.8
H1H2	8.56	0.49	550	8.50	0.50	330	8.53	0.49	894	12.3
TOTAL	6.21	2.23	4455	5.33	2.55	3159	5.84	2.41	7614	100.0
Factor 2	**Men**			**Women**			**Overall**			
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**%**
L1L2	0.53	0.41	276	0.52	0.49	276	0.53	0.49	276	9.7
L1M2	3.05	1.03	295	3.13	1.07	295	3.10	1.05	295	13.7
L1H2	6.70	0.87	48	6.68	0.92	48	6.69	0.90	48	2.4
M1L2	0.63	0.48	567	0.68	0.46	567	0.65	0.47	567	10.7
M1M2	3.30	1.09	1333	3.36	1.09	1333	3.32	1.09	1333	27.4
M1H2	6.74	0.92	372	3.79	0.93	372	6.76	0.93	372	10.7
H1L2	0.77	0.41	178	0.65	0.48	178	0.74	0.43	178	2.0
H1M2	3.61	1.09	836	3.72	1.06	836	3.65	1.08	836	12.5
H1H2	6.97	0.99	550	7.11	1.01	550	7.02	1.00	550	10.9
TOTAL	3.51	2.30	4455	3.61	2.36	4455	3.55	2.33	4455	100.0

Table 3. RT-18 scores for the 9 different factor loading combinations for men, women, and overall continued

Overall Score	Men			Women			Overall			
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**%**
L1L2	2.53	1.19	276	2.29	1.23	276	2.41	1.21	276	7.7
L1M2	5.27	1.43	295	5.04	1.48	295	5.14	1.46	295	9.6
L1H2	9.04	1.27	48	8.63	1.29	48	8.79	1.29	48	1.6
M1L2	6.22	1.26	567	6.05	1.22	567	6.15	1.25	567	11.9
M1M2	9.10	1.60	1333	8.90	1.66	1333	9.02	1.63	1333	28.9
M1H2	12.76	1.40	372	12.63	1.43	372	12.70	1.41	372	9.3
H1L2	9.10	0.64	178	9.03	0.73	178	9.08	0.67	178	3.2
H1M2	12.03	1.24	836	12.12	1.18	836	12.06	1.22	836	16.2
H1H2	15.54	1.16	550	15.61	1.17	550	15.56	1.16	550	11.7
TOTAL	9.72	3.74	4455	8.95	4.10	4455	9.40	3.91	4455	100.0

Note: Factor loading category low, medium and high were based on quartile scores (Low = 0-25%, Medium = 25-75%, High = 75-100%). Factor 1: Low = 0-3, Medium = 4-7 and High = 8-9; Factor 2: Low = 0-1, Medium = 2-5, and High = 6-9. L=low, M = Medium, H = High, 1 = Factor 1, 2 = Factor 2, SD = Standard Deviation, N = Number of subjects

Social drinkers vs recreational drug users

Mean RT-18 scores differed significantly between abstinent subjects, social drinkers, and recreational drug users ($F(2, 7822) = 412.87$, $P < 0.0001$). Mean of the RT-18 score for abstinent subjects was 7.11 (95% CI: 6.61–7.61), mean of the RT-18 score for social drinkers was 7.80 (95% CI: 7.66–7.94), and mean of the RT-18 score for recreational drug users was 10.26 (95% CI: 10.15–10.36). Figure 4 shows the distribution of RT-18 scores of social drinkers (N = 2646) compared to those of recreational drug users (N = 4968).

Construct validity of the RT-18 (Study 3)

A total of 903 surveys were eligible for statistical analysis. Mean score on the RT-18 was 6.58 (95% CI: 6.36–6.80), Cronbach's alpha was 0.74, and the Spearman–Brown split-half reliability was 0.76. For the RT-18, the mean score on Factor 1 (level of risk-taking behavior) was 4.26 (95% CI: 4.10–4.42), and the mean score on Factor 2 (risk assessment) was 2.30 (95% CI: 2.17–2.44). For the SIRI, the mean score on stimulating risk taking was 20.41 (95% CI: 20.11–20.71), and the mean score on instrumental risk taking was 18.11 (95% CI: 17.90–18.31). The RT-18 score correlated significantly with stimulating risk taking ($r = 0.60$, $P < 0.0001$) and instrumental risk taking ($r = 0.21$, $P < 0.0001$) of the SIRI. Factor 1 of the RT-18 correlates significantly with stimulating risk taking ($r = 0.59$, $P < 0.0001$) and instrumental risk taking ($r = 0.25$, $P < 0.0001$) of the SIRI. Factor 2 of the RT-18 also correlates significantly with stimulating risk taking ($r = 0.36$, $P < 0.0001$), but to a lesser extent with instrumental risk taking ($r = 0.08$, $P < 0.023$) of the SIRI.

Discussion

The studies presented in this paper show that the RT-18 is a valid and reliable tool to quickly assess levels of risk-taking behavior. RT-18 scores differentiate clearly between men and women, and between members of groups with known different levels of risk-taking behavior such as social drinkers and recreational drug users. Construct validity of the RT-18 was examined by comparing its outcome with another risk taking questionnaire (Study 3) and performance on the CGT (Study 1). Study 3 showed a significant correlation between scores on the RT-18, its two factors, and the SIRI subscales. Study 1 showed that RT-18 scores also correlate significantly with the risk taking-related parameters of the CGT. The Cronbach's alpha and split-half reliability of the RT-18 were shown to be high.

Factor analysis yielded a two-factor model that provides a logical framework to explain the data (variance explained 33.4%). The first factor is described as "level of risk-taking behavior," while the second includes items best described as "risk assessment." This distinction of two factors is important, since although people are low or high risk takers, they may vary in the way they have thought about the potential consequences of this behavior (i.e., risk assessment). This is evident from Figures 2 and 5.

About 30% of subjects score high on factor 1 and can be considered as moderate to high risk takers. About two-thirds of those people (the H1L1 and H1M2 combination) have a moderate overall RT-18 score because they do consider the potential consequences of risk-taking behavior (expressed in a low score on Factor 2).

Of special concern are two groups. First, those who score high on Factor 1 (risk taking) and low on Factor 2 (risk assessment) (i.e. H1L2). These are high risk takers, although they know the consequences can be adverse, e.g., people who know the consequences of driving after alcohol consumption but still decide to drive a car. Second, the group of people that are high risk takers but do not consider the possible negative outcome (H1H2). These are the people who drive after consuming alcohol without considering possible consequences. Although both groups end up driving, the underlying intention is completely different. The distinctions made by the subscales of the RT-18 are crucial for determining the type of intervention that is necessary to prevent these behaviors. The latter is important because often risky behaviors (such as driving while intoxicated) are not only harmful to risk takers, but also to the people surrounding them. H1H2 risk takers need to be educated about the consequences of their behavior, while for H1L2 risk takers it should be examined why these people are willing to take risks despite their knowledge of possible negative outcomes.

The relevance of our findings is clear, as it is shown that the RT-18 is a useful tool to assess risk-taking behavior that correlates with risk taking in an experimental setting (Study 1) and an existing risk-taking scale (Study 3). Although some correlations presented in this article are low, those correlations with RT-18 scores that are of most importance are moderate to high (e.g., the correlation between RT-18 scores and risk taking on the CGT, or stimulating risk-taking scores on the SIRI).

Future studies should test the psychometric properties of the RT-18 in patient populations with known high risk-taking levels such as ADHD. In alcohol and drug users it is interesting to relate RT-18 scores to frequency of use, and to determine whether high RT-18 scores are a cause or consequence of frequent alcohol and drug use. Although substance abuse is only one example of risk-taking behavior, it is one that has a major socioeconomic impact on society and our healthcare system.1 Substance users are more likely to become involved in additional other risky behaviors, such as criminality, risky driving, and unsafe sex.[29–32] This risky behavior is not only harmful to the individual itself but could potentially harm innocent others. The proposed two-factor model for the RT-18 enables assessment of both the level of risk-taking behavior and risk assessment, and may thus help to identify vulnerable subjects as well as optimizing intervention strategies.

An important advantage of the RT-18 lies in the fact that it is relatively short compared to existing questionnaires. As been pointed out by Allen et al, brief and easy-to-score measures are needed to obtain standardized assessment procedures.[33] RT-18 fulfills these requirements and therefore is a helpful new tool to assess risk-taking behavior in this important population.

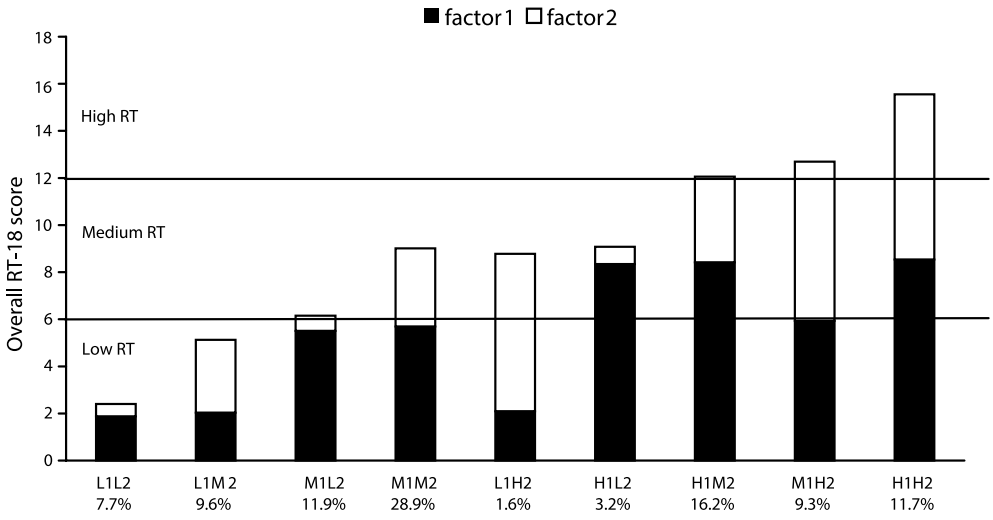
Acknowledgments

The authors want to thank Professor Cloninger for sending us the English version of the TCI, and Professor Zaleskiewicz for sending us the SIRI. We further thank Chris Alford for checking the draft version of the manuscript and providing helpful comments. The Dutch version of the RT-18 can be obtained upon request from the corresponding author.

Disclosure

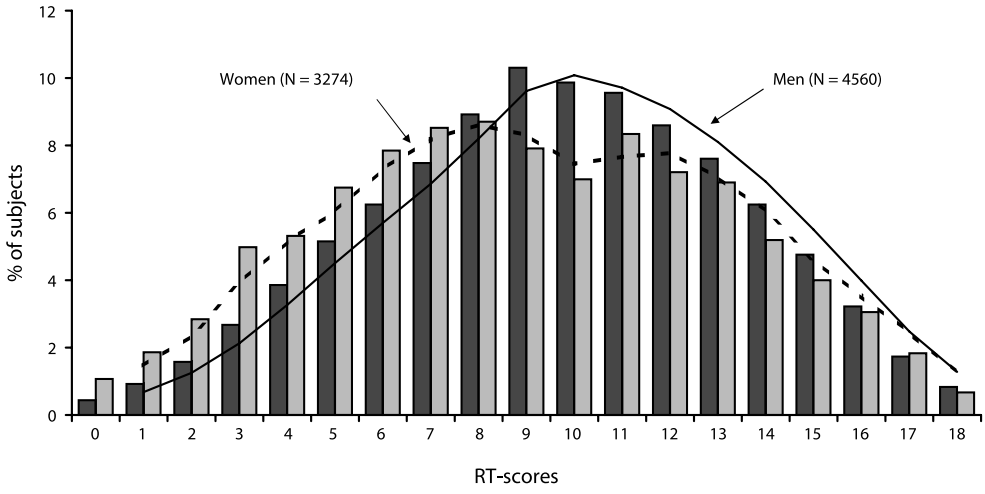
The studies described in this paper were supported by internal University funding. The authors report no conflicts of interest in this work.

Figure 2. Overall RT-18 scores on subgroups that load different on factor 1 and factor 2



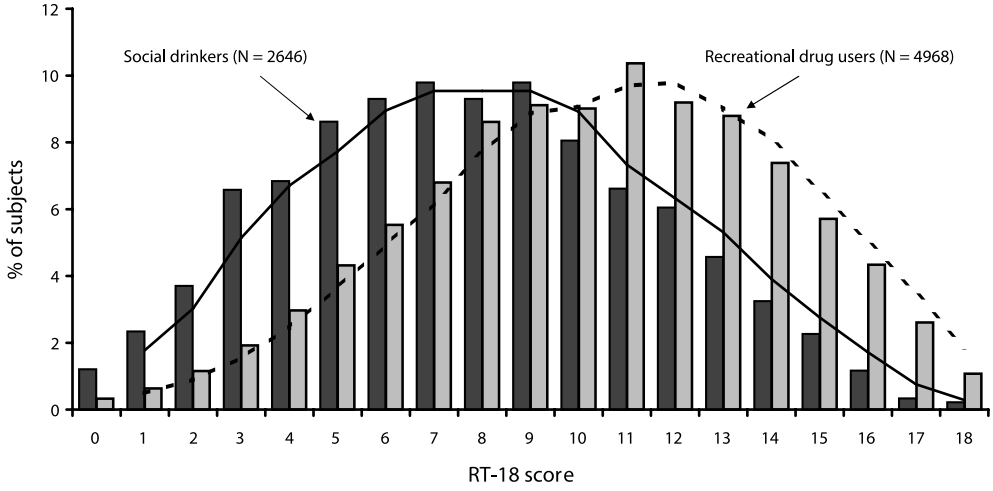
Note: L = Low; M = medium; H = high; RT = risk taking

Figure 3. Distribution of RT-18 scores of men and women



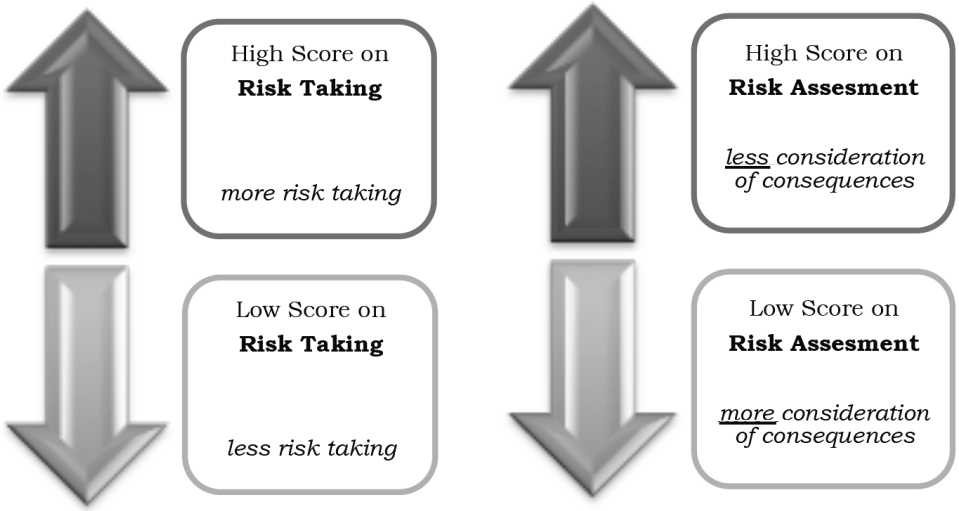
Note: Cut-off scores men: 25% = 7, 50% = 10, 75% = 12. Cut-off scores women: 25% = 6, 50% = 9, 75% = 12

Figure 4. Distribution of RT-18 scores of social drinkers and recreational drug users



Note: Cut-off scores social drinkers: 25% = 5, 50% = 8, 75% = 10. Cut-off scores recreational drug users: 25% = 8, 50% = 10, 75% = 13

Figure 5. Interpretation of scores on the two factors of the RT-18



References

1. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL, editors. Global burden of disease and risk factors. Washington DC: World Bank; 2006.
2. Benizović P, Malatestinić D. Perceived exposure to substance abuse and risk-taking behavior in early adolescence: cross-sectional study. Croat Med J. 2009;50(2):157–164.
3. McNamara J, Vervaeke SL, Willoughby T. Learning disabilities and risk-taking behavior in adolescents: a comparison of those with and without comorbid attention-deficit/hyperactivity disorder. J Learn Disabil. 2008;41(6):561–574.
4. Zuckerman M, Kuhlman DM. Personality and risk-taking: common biosocial factors. J Persy. 2000;68(6):999–1029.
5. Galvan A, Hare T, Vos H, Glover G, Casey BJ. Risk-taking and the adolescent brain: who is at risk? Dev Sci. 2007;10(2):F8–F14.
6. Shapiro R, Siegel AW, Scovill LC, Hays J. Risk-taking patterns of female adolescents: what they do and why. J Adolesc. 1998;21(2):143–159.
7. Eysenck SGB, Pearson PR, Easting G, Allsopp JF. Age norms for impulsiveness, venturesomeness and empathy in adults. Pers Indiv Differ. 1985;6(5):613–619.
8. Zuckerman M, Kuhlman DM, Hornquist M, Kiers H. Five (or three) robust questionnaire scale factors of personality without culture. Pers Indiv Differ. 1991;12(9):929–941.
9. Cloninger CR, Svracik DM, Przybeck TR. A psychobiological model of temperament and character. Arch Gen Psychiatry.1993;50(12):977–991.
10. Zuckerman M. Behavioral expressions and biosocial bases of sensation seeking. Cambridge, UK: Cambridge University Press; 1994.
11. Llewellyn DJ. The psychology of risk-taking: toward the integration of psychometric and neuropsychological paradigms. Am J Psychol. 2008;121(3):363–376.
12. Alexander CS, Kim YJ, Ensminger M, Johnson KE, Smith BJ, Dolan LJ. A measure of risk-taking for young adolescents: reliability and validity assessments. J Youth Adolesc. 1990;19(6):559–569.
13. Lavery B, Siegel AW, Cousins JH, Rubovits DS. Adolescent risktaking: an analysis of problem behaviors in problem children. J Exp Child Psychol. 1993;55(2):277–294.
14. Gullone E, Moore S, Moss S, Boyd C. The adolescent risk-taking questionnaire: development and psychometric evaluation. J Adolescent Res. 2000;15(2):231–250.
15. Gullone E, Paul J, Moore SM. A validation study of the adolescent risk-taking questionnaire. Behav Change. 2000;17(3):143–154.
16. Verster JC, Kuerten Y, Olivier B, van Laar MW. The ACID-survey: methodology and design of an online survey to assess alcohol and recreational cocaine use and its consequences for traffic safety. The Open Addict J. 2010;3:24–31.
17. Greene K, Krcmar M, Walters LH, Rubin DL, Hale JL. Targeting adolescent risk-taking behaviors: the contributions of egocentrism and sensation-seeking. J Adolesc. 2000;23(4):439–461.
18. Newcomb MD, McGee L. Adolescent alcohol use and other delinquent behaviors: a one year longitudinal analysis controlling for sensation seeking. Crim Justice Behav. 1989;16(3):345–369.
19. Zuckerman M. Sensation seeking and risky behavior. Washington, DC: American Psychological Association; 2007.
20. Dalton WT 3rd, Klesges LM, Henderson L, Somes G, Robinson L, Johnson KC. Gender, smoking status, and risk behavior attitudes explain adolescents' patterns of nicotine replacement therapy use. Addict Behav. 2010;35(2):147–151.
21. Lijffijt M, Caci H, Kenemans JL. Validation of the Dutch translation of the I7 questionnaire. Pers Indiv Differ. 2005;38(5):1123–1133.
22. Duijsens IJ, Spinhoven P, Goekoop JG, Spremon T, Eurelings-Bontekoe EHM. The Dutch temperament and character inventory (TCI): dimensional structure, reliability and validity in a normal and psychiatric outpatient population. Pers Indiv Differ. 2000;28(3): 487–499.
23. Zuckerman-Kuhlman Personality Questionnaire. Available from: www.zkpq.com. Accessed on March 1, 2011.
24. Cambridge Cognition. CANTAB Core Cognition. 2011. Available from: http://www.camcog.com/en/science/cantab-core-batteries/cantab-corecognition. Accessed July 18, 2011.
25. Rogers RD, Everitt BJ, Baldacchino A, et al. Dissociable deficits in the decision-making cognition of chronic amphetamine abusers, opiate abusers, patients with focal damage to prefrontal cortex, and tryptophandepleted normal volunteers: evidence for monoaminergic mechanisms. Neuropsychopharmacology. 1999;20(4):322–339.
26. Zaleskiewicz T. Beyond risk seeking and risk aversion: personality and the dual nature of economic risk taking. Eur J Pers. 2001;15(S1):S105–S122.
27. Arbuckle JL. Amos users' guide version 3.6. Chicago: SPSS; 1996.
28. Browne MW, Cudeck R. Alternative ways of assessing model fit. In: Bollen KA, Long JS, editors. Testing structural equation models. 1993, Newbury Park, CA: Sage; 1993:136–162.
29. Breen RB, Zuckerman M. 'Chasing' in gambling behavior: personality and cognitive determinants. Pers Indiv Differ. 1999;27(6):1097–1111.
30. Brown RT. Systematic review of the impact of adult drug-treatment courts. Transl Res. 2010;155(6):263–274.
31. Penning R, Veldstra J, Daamen AP, Olivier B, Verster JC. Drugs of abuse, driving and traffic safety. Curr Drug Abuse Rev. 2010;3(1):23–32.
32. Celentano DD, Latimore AD, Mehta SH. Variations in sexual risks in drug users: emerging themes in a behavioral context. Curr HIV/AIDS Rep. 2008;5(4):212–218.
33. Allen DN, Donohue B, Sutton G, Haderlie M, Lapota H. Application of a standardized assessment methodology within the context of an evidence-based treatment for substance abuse and its associated problems. Behav Modif. 2009;33(5):618–654.

Chapter 3

Reliability Of The Risk Taking Questionnaire 18 Items (RT-18); Internal Consistency, Measurement Error And Retest Reliability In Two Samples Of Young Adults

Lydia de Haan[1], Antoine C.G. Egberts[1,2], Eibert R. Heerdink[1,2].

[1] Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, Netherlands
[2] Department of Clinical Pharmacy, University Medical Center Utrecht, Utrecht, Netherlands

Abstract

Risk-taking behavior amongst individuals does not only result in harm to those individuals, it also places a burden on society at large. The Risk Taking 18 item questionnaire (RT-18) is an instrument recently developed to assess individual differences in risk-taking behavior. This study examined the reliability of the RT-18. The internal consistency, measurement error and test-retest reliability were assessed in two separate samples (n = 104, and n = 92 respectively) of young adults aged 18-30. Our findings in both samples show the RT-18 to have sufficient reliability in young adults as well as in a sample with a group of only alcohol using and a group of alcohol and illicit drug using young adults.

Introduction

Risk-taking behavior amongst individuals does not only result in harm to those individuals, it also places a burden on society at large. Engagement in risky behaviors can endanger a person's health and wellbeing. Young individuals that engage in any form of risk-taking behavior are more likely to engage in additional forms (Childs & Sullivan, 2013), i.e. a person that engages in underage drinking is more likely to engage in other risk behaviors like illicit drug use or unsafe sex. This implies a predisposition for these individuals towards engagement in a constellation of risk-taking behaviors. High levels of risk-taking behavior are likely to be part of a continuous personality construct with low levels or risk-taking averseness at the other end. Risk-taking behavior is frequently present in adolescents and young adults. For instance, underage drinking; 38.7% of USA high school students, nationwide, had consumed alcohol in the past 30 days according to the Youth Risk Behavior Surveillance of 2011 (Eaton et al., 2012). Illicit marijuana consumption was reported by 23.1% (Eaton et al., 2012). A third of these students reported engagement in a physical fight the previous year, and 32.8% reported texting or emailing while driving (Eaton et al., 2012). However, risk-taking behavior is not exclusively observed in young individuals. Some adults continue to display high levels of risk-taking behavior, which can lead to addiction, incarceration, or can even be part of the symptomatology of psychiatric disorders (Maalouf et al., 2011; Swann, 2011).

Personality constructs such as risk-taking behavior can be differentiated into more general traits and specific states. Traits are defined as relatively stable or enduring individual differences, in terms of thoughts, feelings, and behavior, whereas state refers to a temporary construct (i.e. mood) (Church, 2000). Currently, there is no gold standard available for assessing the risk-taking behavior construct, this also applies to "state" and "trait",- despite the variety of available measures that range from gambling tasks to self-report measures. The Risk Taking 18 items questionnaire (RT-18) is an instrument recently developed to assess individual differences in risk-taking behavior (de Haan et al., 2011a). This instrument aims to measure "trait" risk-taking. It comprises two subscales, risk taking and risk assessment, each of which consists of nine items that can be answered yes or no. The first subscale, risk taking, measures actual risk-taking behavior; whereas the second, risk assessment, comprises items regarding risk assessment (i.e. thinking about the potential consequences of risky behaviors or choices). A high score on risk taking indicates a high level of actual risk-taking behavior in a subject, and a high score on risk assessment indicates a low level or less consideration of possible consequences (i.e. 'not thinking something trough'). Completion of the RT-18 takes 2-5 minutes, which is relatively fast. The RT-18 seems to be a promising instrument for the quick assessment (screening) of an individual's level of risk-taking behavior.

In order to establish the reliability of instruments, typically the internal consistency, which reflects the coherence of the components or items, inter-rater reliability (i.e. agreement or concordance between different raters) or test-retest reliability (i.e. intra-rater reliability) have been examined (McCrae, Kurtz, Yamagata, & Terracciano, 2011). Test-retest reliability refers to (short

term) temporal reliability, which can be defined as consistency or agreement across repeated assessments (Chmielewski & Watson, 2009; De Vet, Terwee, Mokkink, & Knol, 2011). Besides examining the reliability of an instrument over time, test-retest designs can also be used to study the temporal stability of a personality trait or other psychological construct. Difference lies in the a priori assumptions made, either the trait or construct remains stable over time, and differences over time will be described to the reliability of the instrument used, or the reliability of instrument over time is considered high, and differences in scores over time will be described to "real" changes in the trait or construct measured. The latter design examines temporal stability, which in its turn can be divided in absolute and relative stability. Absolute (or mean-level) stability refers to changes in population averages of trait levels over time, and is usually determined by mean-level differences in traits over time, to explore whether a population as a whole displays increases or decreases on a particular trait (Caspi et al., 2005). Whereas relative (or differential or rank-order) stability indicates the extent to which the relative differences within individuals on a particular construct remain the same over time (Caspi et al., 2005; Hopwood et al., 2011).

Not many questionnaires measuring similar and/or overlapping personality constructs, have been assessed thoroughly on test-retest properties (Blais & Weber, 2006; Eysenck, Pearson, Easting, & Allsopp, 1985; Luengo, Carrillo-De-La-Pena, & Otero, 1991; Patton & Stanford, 1995; Stanford et al., 2009; Weafer, Baggott, & de Wit, 2013; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993b). Moreover, most assessments have not been very detailed. Test-retest reliability is traditionally examined using either Pearson's product-moment correlation (r) or the Spearman correlations (rho); however, it has been argued that the Intra-Class Correlation is a more appropriate estimate for this purpose, for it takes in account systematic error between the test and retest situation. Furthermore, it is sometimes unclear whether the study examined test-retest reliability, in order to investigate psychometric properties of an instrument, or aimed to examine temporal stability (e.g. absolute and or relative stability) of a certain personality trait or construct.

The aim of this study is to assess the reliability of the RT-18, more precisely the internal consistency, measurement error and test-retest reliability, in two different samples of young adults. Accordingly, we hypothesized that 1) both of the RT-18 subscales show sufficient internal consistency (Cronbach's α will be >0.700). Furthermore if we assume the RT-18 to measure a stable personality construct of risk-taking (i.e. no "true" change in risk –taking behavior will occur), we hypothesize 2) test-retest reliability to be high (i.e. Intra Class Correlation <0.700).

Materials and Methods

Reliability of RT-18 scores was assessed in two separate samples.

Sample 1

Subjects

Students from Utrecht University were approached on campus and asked to fill out a short pen and paper five item survey inquiring gender and age, as well as alcohol, tobacco, illicit drug use and medication use, after which subjects were screened for inclusion-and exclusion-criteria. Accordingly, subjects were asked by email to participate in this study. Inclusion criteria were as follows; subjects needed to be between 18 and 30 years of age, and should drink alcohol on a regular basis (at least one alcoholic consumption a week). Incentive for participation was 30 euros and additionally one iPad through raffle. Physical contact with the experimenters was not required at any point during the study. Online Informed consent forms were signed on the first day. In case subjects did not give their informed consent, participants were thanked for their time and effort after which the designated SurveyMonkey® internetpage shut down. Approval for this study by a Medical Ethics Committee was not necessary according to Dutch law on medical scientific research with humans (WMO), since the study did not directly address a medical question nor were the participants subjected to any kind of regiment or invasive procedure.

Data collection and validation

The 31-day diary started on the 29th of December 2012. During this online diary study (in Dutch) using Surveymonkey® (SurveyMonkeyTM), daily questions were asked regarding the alcohol, tobacco, and illicit drug consumption of the previous day (e.g. quantity, location, and peers), as well as daily level of sleepiness, as measured by the Karolinska Sleepiness Scale (Åkerstedt & Gillberg, 1990). On the first day participants were asked to provide demographic variables. There were two instances (day 1, day 31) where additional data collection took place of the RT-18, and other questionnaires. Results from SurveyMonkey® were imported into Excel, to be prepared for SPSS analyses. After cleaning of the data, n = 109 participants remained suitable for analyses (n =114 started on day one, 1 participant was excluded for not giving informed consent, 4 participants did not finish the study, i.e. they had at least 18 consecutive days of missing entries). Data from this study outside the scope of present article will be discussed elsewhere.

Sample 2

Subjects

Students were approached on Utrecht University's campus and asked to fill out a short pen and paper survey of 18 items inquiring their risk-taking level as measured by the RT-18, as well as two items regarding gender and age. Subjects (n = 120) were invited by email to join the study. Participants needed to be aged between 18-30 years. Exclusion criteria were alcohol use 24h before testing, substance use two weeks prior to first visit. A total of 109 subjects completed the first visit, 70 of which also completed the second visit. Subjects received monetary incentive, 15 euros for the completion of visit 1 and another 20 euros after the completion of visit 2. Subjects gave informed consent for visit 1 and 2 separately. Approval for this study by a Medical Ethics Committee was not necessary according to Dutch law on medical scientific research with humans (WMO), for the study did not directly address a medical question nor were the participants subjected to any kind of regiment or invasive procedure.

Data collection and validation

Data collection took place between September 2010 and January 2011. Participants were tested on two separate visits. On the first visit (2-3 weeks after inclusion-survey) pen and paper questionnaires were filled out; alongside the RT-18, and additional risk-taking assessments. Furthermore some additional demographics were acquired. On the second visit, approximately 25 (SD = 14.6) days later on average, participants completed the RT-18 and some additional pen and paper questionnaires, as well as three computerized risk-taking tasks. Results were gathered in Excel and prepared for analyses by SPSS version 20. After cleaning the data for this article (n = 2 missing baseline total RT-18 scores, n = 13 missing factor scores at baseline, n = 2 missing item-score at baseline), n = 40 males and n = 52 females were suitable for analyses. From these participants, n = 25 males and n = 35 females completed the second visit. Data from this study outside the scope of the present article will be discussed elsewhere.

Statistical Analyses

For the reliability analyses of the RT-18 in sample 1, subjects were divided into 2 groups, those who reported only alcohol use within the past year (A), and subjects who reported both alcohol and illicit drug use (AD). Furthermore, for sample 1, day 1 was considered baseline, whereas the last day was considered a follow-up. For sample 2, the inclusion-survey of this study was considered baseline, the first visit was considered as "follow-up 1", and the second visit was considered as "follow-up 2." Both samples (1 and 2) were analyzed separately using SPSS for Windows (release 20.0). RT-18 scores were found to be non-normally distributed in sample 1 and sample 2, therefore 25^{th}, 50^{th} and 75^{th} percentile scores will be noted. Internal consistency was examined for both risk-taking and risk assessment for all measurements using

Cronbach's alpha. Measurement error will be examined by the Standard Error of Measurement for agreement ($SEM_{agreement}$) and the Smallest Detectable Change (SDC). $SEM_{agreement}$ was calculated using the following formula: $SEM_{agreement} = \sqrt{(\sigma^2_o + \sigma^2_{residual})}$(De Vet et al., 2011), where σ^2_o is defined as the variance due to systematic differences between observations and $\sigma^2_{residual}$ is the random error variance. To estimate these variance components, the Restricted Maximum Likelihood Estimation (REML) method was used. This method will result in three variance components; σ^2_o, and $\sigma^2_{residual}$, and σ^2_p (i.e. variance of the subjects or the systematic differences between the 'true' scores of the subjects). Only the first two terms will be used to calculate $SEM_{agreement}$. The SDC was calculated using the following formula: SDC = 1.96 x $\sqrt{(2x\ SEMagreement)}$ (De Vet et al., 2011). To determine the test-retest reliability of the RT-18 and factor scores, Intra Class Correlations for agreement between observations ($ICC_{agreement}$; two-way random model) and 95% confidence intervals (CIs) were calculated. When comparing two measurements (e.g. baseline and follow-up) $ICC_{agreement}$ for single measures was used, whereas the $ICC_{agreement}$ for average measures was used to examine test-retest reliability over three measurements (e.g. for baseline and follow-up 1 and follow-up 2). All statistical tests were two-sided, and effects with p-values < 0.05 were considered significant.

Results

Subjects

Sample 1

The first sample comprised 104 subjects, of whom 54 were classified as group A and 50 as belonging to group AD (n = 5 could not be classified as belonging to A or AD group). Group A consisted of 37 females and 17 males, whereas group AD consisted of 31 females and 19 males. A X^2-test did not show a significant difference for gender between groups. Mean age for group A was 21.0 (SD = 2.3), and 21.6 (SD = 2.4) for group AD. An independent t-test yielded no significant difference for age between the two groups.

Sample 2

The second sample comprised 92 subjects, of whom 40 were male and 52 female. Mean age was 20.0 (SD = 2.1).

Internal Consistency

Sample 1

The internal consistencies of both the risk-taking and risk assessment scales were assessed for all available measurements (e.g. baseline and follow-up). Cronbach's alphas for the AD group were slightly higher (0.751-0.779) compared to the A group (0.685-0.788). Only at the baseline measurement of group A, Cronbach's alpha did not reach values above the cut of point of 0.700 for good internal consistency. See table 1.

Sample 2

Cronbach's alpha was determined at baseline, follow-up 1 and 2 for risk-taking and risk assessment. Both scales show good internal consistency (i.e. α >0.700) at all time-points. See table 2.

Measurement Error

Sample 1

For group A the REML of variance components of the RT18 total scores yielded σ^2_p = 12.182 between subjects, σ^2_o = 0.006 between observations, and another 1.763 of random error variance. $SEM_{agreement} = \sqrt{(0.006+1.763)} = 1.330$. The RT18 risk-taking scores yielded σ^2_p = 4.499 between subjects, σ^2_o = 0.031 between observations, and $\sigma^2_{residual}$ = 0.978. $SEM_{agreement} = \sqrt{(0.031+0.978)} = 1.004$. Variance of the subjects was 3.958, σ^2_o = 0.000 and $\sigma^2_{residual}$ = 0.926 for the RT18 risk assessment scores. SEMagreement = $\sqrt{(0.000+0.926)} = 0.962$. SDC's for total, risk-taking and risk assessment were 3.7, 2.8, and 2.7 respectively.

The AD group REML analyses of RT18 total scores resulted in σ^2_p = 12.328, σ^2_o = 0.003, and 1.817 for random error variance. $SEM_{agreement}$ = √(0.003+1.817) = 1.349. The risk-taking scores were σ^2_p = 5.271, σ^2_o = 0.000, and $\sigma^2_{residual}$ = 0.850. $SEM_{agreement}$ = √(0.000+0.850) = 0.922. Variance between subjects was 3.557, σ^2_o = 0.000 and $\sigma^2_{residual}$ = 1.110 for the RT18 risk assessment scores. $SEM_{agreement}$ = √(0.000+1.110) = 1.054. SDC's for total, risk-taking and risk assessment were 3.7, 2.6, and 2.9 respectively.

Sample 2

REML of variance components for the RT18 total scores was σ^2_p = 15.339, σ^2_o = 0.005, and $\sigma^2_{residual}$ = 2.459. $SEM_{agreement}$ = √(0.005+2.459) = 1.570. The RT18 risk-taking scores yielded σ^2_p = 6.181, σ^2_o = 0.000, and $\sigma^2_{residual}$ = 0.823. $SEM_{agreement}$ = √(0.000+0.823) = 0.907. For the RT18 risk assessment scores σ^2_p = 3.944, σ^2_o = 0.000 and $\sigma^2_{residual}$ = 1.217. $SEM_{agreement}$ = √(0.000+1.217) = 1.103. SDC's for total, risk-taking and risk assessment were 4.4, 2.5, 3.1 and respectively.

Relative Stability

Sample 1

The $ICC_{agreement}$ calculated to examine the relative stability ranged from 0.762 to 0.873, with the two lowest 95% CI boundaries at 0.615 for risk assessment AD group and 0.693 risk assessment A group. All $ICC_{agreement}$ values were above the threshold for high relative stability (i.e. >0.700).

Sample 2

$ICC_{agreement}$ values ranged from 0.931 to 0.961 when looking at all three time-points, with the lowest 95%CI for risk assessment (0.894 – 0.954). All values were above 0.700. When examining the two periods (baseline to follow-up 1 and follow-up 1 to follow-up 2), $ICC_{agreement}$ values were slightly higher for the second period (0.863 – 0.902) compared to the first (0.749 – 0.888).

Discussion

In the present article, we assessed the reliability of the Risk-Taking 18 items questionnaire, through internal consistency, measurement error and test-retest reliability in two samples of young adults. Based on our findings in both samples, the RT-18 shows good internal consistency, for both scales; risk-taking and risk assessment, as well as good test-retest reliability in a sample of students and a sample of alcohol using students and alcohol and illicit drug using students.

Internal consistency was examined using Cronbach's alpha. Values between 0.700 and 0.900 are widely accepted as sufficient (De Vet et al., 2011). Only in sample 1 for group A at baseline was this criterion not met, for α was 0.685 for risk-taking and 0.694 for risk assessment. This means that out of seven measurements (across all samples) only one was somewhat below 0.700, and this is the case for both scales.

Table 1. Sample 1. Internal consistency for baseline and follow-up 1: Cronbach's alpha

RT-18 Scores	Baseline	Follow-up 1
Group A (n = 54)		
Risk taking	.685	.744
Risk assessment	.694	.788
Group AD (n = 50)		
Risk taking	.751	.779
Risk assessment	.751	.771

Table 2. Sample 2. Internal consistency for baseline and follow-up 1 and 2: Cronbach 's alpha

RT-18 Scores	Baseline	Follow-up 1	Follow-up 2
	n = 92	**n = 92**	n = 60
Risk taking	.804	.799	.841
Risk assessment	.713	.743	.780

Table 3; Sample 1. ICCagreement and 95%CI of RT18 scores

Baseline to follow-up 1 to follow-up 2		
RT-18 scores	**ICCagreement**	**95% CI**
Group A (n = 54)		
Total	.873	.792 - .924
Risk taking	.817	.704 - .889
Risk assessment	.810	.693 - .886
Group AD (n = 50)		
Total	.871	.785 - .925
Risk taking	.861	.768 - .919
Risk assessment	.762	.615 - .857

Table 4; Sample 2. ICCagreement and 95%CI of RT18 scores

	Overall*			Baseline to Follow-up 1			Follow-up 1 to Follow-up 2		
RT-18	**(n)**	**$ICC_{agreement}$**	**95% CI**	**(n)**	**$ICC_{agreement}$**	**95% CI**	**(n)**	**$ICC_{agreement}$**	**95% CI**
Total	(60)	.961	.941 - .976	(92)	.868	.807 - .911	(60)	.902	.842 - .940
Risk-taking	(60)	.961	.941 - .976	(92)	.888	.836 - .925	(60)	.917	.865 - .950
Risk assessment	(60)	.931	.894 - .954	(92)	.749	.644 - .827	(60)	.863	.780 - .915

Note: * = from baseline to follow-up 1 to follow-up 2

We have also determined the level of measurement error for total, risk-taking and risk-assessment scores. Classical test theory defines the observed score on a particular item as based on a subjects true score and measurement error. Following the COSMIN (Mokkink et al., 2010) definition measurement error would then be defined as "the systematic and random error of a subject's score that is not attributed to true changes in the construct to be measured". In both samples the systematic error variance component (σ^2_o) was small, ranging from 0.000 to 0.031 across all observations. The random error component ($\sigma^2_{residual}$) ranged from 0.823 to 2.459. The resulting $SEM_{agreement}$ for RT18 total scores were 1.33,1.35, and 1.57, whereas measurement error for the subscales was slightly lower (1.00, 0.922, and 0.907 for risk-taking and 0.962, 1.054, and 1.103 for risk assessment). These values are easier to interpret when calculated into the smallest detectable change (SDC). SDCs for risk-taking were 2.5, 2.6 and 2.8. This is a rather large value when taking into account the maximum score on this scale that can be obtained is 9. The risk assessment performs even worse with SDCs of 2.7, 2.9 and 3.1. Despite these rather

large values of the SCD, we think this does not affect our judgment about the reliability of the RT18 in these samples, for the simple reason that the RT18 was intended as an instrument to screen for risk-taking behavior rather than an instrument capable of measuring change over time very precisely. To that extent, the SDC is something to keep in mind, but not of the utmost importance when determining the reliability of the RT18.

The test-retest reliability of the RT-18 assessed with ICCs for agreement were high across both studies, ranging from 0.762-0.873 (sample 1) and 0.931 to 0.961 over three time-points (sample 2). The confidence intervals reflect the small sample sizes, ranging from moderate (0.615) to excellent (0.976) levels of intra-rater reliability. To assess the test-retest reliability we assumed the RT18 to measure a temporal stable construct. Since we have used assessment intervals ranging from 2-3 weeks to 4-6 weeks, and it is argued that a 2-3 month period might be long enough for behavior to change (Chmielewski & Watson, 2009; Roberts et al., 2006), we think this assumption was not violated.

We have specifically chosen to use Intra-Class Correlations for agreement between observations instead of product-moment correlations (which have been widely used to assess test-retest reliability of instruments and relative stability of personality traits), for an ICC is more appropriate since it takes into account systematic error between measurements, whereas the product-moment correlation does not have this ability (Cicchetti, 1994; Rousson, Gasser, & Seifert, 2002). Other studies have found similar test-retest reliabilities (or relative stabilities) for related personality constructs, albeit not measured with ICC (Stanford et al., 2009; Weafer et al., 2013; Luengo et al., 1991; Zuckerman et al., 1993a; Blais & Weber, 2006).

Although our results strongly indicate the RT18 to have sufficient reliability in terms of internal consistency, measurement error and test-retest reliability, some limitations have to be noted. Firstly, the 95% CIs calculated for the test-retest reliability ranged from moderate to excellent. For more precise estimations of these correlations, samples sizes of 300-400 are recommended (Calamia, Markon, & Tranel, 2013; Watson, 2004). However, a sample size of 50 is proposed as sufficient by De Vet et al. (2011) when examining reliability. Furthermore, although it is a widely used measure of reliability, Cronbach's alpha is an approximation of the internal consistency and is known to underestimate the reliability. Moreover, Cronbach's alpha is positively influenced by the number of items of a scale (i.e. the more items, the higher α becomes)(Cortina, 1993).

Other aspects that affect generalizability of our results are the fact that all participants were recruited at Utrecht University, and that we assessed only young adults between the ages of 18-30 (group-means for both studies were between 20-21 years of age). Another point that should be taken into account is the fact that the RT-18 is a self-report instrument and it should be noted that self-report instruments are confounded by many factors like for instance response bias, however, the first sample was entirely web-based without any physical tester-participant interactions.

Future studies should replicate these results, not only with larger sample sizes, but also by examining the reliabilities, especially test-retest reliability of other instruments assessing similar "risk behavior" constructs, using Intra Class Correlations. Furthermore, other psychometric properties of the RT-18 should be examined in more detail, to establish whether the RT-18 has sufficient qualities, to screen individuals for (high) risk-taking behavior. Of interest are also cross-country comparisons, for most studies regarding the RT-18 were performed on Dutch student or young adult samples.

In conclusion, the RT-18 showed sufficient reliability in two short-term test-retest samples of young adults.

REFERENCES

Åkerstedt, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. International Journal of Neuroscience, 52(1-2), 29-37.

Blais, A., & Weber, E. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. Judgment and Decision Making, 1(1), 33-47.

Calamia, M., Markon, K., & Tranel, D. (2013). The robust reliability of neuropsychological measures: Meta-analyses of Test–Retest correlations. The Clinical Neuropsychologist, 27(7), 1077-1105.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. Annual Review of Psychology, 56, 453-484.

Childs, K. K., & Sullivan, C. J. (2013). Investigating the underlying structure and stability of problem behaviors across adolescence. Criminal Justice and Behavior, 40(1), 57-79.

Chmielewski, M., & Watson, D. (2009). What is being assessed and why it matters: The impact of transient error on trait research. Journal of Personality and Social Psychology, 97(1), 186-202.

Church, A. T. (2000). Culture and personality: Toward an integrated cultural trait psychology. Journal of Personality, 68(4), 651-703.

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychological Assessment, 6(4), 284-190.

Cortina, J. M. (1993). What is coefficient alpha? an examination of theory and applications. Journal of Applied Psychology, 78(1), 98.

De Haan, L., Kuipers, E., Kuerten, Y., van Laar, M., Olivier, B., & Verster, J. C. (2011a). The RT-18: A new screening tool to assess young adult risk-taking behavior. International Journal of General Medicine, 4, 575-584.

De Vet, H. C., Terwee, C. B., Mokkink, L. B., & Knol, D. L. (2011). Measurement in medicine: A practical guide Cambridge University Press.

Eaton, D. K., Kann, L., Kinchen, S., Shanklin, S., Flint, K. H., Hawkins, J., Wechsler, H. (2012). Youth risk behavior Surveillance—United states, 2011. Morbidity and Mortality Weekly Report, Centers for Disease Control and Prevention, 61(4), 1-162.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. Personality and Individual Differences, 6(5), 613-619.

Hopwood, C. J., Brent Donnellan, M., Blonigen, D. M., Krueger, R. F., McGue, M., Iacono, W. G., & Alexandra Burt, S. (2011). Genetic and environmental influences on personality trait stability and growth during the transition to adulthood: A three-wave longitudinal study. Journal of Personality and Social Psychology, 100(3), 545-556.

Luengo, M., Carrillo-De-La-Pena, M., & Otero, J. (1991). The components of impulsiveness: A comparison of the I. 7 impulsiveness questionnaire and the barratt impulsiveness scale. Personality and Individual Differences, 12(7), 657-667.

Maalouf, F. T., Brent, D., Clark, L., Tavitian, L., McHugh, R. M., Sahakian, B. J., & Phillips, M. L. (2011). Neurocognitive impairment in adolescent major depressive disorder: State vs. trait illness markers. Journal of Affective Disorders, 133(3), 625-632.

McCrae, R. R., Kurtz, J. E., Yamagata, S., & Terracciano, A. (2011). Internal consistency, retest reliability, and their implications for personality scale validity. Personality and Social Psychology Review, 15(1), 28-50.

Mokkink, L. B., Terwee, C. B., Patrick, D. L., Alonso, J., Stratford, P. W., Knol, D. L., de Vet, H.C. (2010). The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. Journal of Clinical Epidemiology, 63(7), 737-745.

Patton, J. H., & Stanford, M. S. (1995). Factor structure of the barratt impulsiveness scale. Journal of Clinical Psychology, 51(6), 768-774.

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. Psychological Bulletin, 132(1), 1-25.

Rousson, V., Gasser, T., & Seifert, B. (2002). Assessing intrarater, interrater and test–retest reliability of continuous measurements. Statistics in Medicine, 21(22), 3431-3446.

Stanford, M. S., Mathias, C. W., Dougherty, D. M., Lake, S. L., Anderson, N. E., & Patton, J. H. (2009). Fifty years of the barratt impulsiveness scale: An update and review. Personality and Individual Differences, 47(5), 385-395.

SurveyMonkeyTM. Retrieved, 2013, from www.surveymonky.com

Swann, A. C. (2011). Antisocial personality and bipolar disorder: Interactions in impulsivity and course of illness. Neuropsychiatry, 1(6), 599-610.

Watson, D. (2004). Stability versus change, dependability versus error: Issues in the assessment of personality over time. Journal of Research in Personality, 38(4), 319-350.

Weafer, J., Baggott, M. J., & de Wit, H. (2013). Test–Retest reliability of behavioral measures of impulsive choice, impulsive action, and inattention. Experimental and Clinical Psychopharmacology, 21(6), 475-481. doi:10.1037/a0033659

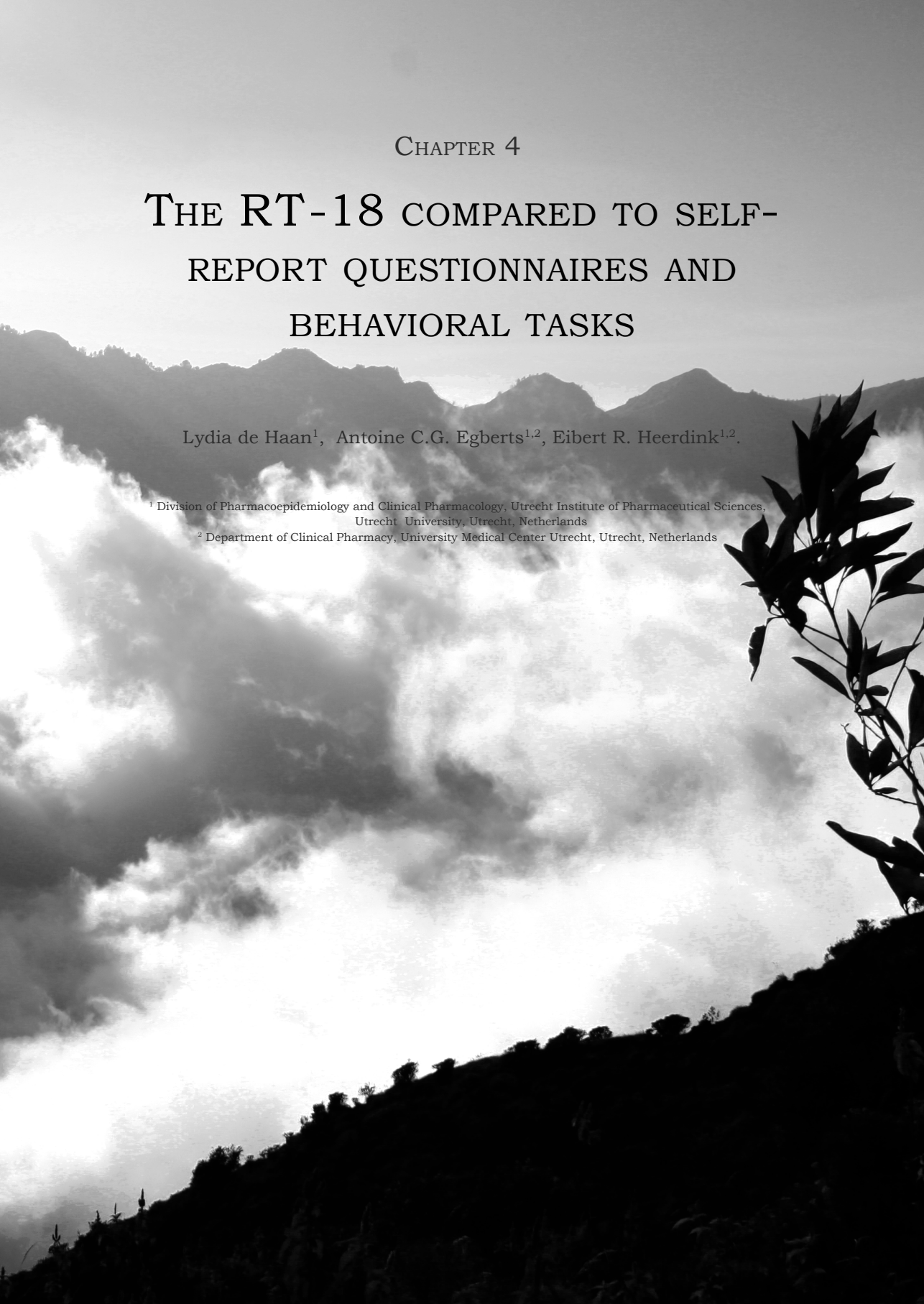
Zuckerman, M., Kuhlman, D. M., Joireman, J., Teta, P., & Kraft, M. (1993a). A comparison of three structural models for personality: The big three, the big five, and the alternative five. Journal of Personality and Social Psychology, 65(4), 757.

Chapter 4

The RT-18 compared to self-report questionnaires and behavioral tasks

Lydia de Haan[1], Antoine C.G. Egberts[1,2], Eibert R. Heerdink[1,2].

[1] Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, Netherlands
[2] Department of Clinical Pharmacy, University Medical Center Utrecht, Utrecht, Netherlands



Abstract

Aim. Risk Taking questionnaire 18 items (RT-18) is a brief self-report instrument assessing risk-taking behavior on two scales: risk-taking and risk assessment. Aim of this study was to assess the construct validity of the RT-18.

Methods. Construct validity was assessed in 106 Dutch young adults (aged 18-30) by comparing RT-18 scores to those of questionnaires measuring equivalent constructs of risk-taking behavior. To ease analyses, these instruments are clustered based on similarity in methodology or measured construct. Moreover, RT-18 subscale scores were assessed for gender differences. Finally, RT-18 scores are compared to three behavioral lab tasks to examine the amount of overlap in construct representation

Results. We expected to find at least moderate to high correlations in the first group of self-report instruments (ZKPQ-ImpSS, IVE-v, IVE-I, and TCI-ns), based on the fact that the RT-18 items originate from these instruments and that the method of assessment is very similar to the RT-18. All correlations were above r = .51 except for risk assessment which correlated a little lower with IVE-v (r = .26). When comparing RT-18 risk-taking scores to scores of four other self-report instruments (DOSPERT, EVRDTS, RSQ and RPQ), which measure risk-taking in very distinct behavioral constructs, that either completely or partly overlap with the RT18, we expected at least low to moderate correlations. For RT-18 risk-taking all effects were notably higher than expected (correlations between .50 and .71 were observed). Effects for RT-18 risk assessment were somewhat lower, between .23 and .46. In addition, men scored significantly higher than women on RT-18 risk taking, as was expected, but did not on risk assessment. Finally, we observed what was to be expected from the literature, namely that there is little or no overlap between self-report and behavioral lab tasks. From the three DG outcomes, only driving produced significant correlations with RT-18 risk-taking (r = .27). None of the BART outcomes correlated with the RT-18 scores. From the six CGT outcomes, only overall proportion bet, risk adjustment and risk-taking correlated with the RT-18 scales. Interestingly, none of the behavioral lab tasks correlated with each other and thus it seems that the risk-taking constructs underlying the DG, BART and CGT are very dissimilar.

Conclusion. Compared to eight self-report instruments, and when examining gender differences, the RT-18 showed satisfactory construct validity. However, as was to be expected from previous research in this field, there was little overlap of RT-18 scores with three behavioral lab tasks. Therefore, we conclude more research into the validity of the RT-18 is needed, and in particular into the relation between RT-18 and real world risk-taking behavior, thus clinical validity should be examined.

Introduction

Risk-taking behavior and its associate negative consequences like reckless driving, practicing unsafe sex, substance abuse, interpersonal aggression and criminal behavior are a concern to society at large. Recently the Risk Taking questionnaire 18 items (RT-18) was developed to assess risk-taking behavior in minimal time [1]. The dichotomous 'yes' or 'no' items of the RT-18 originate from four subscales of three widely used personality questionnaires: the novelty-seeking dimension (TCI-ns) from Cloninger's Temperament and Character Inventory [2], the impulsiveness (IVE-i) and venturesomeness (IVE-v) subscales from the Impulsiveness-Venturesomeness-Empathy questionnaire [3], and the impulsive sensation seeking scale (ZKPQ-ImpSS) from the Zuckerman Kuhlman Personality Questionnaire Cross-cultural 50-item version [4,5]. Factor analysis suggested two underlying dimensions: risk assessment and risk-taking, which are reflected in two subscale scores (nine items each) [1]. The former reflects thinking about the potential consequences of risky behaviors or choices, and the latter comprises actual risk-taking behavior. Both Cronbach's alpha ($\alpha = 0.89$), and the test-retest reliability ($r = .94$) proved to be adequate for the RT-18 in a sample of students ($n = 522$ and $n = 100$ respectively) [1]. A large sample of partygoers ($n = 7834$) indicated that the RT-18 has an internal consistency of 0.80. Moreover, RT-18 total scores were different between abstinent individuals, social drinkers and recreational drug users, as well as between men and women [1].

At the moment, there is no gold standard for assessing the risk-taking behavior construct despite the plethora of available measures that range from gambling tasks to self-report measures [6]. Based on the before mentioned differences in research perspectives on risk-taking behavior, two major leagues in the assessment of risk-taking behavior can be distinguished, personality psychologists and decision-making researchers, who operationally define risk in quite different ways [7]. Whereas hypothetical gambles or choice dilemmas are the favorite stimuli in experimental research, personality psychologists examine risk-taking behavior in applied settings, such as driving behavior, health behavior, pathological gambling, and high-risk or "thrill-seeking" sports [7]. Appelt et al. reported seven categories of available instruments across all research fields involved; decision making measures, risk attitude measures, cognitive ability measures, motivation measures, personality inventories, personality construct measures, and miscellaneous measures [6]. In general, instruments assessing risk-taking behavior can be divided in two categories of methodology; questionnaires based on self-report (either pen and paper or computer-based versions) and laboratory tasks (i.e., performance based tasks that usually involve a computer-based testing design). Interestingly, there has been little empirical evidence examining the overlap in nomothetic span for self-report measures and construct representation for behavioral lab tasks [8]. Most of the relationships that have been studied between different kinds of risk-taking measures are weak or non-existent [9].

When no gold standard exists to examine criterion validity of an instrument, De Vet et al.[10] recommend to assess construct validity by examining three aspects of construct validity; structural validity, hypotheses testing, and cross-cultural validity. This study will focus on hypothesis testing, i.e., we will formulate hypotheses about the relationships of scores on the instrument of interest with scores on other instruments measuring similar or dissimilar constructs, or differences in the instrument scores between specific groups of people that are assessed with the instrument. To that extent, the present study assesses construct validity of the RT-18 in a Dutch population of young adults by comparing RT-18 scores to those of instruments measuring equivalent constructs of risk-taking behavior in a self-report format. Moreover, RT-18 subscale scores were assessed for gender differences. Finally, RT-18 scores are compared to three behavioral lab tasks to examine the amount of overlap in construct representation.

Materials & Methods

Setting and Subjects

Students were approached on Utrecht University campus to fill out the RT-18 on the spot. From those who completed the survey and stated to be interested in participation, 120 individuals were invited by email to join the study. We aimed to include an equal number of males and females, dispersed over three categories of RT-18 total scores; low (0-6), medium (7-12) and high (13-18). Subjects needed to be 18-30 years of age. Testing took place on two separate days and a monetary incentive was offered (€15 for visit 1, €20 for visit 2). Informed consent was given for both visits separately. Exclusion criteria were alcohol use during the 24h before the second visit, and a positive drug screening at this visit. Approval for this study by a Medical Ethics Committee was not necessary according to Dutch law on medical scientific research with humans (WMO), for the study did not directly address a medical question nor were the participants subjected to any kind of regiment or invasive procedure.

Procedures

During the first visit (2-3 weeks after the inclusion-survey) respondents answered pen and paper versions of the RT-18, and all first and second category (see below) instruments. Groups of 1-16 subjects were tested in a classroom, that was set-up for an exam, taking about 60-90 min to complete all items.. The second visit was planned 2-4 weeks after the first visit. Breath alcohol concentration (BAC) was determined with a Draeger Alcotest® breath analyzer. Urine-samples were tested for benzodiazepines, barbiturates, opiates, THC, cocaine, and amphetamine. Each computerized task was performed in a separate room. In between testing, participants got a short break of 30 minutes during which the RT-18 was filled out a third time.

To ease analyses, the instruments that will be compared to the RT-18 are clustered in three groups based on similarity in methodology or measured construct. Groups 1 and 2 are both comprised of self-report instruments, whereas the third cluster instruments are behavioral lab tasks. Finally, since gender is known to influence risk-taking behavior we were interested in differences between males and females on RT-18 outcomes. Based on earlier results from the RT-18 [1], and the fact that men typically take more risks than women [11], and women are found to be more risk averse [12], we expected a significant gender-difference between RT-18 risk-taking and risk assessment scores, with males scoring higher than females.

Group 1 self-report instruments

The first group of instruments are four subscales from three instruments that resemble the RT-18 the most, in both content and structure; the subscales from which RT-18 items originated, the ZKPQ-ImpSS, TCI-ns, IVE-i and IVE-v. De Haan et al. (2011) described the risk-taking behavior constructed as measured by the RT-18 to comprise the sensation seeking, venturesomeness, impulsivity and novelty seeking constructs measured by the above mentioned instruments. Thus these constructs can be seen as sub-traits of the risk-taking behavior trait. We expected correlations to be at least moderate to high in this category.

Impulsive sensation seeking subscale

The 10-item ImpSS from the ZKPQ-50-cc was designed to assess impulsivity and sensation seeking [4,5]. Impulsivity reflects "lack of planning and a tendency to act quickly on impulse without thinking" and sensation seeking measures "a general need for thrills and excitement, a preference for unpredictable situations and friends, and the need for novelty and change" [4]. Each item has the format of a statement which can be answered dichotomously with 'true' or 'false'. The total score of the ZKPQ-ImpSS scale can be obtained by adding the scores of all items. Aluja et al. (2006) reported internal consistencies (Cronbach's alpha) of the ZKPQ-ImpSS to be 0.72, 0.73, 0.73 and 0.74 for a American, German, Spanish, and Swiss sample. Women scored significantly lower than men.

Novelty-seeking subscale

The TCI-ns from Cloninger's Temperament and Character Inventory Revised Short Version consists of 20 items comprising the following subscales: Explorative Excitability, impulsiveness, extravagance, and disorderliness [2]. Low scores indicate "slow tempered, uninquiring, tolerant of monotony, orderly, reserved, rigid, frugal and stoic" individuals. High scores indicate "quick-tempered, exploratory, curious, impulsive, easily bored, extravagant, disorderly and irritable behavior" [2]. Although most versions of the TCI contain dichotomously scored true/false items, the TCI-R is scored on a 5 point Likert-scale. For this study the true/false format was used. Dutch translation by Duijsens et al. was used [13]. Coefficient alpha was 0.78 for novelty seeking and mean item intercorrelation was $r = 0.15$ [14].

Impulsiveness subscale and Venturesomeness subscale

The 54-item Impulsiveness-Venturesomeness-Empathy questionnaire was developed to assess impulsiveness (IVE-i) and venturesomeness (IVE-v) [3,15]. The latter is described as "taking risks and seeking thrill and adventure" and is seen as a characteristic of individuals who are fully conscious of the risk they are going to take but also fully decide to take it. Impulsiveness is defined as "acting and talking without thinking things through and not realizing the possible risks

involved" [15,16]. All items are dichotomous yes/no items. The IVE-i scale comprises 19 items of which 3 are reversely scored, whereas IVE-v consists of 16 items of which 5 are negatively keyed. Scale score are obtained by adding up specific item scores. Dutch version of the I_7 questionnaire was validated by Lijffijt et al. (2005). KR-20 coefficients were calculated to assess scale reliability and yielded for IVE-i 0.81 and 0.80 for males and females respectively, and 0.80 and 0.75 for IVE-v. Men scored higher than women on impulsiveness and venturesomeness, but only the latter difference was statistically significant [17].

Group 2 self-report instruments

In the second group comparisons, RT-18 outcomes were compared with performance on five outcomes (i.e. two subscales and three total scores) from four unrelated instruments measuring similar constructs of risk-taking behavior. This choice was based on two aspects. These instruments are, like the RT-18, survey-based self-reports, and thus share the method of assessment. Even more importantly, all of these instruments measure risk-taking in very distinct behavioral constructs, that either completely or partly overlap with risk-taking and risk assessment as measured by the RT18. We expected at least low to moderate correlations in this category.

Risk-taking subscale and risk assessment subscale (from Domain Specific Risk-Taking Scale)

The DOSPERT comprises three assessments; risk-taking, risk perception and expected benefits, which are all based on the same 30 items [18,19,19,19,19]. Each item is rated thrice for each assessment, ranging from 0-7 on a Likert scale. The risk-taking subscale (DOSPERT-rt), i.e. self-reported level of risk-taking, is yielded directly from the risk-taking assessment. The perceived-risk attitudes subscale (DOSPERT-ra), i.e. willingness to engage in a risky activity as a function of its perceived riskiness and expected benefits, is obtained by regressing risk-taking scores on the perceived risk scores and expected benefit scores for each item and each person. Dutch revised version of the DOSPERT comprising 30 items was used which is available at http://www.dospert.org [19]. Cronbach's alpha ranged between 0.71 to 0.86 for the risk-taking domains in an English sample and from 0.57 to 0.82 in a French sample. Alpha's for risk attitude were 0.74-0.83 and 0.62-0.68 respectively [19].

Evolutionary Valid domain-Specific Risk-Taking Scale

The EVDSRTS is developed by Kruger et al. (2007). Five domains are specified that reflect the types of challenges (survival and reproductive) that humans faced during their evolutionary history; between-group competition, within-group competition, resource allocation for mate attraction and mating, environmental risks, and fertility. The EVDSRTS comprises 15 items, three for each domain. Respondents are asked to indicate the likelihood of engaging in

any situation on a five-point Likert scale, from very unlikely to very likely. A total score can be calculated by adding all items scores, whereas domain score can be calculated by adding the score of the specific three items belonging to that scale. The English items of the EVDSRTS were translated into Dutch by a professional translation agency, with respect to the meaning of each item.

Risk Scenario Questionnaire

The RSQ was designed by Rohrmann to assess a person's attitude towards risk taking (i.e. risk attitude) [20,21]. The RSQ has 19 items, each containing a short story of a real-life situation comprising a dilemma. The participant is asked to indicate how he or she would decide in this situation, on a 0-10 Likert-scale ranging from 'definitely not', to 'for sure'. Total score is obtained by adding up all item scores. Dilemmas of the RSQ were translated into Dutch by a professional translation agency, with respect to the meaning of each item.

Risk Propensity Questionnaire

The RPQ was also designed by Rohrmann to assess risk attitude [20,21]. The RPQ comprises four items asking the respondent to rate their risk propensity in general in each of the following categories; physical hazards with risk of accidents, physical hazards with risk of illness, financially risky actions, risky social behaviors. Ratings are indicated on a 0-10 Likert-scale, anchored by 'extremely low' and' extremely high'. Overall risk propensity is calculated by adding up the four item scores. Items of the RPQ were translated into Dutch by a professional translation agency, with respect to the meaning of each item.

Behavioral lab tasks

We evaluated three behavioral lab tasks assessing risk-taking behavior. As Cyders and Coskunpinar (2011) stressed, it is important to use multiple methods to assess personality traits and therefore both questionnaires and behavioral lab tasks should be used in the validation process [8]. We have chosen three for they measure risk-taking behavior in a computerized laboratory task setting, while using "real world" paradigms. Since it is difficult to conceptually compare the underlying constructs between these types of lab tasks and the RT-18, we had no specific a priori hypotheses about these comparisons

Driving Game

The DG is a behavioral measure of risk-taking in the form of a game played on a computer consisting of 15 trials [22]. Each trial starts with a car approaching a green traffic light, that will turn immediately to yellow. The participant has to decide to continue or to stop driving. Goal is to drive the car towards the traffic light and earn as many points as possible. Participants are allowed to stop and

start driving whenever and as often as they desire, however at some random point in time the traffic light will turn red. If the car is not moving when this happens, the trial is won and a "Yippie!" was heard. However if the subject was still driving the car, that trial was lost, and a police siren was heard. Three variables are of interest; average number of car restarts (restarts), overall proportion time spent driving under yellow light (driving), and total points earned (earnings).

Balloon Analogue Risk Task

The BART designed by Lejuez et al. assesses risk preferences in 30 trials in which a computerized balloon needs to be inflated by pumping it to its maximum inflation without exploding [23]. Points are earned for each pump that inflates the balloon, which is collected in a temporary bank that can be emptied into the permanent bank on each moment in the trial whenever the participant decides to stop pumping. When the balloon explodes, points of that trial are lost. All balloons had a different explosion point between 1-128 pumps. Variables of interest are: total points (earnings), number of explosions (explosions), and average adjusted number of pumps, i.e. the average number of pumps excluding trials were the balloon exploded (pumps). The BART has been correlated to other instruments of risk taking behavior such as the Sensation Seeking Scale [24], and as well as self-reported real-life risk behaviors such as alcohol and tobacco use [25].

Cambridge Gambling Task

The CGT from the Cambridge Neuropsychological Test Automated Battery (CANTAB) assesses risk-taking behavior outside a learning context [26,27]. The CGT is performed on a touch-screen computer. It comprises two stages, each consisting of 36 trials. On each trial, ten boxes with the proportion red and blue boxes varying between trials are shown. Participants have to guess whether a yellow token is hidden underneath a blue or red box. Each participant starts with 100 points. A proportion of these points (5%, 25%, 50%, 75% or 95%) can be selected to bet. If betted correctly, points are added, otherwise subtracted. The CGT stages refer to the way the proportion of points are presented to the subject (ascending or descending). Participants are randomly assigned to perform the ascending stage first or the descending first. The CGT yields six variables: quality of decision making (the proportion of the trials on which the subject chooses the most likely color to bet on), deliberation time (the time between presenting the ten blue or red boxes and the choice of the participant to place a bet), risk-taking (the mean proportion of points which the participant chose to bet on the trials where he had chosen the most likely color, this proportion can vary between 0.05 (low risk-taking) and 0.95 (high risk-taking)), risk adjustment (tendency to bet a higher amount of points (a higher proportion) on trials where the odds ratio is in favor), delay aversion (the delay aversion is the tendency to bet. Short waiting is related to low bets in the ascending stage and high bets in the descending stage. Delay aversion is calculated with the formula: risk-taking descending trials – risk-taking ascending trials, and overall proportion bet is defined as the average proportion of points the participant chose to bet on each trial.

Data collection and analyses

Data collection took place between September of 2010 and January of 2011. Results were gathered in Excel and prepared for analyses by R version 3.0.2 [28]; packages Hmisc, Psy, Psych, Tables and Boot. Data from this study outside the scope of the present article will be discussed elsewhere. There were no missing data points relevant to this analysis.

Demographic variables describing the sample were denoted using means and standard deviations (SD) and percentages. Scores on all instruments used were described using percentiles. Internal consistency of both RT-18 subscales were assessed with Cronbach's alpha. Test-retest reliability was examined through calculating the Intra Class Correlation coefficient ($ICC_{agreement}$) for RT-18 scores of visit 1 and visit 2. To assess the construct validity we will compare RT-18 subscale (i.e., risk-taking and risk assessment) scores with scores from self-report instruments in group 1 and 2. In addition we will examine gender differences in RT-18 subscale scores and RT-18 subscale scores will also be compared to three behavioral lab tasks. Most comparisons were assessed by calculating either Pearson's correlation coefficient (r) or Spearman's (rho) and 95% Confidence Intervals (95%CIs). Each correlation was visualized by a scatterplot and completed with a simple linear regression line. Gender differences for RT-18 scores were assessed with unpaired t-tests or Mann-Whitney tests and 95%CIs. In case of non-normal distribution, 95%CIs were estimated using bootstrap. For all analyses regarding construct validity, RT-18 scores obtained at visit 1 were used. All tests were performed 2-sided and confidence intervals that do not contain zero were considered significant.

Results

Subjects

In total n = 106 subjects were included for participation (who all completed visit 1), of which n = 57 (54%) were women. The second visit was completed by n = 67 (n = 37 or 55% females) from the original 106 subjects. Out of the 57 females, n = 26 scored low on RT-18 total score at visit 1, n = 26 scored medium, and n = 5 scored high. From the 49 males, RT-18 total scores were; n = 13 scored low, n = 27 scored medium and n = 9 scored high. Percentile scores on the RT-18, ZKPQ-ImpSS, TCI-NS, IVE-V, IVE-I, DOSPERT, RPQ, RSQ, CGT, DG and BART are shown in table 1. The second visit was completed on average (sd) 26 (14) days after visit 1. All 67 participants had a BAC of 0.00 and a negative urine test. Mean (sd) age was 20.3(2.2) years. Non-psychoactive medication use was reported by n = 15, and psychoactive medication use by n = 2 (keppra, anti-epileptic drugs). For average weekly alcohol use, 15% reported zero glasses of alcohol consumption, 46% reported 1-6 glasses, 23% 7-14 glasses, 11% 15-21, and finally 5% consumed on average 22-42 glasses of alcohol weekly. For tobacco use, 70% reported 'never', 8% reported daily use, and 22% reported sometimes. 58% have never used Illicit drugs in the past year, 26% reported 1 to 2 times, 12% 3-11, 2% reported monthly use, 4% weekly use of illicit drugs.

Table 1. Risk-taking behavior scores

Instrument	Subscale	25%	50%	75%	n
RT-18a	Risk-taking	4.00	5.00	8.00	106
	Risk assessment	1.00	2.00	4.00	106
RT-18b	Risk-taking	4.00	6.00	8.00	67
	Risk assessment	1.00	2.00	5.00	67
ZKPQ	Impulsive sensation seeking	3.25	5.00	7.00	106
TCI	Novelty seeking	8.00	10.00	13.00	106
IVE	Venturesomeness	8.00	12.00	14.00	106
	Impulsivity	3.00	5.00	8.75	106
DOSPERT	Risk-taking	90.00	103.50	122.80	106
	Risk attitude	99.00	104.50	116.00	106
EVDSRTS		32.00	38.00	44.75	106
RSQ		79.00	92.00	107.75	106
RPQ		15.00	19.50	23.75	106
DG	Restarts	1.33	1.73	2.80	67
	Earnings	710.00	816.00	940.00	67
	Driving	0.60	0.70	0.74	67
BART	Earnings	3455.00	3800.00	4148.00	67
	Explosions	5.50	8.00	10.50	67
	Pumps	29.35	34.55	41.81	67
CGT	Delay aversion	0.07	0.15	0.21	67
	Deliberation time	1463.00	1638.00	2019.00	67
	Overall proportion bet	0.49	0.55	0.64	67
	Quality of decision making	0.98	1.00	1.00	67
	Risk adjustment	1.03	1.51	2.10	67
	Risk-taking	0.53	0.59	0.68	67

Note: a = assessed at visit 1, b = assessed at visit 2, RT-18 = Risk Taking 18 items questionnaire, ZKPQ = Zuckermann-Kuhlmann Personality Questionnaire, IVE = Impulsivity Venturesomeness and Empathy questionnaire, DOSPERT = Domain Specific Risk Taking Questionnaire, EVDSRTS = Evolutionary Valid domain-Specific Risk-Taking Scale, RSQs = Risk Scenario Questionnaire, RPQ = Risk Propensity Questionnaire, DG = Driving Game, and BART = Balloon Analogue Risk Task, and CGT = Cambridge Gambling Task

Internal consistency and test-retest reliability

Cronbach's alpha for the first visit was 0.79 (95%CI = 0.70, 0.88) for risk-taking and 0.73 (95%CI = 0.62, 0.83) for risk assessment. The second visit showed a higher internal consistency with alpha's of 0.82 (95%CI = 0.74, 0.90) and 0.77 (95%CI = 0.68, 0.87), respectively. Test-retest reliability yielded an $ICC_{agreement}$ of 0.92 (95%CI = 0.85, 0.96) for the first factor risk-taking and 0.86 (95%CI = 0.80, 0.91) for the second risk assessment.

Group 1

After calculating the Spearman correlation coefficients for RT-18 risk-taking and risk assessment scores with the scores from ZKPQ-ImpSS, TCI-NS, IVE-V, IVE-I (see figure 1), the highest correlations found for risk-taking are with ZKPQ-ImpSS scores (r = 0.89, 95%CI = 0.84-0.92), and Venturesomeness (r = 0.75, 95%CI = 0.67-0.84). Whereas the RT-18 risk assessment correlates the most with Impulsivity (r = 0.85, 95%CI = 0.79-0.90) and Novelty Seeking (r = 0.76, 95%CI = 0.63-0.81).

Group 2

As shown in figure 2, a correlation of r = 0.71 (95% CI = 0.56-0.77) was found for DOSPERT risk-taking and RT-18 risk-taking scores. RT-18 risk assessment scores yield a similar pattern of correlations, albeit that the strength of the correlations with the DOSPERT scales is almost halved compared to RT-18 risk-taking correlations. For the EVDSRTS a correlation of 0.52 (95%CI = 0.37-0.65) was found for risk-taking and r = 0.34 (95%CI = 0.20, 0.53) for risk assessment. Both the RSQ and the RPQ correlate r = 0.50 (95%CI = 0.38-0.66, and 95%CI = 0.33-0.62 respectively) with RT-18 risk-taking. Risk-assessment correlates slightly weaker with the RSQ (r = 0.44, 95%CI = 0.26-0.57) and the RPQ (r = 0.46, 95%CI = 0.29-0.59).

Gender differences

Possible gender differences in RT-18 scores were assessed at visit 1 scores. Significant differences were found for risk-taking. Women scored significantly lower compared to men (f: median = 5.0, m: median = 6.0, U = 1843, 95%CI = 0.00000859, 2.99). However, this was not the case for risk assessment (f: median=2.0, m: median=3.0, U = 1483, 95%CI = -1.00, 1.00).

Behavioral lab tasks

Spearman's correlation coefficients were also calculated for RT-18 scores of visit 1 with lab tasks of visit 2. RT-18 scores did not correlate with any variable derived from the BART. There was a correlation of r = 0.27 (95%CI = 0.09, 0.52) for RT-18 risk taking observed with DG driving. When looking at CGT scores in figure 3, we see that overall proportion bet and CGT risk-taking correlate r = 0.99 (95%CI = 0.98, 0.99) with each other, and with RT-18 risk-taking and risk assessment scores as well. RT-18 risk-taking displays two correlations (overall proportion bet: r = 0.28, 95%CI = 0.01, 0.46 and CGT risk-taking: r = 0.25, 95%CI = 0.01, 0.46), whereas risk assessment correlates only with overall proportion bet (r = 0.24, 95%CI = 0.04, 0.49). Risk assessment also displays a correlation with CGT risk adjustment (r = -0.36, 95%CI = -0.49, -0.04).

Discussion

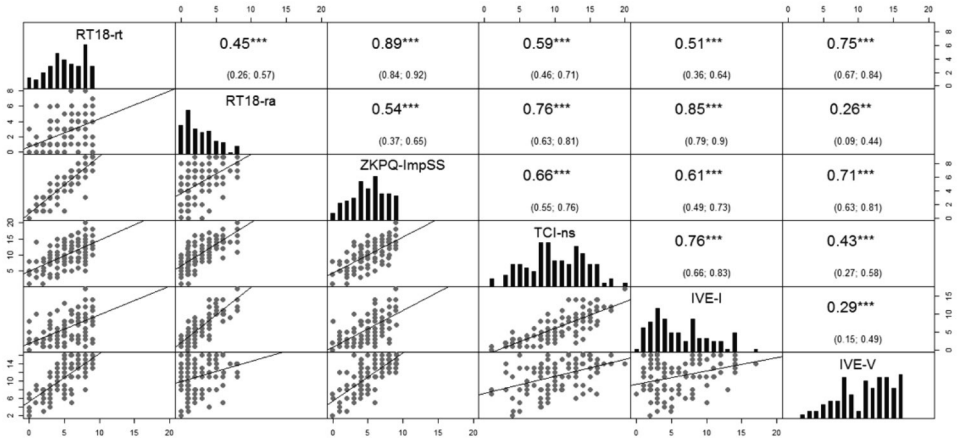
This study aimed to assess the construct validity of the RT-18 questionnaire in a sample of Dutch young adults by assessing RT-18 subscale scores compared with two groups of self-report instruments that measure risk-taking behavior or a similar construct. Moreover, RT-18 subscale scores were assessed for gender differences. Finally, we examined RT-18 subscale score compared to three behavior lab tasks that measure risk-taking behavior using a "real world risk-taking" paradigm.

Our results showed that the RT-18 when compared to the first group of self-report instruments that provided the items for the RT-18 (i.e. the TCI-ns, IVE-i, IVE-v, and ZKPQ-ImpSS), performed good. We expected to find at least moderate to high correlations, based on the fact that the RT-18 items originate from these instruments and that the method of assessment is very similar to the RT-18. All correlations were above r = .51 except for risk assessment which correlated a little lower with IVE-v (i.e. r = .26). Interestingly, RT-18 risk-taking correlated highest with ZKPQ-ImpSS and IVE-v, whereas this pattern was completely opposite for risk assessment that showed strongest effects with TCI-ns and IVE-i. This confirms that both RT-18 scales represent related but distinct risk-taking constructs.

When comparing RT-18 risk-taking scores in the second group to scores of four other self-report instrument measuring risk taking behavior, which are, like the RT-18, survey-based self-reports, but measure risk-taking in very distinct behavioral constructs, that either completely or partly overlap with risk-taking and risk assessment as measured by the RT18, we expected at least low to moderate correlations. For RT-18 risk-taking all effects were notably higher than expected (i.e. correlations between .50 and .71 were observed). This indicates RT-18 risk-taking to resemble the risk-taking behavior constructs as measured with the DOSPERT, EVRDTS, RSQ and RPQ, and would thus confirm good construct validity within this cluster of comparisons. Effects for RT-18 risk assessment were somewhat lower, between .23 and .46, and the lowest correlation was observed with DOSPERT risk assessment. It seems like the DOSPERT risk assessment construct is not quite similar to our RT-18 risk assessment, for the correlation between the two is lower, than of the latter with DOSPERT risk-taking (i.e. r = .23 versus r = .44). Also when comparing the two DOSPERT scales, they correlate much higher (r = .71) than the two RT-18 scales (r = .45), again confirming a probable disparity in underlying constructs for both risk assessment scales.

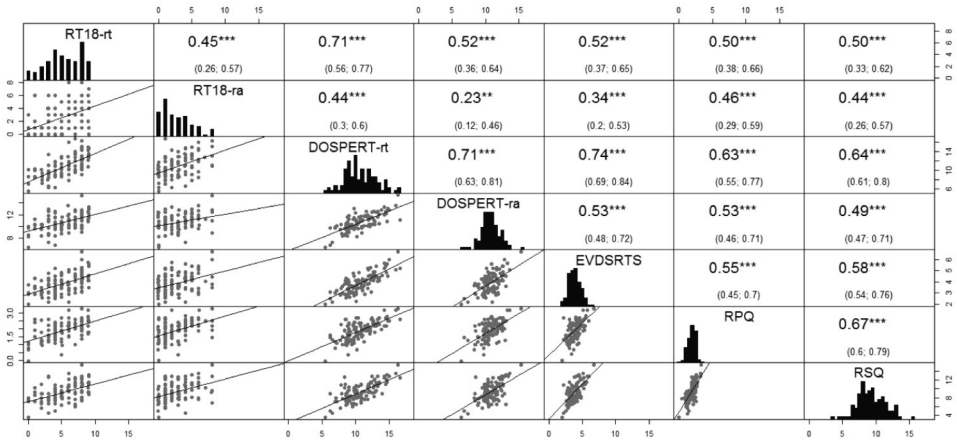
So far, we conclude that the construct validity of the RT-18 scales is satisfactory when compared to eight instruments that assess risk-taking behavior applying identical methods (e.g. survey-based self-report). In addition, we examined expected gender differences in RT-18 scores. Men scored significantly higher than women, as expected on RT-18 risk taking. We have not found a significant difference in risk assessment scores.

Figure 1. Spearman correlations for RT-18, ZKPQ-ImpSS, TCI-ns, IVE-I and IVE-V



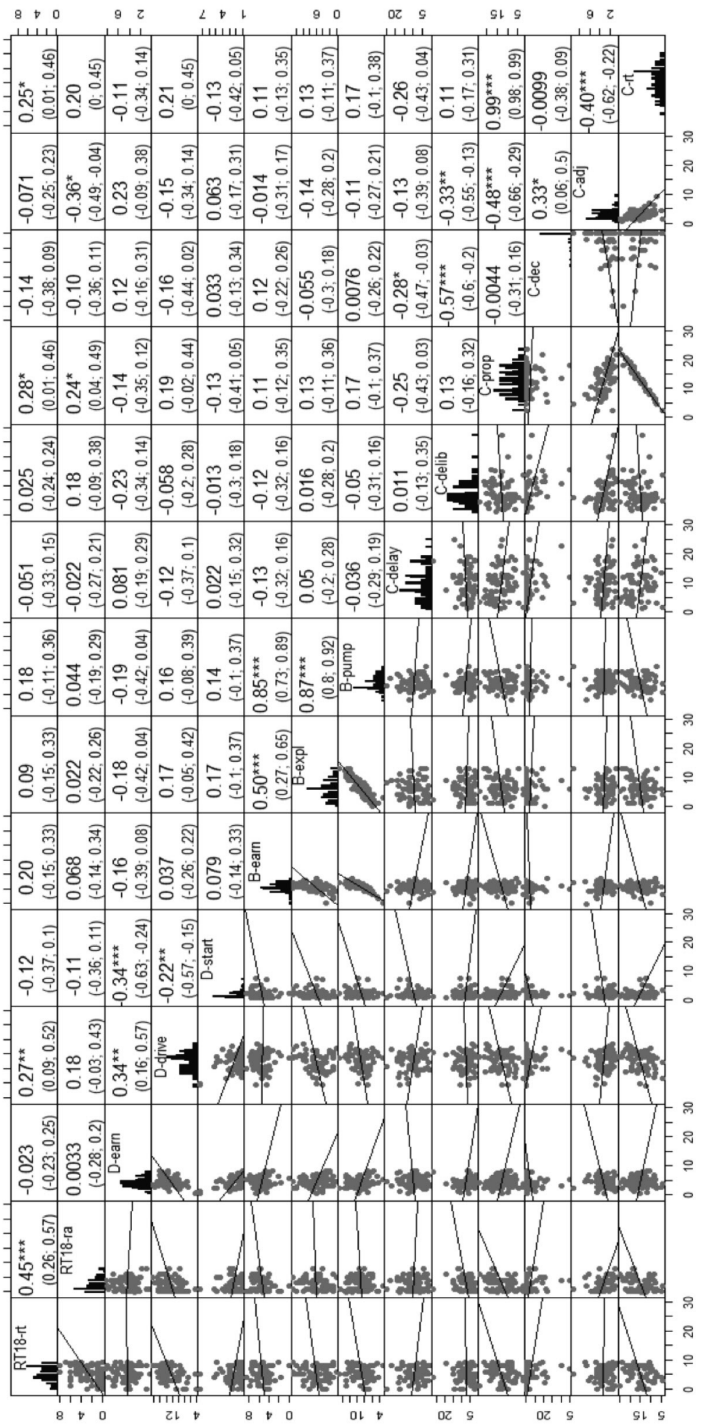
Note: Upper panels Spearman correlation coefficients accompanied by their 95% confidence interval given below. * = P-value <0.05. ** = p-value <0.01. *** = p-value <0.001. Diagonal panels Histograms for (from left to right) RT-18 Risk Taking, RT-18 Risk Assessment, ZKPQ-Impulsive Sensation Seeking, TCI-novelty seeking, IVE-impulsivity, and IVE-venturesomeness (all measured at visit 1). Lower panels Scatterplots and simple linear regression lines

Figure 2. Spearman correlations for RT-18, DOSPERT, EVDSRTS, RSQ and RPQ



Note: Upper panels Spearman correlation coefficients accompanied by their 95% confidence interval given below. * = P-value <0.05. ** = p-value <0.01. *** = p-value <0.001. Diagonal panels Histograms for (from left to right) RT-18 risk taking, RT-18 risk assessment, DOSPERT-risk taking, DOSPERT-risk attitude, EVDRTS, RSQ, and RPQ scores at visit 1. All DOSPERT scores as well as EVDRTS and RSQ and RPQ scores have been divided by ten to create similar scaling for this figure. Lower panels Scatterplots and simple linear regression lines

Figure 3. Spearman correlations for RT-18, DG, BART, and CGT scores



Note: Upper panels Spearman correlation coefficients accompanied by their 95% confidence interval given below. * = P-value <0.05. ** = p-value <0.01. *** = p-value <0.001. Diagonal panels histograms for (from left to right) RT-18 risk-taking, RT-18 risk assessment, DG Total points earned (x/100*4), DG Overall proportion time spent driving under yellow light (x*100/3-10), DG Average number of car restarts, BART Total points earned (x/400-4), BART Number of explosions (x-2), BART Average adjusted number of pumps(x/4), CGT Delay aversion(x*50+2), CGT Deliberation time(x/100-10), CGT Overall proportion bet (x*50-15), CGT Quality of decision making (x*100-70), CGT Risk adjustment (x^2), and CGT Risk-taking (x*50-15) scores at visit 1. To create similar scaling for this figure some variables have been rescaled using the formulae mentioned behind the variable. Lower panels Scatterplots and simple linear regression lines

When examining the associations between RT-18 and behavioral risk-taking tasks, we observed what was to be expected from the literature, namely that there is little or no overlap between these two types of assessment. From the three DG outcomes, only driving produced significant correlations with RT-18 risk-taking (r = .27). None of the BART outcomes correlated with the RT-18 scores. From the six CGT outcomes, only overall proportion bet, risk adjustment and risk-taking correlated with the RT-18 scales. Striking is the r = .99 correlation between CGT overall proportion bet and CGT risk-taking, indicating both outcomes measure practically the same construct. In addition, we noticed that None of the three DG outcomes correlated with any of the outcomes from the other instruments of the third category. This implies that the DG probably measures a different risk-taking construct than BART and CGT do. Moreover, we see that the BART outcomes probably measure a different kind of risk-taking concept, for they do not show any overlap with either DG or CGT scores. And logically it follows that we see that none of the CGT outcomes correlated with either the DG or the BART outcomes. Taken together, it seems that the risk-taking constructs underlying the DG, BART and CGT are very dissimilar from another.

Overall, the convergent validity with other self-report instruments measuring risk-taking and related constructs was good, although risk-taking performed somewhat better than risk assessment. However, convergent validity when assessed with different measurement methods (i.e. across self-report and behavioral lab tasks) was poor for both RT-18 scales, but this is completely in line with the existing literature. Interestingly, convergent validity among the DG, BART and CGT outcomes was not there at all, for none of these instruments correlated with another. This might be partly explained by the fact that the term "risk-taking behavior" has been used to refer to a variety of behaviors (e.g. externalizing, antisocial, problem behaviors, delinquency, and norm breaking) [1,29]. Inconsistencies in the concept of risk-taking behavior have led to several related and (partial) overlapping personality constructs, such as sensation seeking, venturesomeness, impulsivity, novelty seeking, and thrill seeking, which are thought to underlie these behaviors [30]. This lack of consensus has led to numerous definitions of risk-taking behavior, usually referring to goals, values, options, and outcomes [11]. Furthermore, as Cyders and Coskunpinar (2011) stress "there has been little empirical evidence examining the overlap in nomothetic span for self-report measures and construct representation for behavioral lab tasks in most psychological constructs". Lejuez et al. (2003) reported that the BART did not correlate with several self-report instruments (IVE-i, Sensation Seeking Scale, Rosenberg Self-Esteem Scale) [31]. Xu et al. (2013) also failed to find any relations between the BART and the IVE-I and the Sensation Seeking Scale and concluded that behavioral tasks and self-report measures may tap different aspects of impulsivity [32]. The Barrat Impulsiveness Scale was compared to four inhibition tasks, and correlated to only one of those [33]. Reynolds et al. (2006) report that out of 40 correlations assessed between behavioral tasks and questionnaires of impulsivity, only one was significant. In a meta-analyses of 27 studies comparing self-report to behavioral lab tasks of impulsivity, the general relationship was only r = 0.097 (95% CI = 0.089-0.106, based on 608 comparisons)[8]. When actually comparing six different behavioral paradigms with the UPPS-P impulsive behavior scale, Cyders and Coskunpinar

(2012) concluded they had to affirm their previous conclusions drawn from their meta-analyses, that although some overlap was found between these measures, there was no variance shared by self-report and lab task measures of impulsivity, suggesting the discreteness of these methods of assessment [34]. A recent study on a rather large sample (n = 266) found no evidence of convergent validity between the Barratt Impulsivity Scale and two lab tasks, the Iowa Gambling Task and the Continuous Performance Task, and the authors concluded "... both the types of measures need to be used because there is no ready golden standard that allows psychologists to know which is the best measure to characterize impulsive behavior" [35].

An important methodological limitation of this study is that since there is not a gold standard to measure risk-taking behavior, we needed to assume that the instruments used to compare the RT-18 with, are valid measures of the risk-taking behavior construct themselves. Furthermore, generalizability of this study is limited by the relatively small sample size (n = 109),and the specific population used (students of Utrecht University).

Compared to eight survey-based self-report instruments measuring risk-taking behavior, and when examining gender differences, the RT-18 showed satisfactory construct validity . However, as was to be expected from previous research in this field, there was little overlap of RT-18 scores with three behavioral lab tasks. Therefore, we conclude more research into the validity of the RT-18 is needed, and in particular into the relation between RT-18 and real world risk-taking behavior, thus clinical validity should be examined.

Acknowledgements

The authors would like to thank S.V. Belitser for guidance on statistical analyses and R-programming.

References

1. de Haan L, Kuipers E, Kuerten Y, van Laar M, Olivier B, Verster JC. The RT-18: A new screening tool to assess young adult risk-taking behavior. Int J Gen Med. 2011;4:575-584.
2. Cloninger CR, Svrakic DM, Przybeck TR. A psychobiological model of temperament and character. Arch Gen Psychiatry. 1993;50(12):975.
3. Eysenck SBG, Pearson PR, Easting G, Allsopp JF. Age norms for impulsiveness, venturesomeness and empathy in adults. Pers Indiv Differ. 1985;6(5):613-619.
4. Zuckerman M. Zuckerman-kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model. Big five assessment. 2002:377-396.
5. Aluja A, Rossier J, García LF, Angleitner A, Kuhlman M, Zuckerman M. A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to english, french, german, and spanish languages. Pers Indiv Differ. 2006;41(4):619-628.
6. Appelt KC, Milch KF, Handgraaf MJ, Weber EU. The decision making individual differences inventory and guidelines for the study of individual differences in judgment and decision-making research. Judgm Decis Mak. 2011;6(3):252-262.
7. Lauriola M, Levin IP. Personality traits and risky decision-making in a controlled experimental task: An exploratory study. Pers Indiv Differ. 2001;31(2):215-226.
8. Cyders MA, Coskunpinar A. Measurement of constructs using self-report and behavioral lab tasks: Is there overlap in nomothetic span and construct representation for impulsivity? Clin Psychol Rev. 2011;31(6):965-982.
9. Dahlbäck O. Personality and risk-taking. Pers Indiv Differ. 1990;11(12):1235-1242.
10. De Vet HC, Terwee CB, Mokkink LB, Knol DL. Measurement in medicine: A practical guide. Cambridge University Press; 2011.
11. Byrnes JP, Miller DC, Schafer WD. Gender differences in risk taking: A meta-analysis. Psychol Bull. 1999;125(3):367-383.
12. Eriksson K, Simpson B. Emotional reactions to losing explain gender differences in entering a risky lottery. Judgm Decis Mak. 2010;5(3):159-163.
13. Duijsens IJ, Spinhoven P, Goekoop JG, Spermon T, Eurelings-Bontekoe EHM. The dutch temperament and character inventory (TCI): Dimensional structure, reliability and validity in a normal and psychiatric outpatient sample. Pers Indiv Differ. 2000;28(3):487-499.
14. Farmer RF, Goldberg LR. A psychometric evaluation of the revised temperament and character inventory (TCI-R) and the TCI-140. Psychol Assess. 2008;20(3):281.
15. Eysenck SB, Eysenck HJ. Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. Psychol Rep. 1978;43(3f):1247-1255.
16. Caci H, Nadalet L, Baylé FJ, Robert P, Boyer P. Cross-cultural study of the impulsiveness-venturesomeness-empathy questionnaire (IVE-7). Compr Psychiatry. 2003;44(5):381-387.
17. Lijffijt M, Caci H, Kenemans JL. Validation of the dutch translation of the I7 questionnaire. Pers Indiv Differ. 2005;38(5):1123-1133.
18. Weber EU, Blais A, Betz NE. A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. J Behav Decis Making. 2002;15(4):263-290.
19. Blais A, Weber E. A domain-specific risk-taking (DOSPERT) scale for adult populations. Judgm Decis Mak. 2006;1(1):33-47.
20. Rohrmann B. Risk attitude scales: Concepts and questionnaires. Melbourne: University of Melbourne. 2002.
21. Rohrmann B. Risk attitude scales: Concepts, questionnaires, utilizations. Project report. Online access http://www.rohrmannresearch.net/pdfs/rohrmann-ras-report.pdf. 2005;13:2012.
22. Mather M, Gorlick MA, Lighthall NR. To brake or accelerate when the light turns yellow? stress reduces older adults' risk taking in a driving game. Psychol Sci. 2009;20(2):174-176.
23. Lejuez C, Read JP, Kahler CW, et al. Evaluation of a behavioral measure of risk taking: The balloon analogue risk task (BART). J Exp Psychol Appl. 2002;8(2):75.
24. Zuckerman M, Bone RN, Neary R, Mangelsdorff D, Brustman B. What is the sensation seeker? personality trait and experience correlates of the sensation-seeking scales. J Consult Clin Psychol. 1972;39(2):308.
25. Hunt MK, Hopko DR, Bare R, Lejuez CW, Robinson EV. Construct validity of the balloon analog risk task (BART): Associations with psychopathy and impulsivity. Assessment. 2005;12(4):416-428.
26. Rogers RD, Owen AM, Middleton HC, et al. Choosing between small, likely rewards and large, unlikely rewards activates inferior and orbital prefrontal cortex. J Neurosci. 1999;19(20):9029-9038.
27. Owen AM, Downes JJ, Sahakian BJ, Polkey CE, Robbins TW. Planning and spatial working memory following frontal lobe lesions in man. Neuropsychologia. 1990;28(10):1021-1034.
28. RCoreTeam. R: A language and environment for statistical computing. 2014.
29. Arnett J. Reckless behavior in adolescence: A developmental perspective. Dev rev. 1992;12(4):339-373.
30. Boyer TW. The development of risk-taking: A multi-perspective review. . Dev Rev. 2006;26(3):291-345.
31. Lejuez C, Aklin WM, Zvolensky MJ, Pedulla CM. Evaluation of the balloon analogue risk task (BART) as a predictor of adolescent real-world risk-taking behaviours. J Adolesc. 2003;26(4):475-479.
32. Xu S, Korczykowski M, Zhu S, Rao H. Risk-taking and impulsive behaviors: A comparative assessment of three tasks. Social Behavior and Personality: an international journal. 2013;41(3):477-486.
33. Enticott PG, Ogloff JR, Bradshaw JL. Associations between laboratory measures of executive inhibitory control and self-reported impulsivity. Personality and Individual Differences. 2006;41(2):285-294.
34. Cyders MA, Coskunpinar A. The relationship between self-report and lab task conceptualizations of impulsivity. J Res Personal. 2012;46(1):121-124.
35. Gomide Vasconcelos A, Sergeant J, Corrêa H, Mattos P, Malloy-Diniz L. When self-report diverges from performance: The usage of BIS-11 along with neuropsychological tests. Psychiatry Res. 2014;218(1-2):236-43.

Part 2

Assessment of the association between RT-18 and various expressions of risk-taking behavior

Chapter 5

The Relation between Risk-taking Behavior and Alcohol Use in Young Adults is Different for Men and Women

L. de Haan[a] , A.C.G. Egberts[a,b], E.R. Heerdink[a,b].

[a] Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Universiteitsweg 99, 3584 CG, Utrecht, Netherlands
[b] Department of Clinical Pharmacy, University Medical Center Utrecht, Heidelberglaan 100, 3584 Utrecht, Netherlands

Drug and Alcohol Dependence 2015:155 222-227.

Abstract

Objective. The present study examined the relationship of risk-taking behavior and alcohol use and the role of sex herein, while adjusting for age, depression, anxiety, stress and lifestyle.

Methods. Participants were 6002 university students. They were classified as either abstinent, drinker but non-binge drinker, or binge drinker based on self-reported alcohol consumption. Risk-taking and risk assessment were evaluated with the RT-18 and depression, anxiety and stress with the DASS-21.

Results. The odds of being a binge versus non-binge drinker increased with risk-taking as well as risk assessment for both men and women. The odds being a non-binge drinker versus abstinent were increased by risk-taking for women only. For binge drinking versus abstinence, risk-taking had a significant increasing effect for both sexes, but risk assessment was only significant in women.

Conclusion. These results may assist with alcohol use prevention techniques because risk-taking behavior exerts, even when corrected for age, lifestyle, depression, anxiety, and stress levels, a solid, sex-specific independent effect on alcohol use.

Introduction

Nearly eight and four percent of all male and female deaths, respectively could be attributed to alcohol use worldwide in 2012 (World Health Organization, 2014). This sex difference is largely explained by variations in consumption: women are more often abstainers, drink alcohol less frequently and in smaller quantities, and are less often engaged in heavy episodic drinking (Dawson and Archer, 1992; World Health Organization, 2014).

This sex-specific pattern of alcohol use could also partly be explained by physical characteristics. Females need less alcohol to reach the same state of inebriety as men due to their average lower body weights, smaller liver capacities to metabolize alcohol, and higher proportions of body fat (Smarandescu et al., 2014; World Health Organization, 2014).

Psychological factors could also contribute to sex differences in alcohol use. A large body of research has identified that personality traits such as impulsivity and sensation seeking consistently correlate with alcohol use (Ball, 2005; Dick et al., 2010; Hittner and Swickert, 2006; Ibáñez et al., 2010). Sex differences in risk-taking behavior and related personality traits are also well known, with men typically being more likely to engage in risky behavior than women (Byrnes et al., 1999). In general, men score higher on measures of behavioral disinhibition, impulsivity and sensation seeking, each of which correlate to heavy alcohol use and related problems (Nolen-Hoeksema, 2004; Rounsaville et al., 1998).

In addition to risk-taking behavior, psychiatric disorders have been linked to alcohol use (Ball, 2005; Rounsaville et al., 1998). An association between major depression and alcohol consumption exists, although the causality and direction of this relationship varies based on patient characteristics and is thus unclear (Boden and Fergusson, 2011). In general, women are twice as likely to experience depression as men (Nolen-Hoeksema and Girgus, 1994), implying different relations between alcohol use and depression based on the heavier alcohol consumption in men. Other psychiatric disorders that influence or coincide with alcohol use also have well known sex-related disparities. For instance, women are more likely to develop anxiety disorders (McLean and Anderson, 2009) and female problem drinkers have reported more serious depressive symptoms and health-related stressful events compared to males (King et al., 2003).

Sex differences in alcohol use can thus be attributed to physical and psychological factors, as well as psychiatric disorders. We were particularly interested in the relationship between risk-taking behavior, alcohol consumption and the role of sex herein in young adults. This age group is known to consume alcohol in dangerous levels (e.g., binge drinking or more than 4 (female)/5 (male) consecutive alcoholic consumptions)(Wechsler et al., 1995a; Wechsler et al., 1995b) and have elevated levels of risk-taking behavior as well (Steinberg et al., 2008). Therefore, the present study examined the relationship between risk-taking behavior and alcohol use in a large sample of young male and female adults while adjusting for age, depression, anxiety, stress, and lifestyle. We hypothesized: 1) risk-taking behavior is significantly and positively related to alcohol use, even after adjustments for age, depression, anxiety, stress, and lifestyle and that 2) this relation is different for men and women.

Material & Methods

Participants

Participants were 6002 students from the online Utrecht Student Survey (USS) (de Haan et al., 2012b), which has been extensively described elsewhere. In brief, the USS was conducted in June of 2011, among students from Utrecht University and the University of Applied Sciences Utrecht. These students were invited to participate via an internal university email. The aim of the survey was 3-fold: 1) to determine the potential impact of alcohol mixed with energy drinks (AMED) on overall alcohol consumption and alcohol-related consequences; 2) to investigate motivations for specific alcohol consumption patterns; 3) to identify personality characteristics, risk-taking behavior and their relationship with alcohol consumption. Data from this sample were previously analyzed for the purpose of evaluating AMED and alcohol consumption (de Haan et al., 2012a). Approximately 70,000 students received the email containing the link to the online survey. A total of 7158 students opened the link to the survey provided by email, yielding a response rate of 10.2%. Respondents were first presented with the online informed consent form stating the purpose, procedures, risks, confidentiality, compensation, and contact information. To proceed, participants had to agree by clicking on the "I agree to participate" button. In case the participant chose to click the "I decline to participate" button, they were redirected to a thank you page, and the survey was shut down. After cleaning the data, 6002 students remained for analysis (de Haan et al., 2012b). A total of 39 were excluded for not giving consent; 570 did not meet the age criterion of 18-30 years; 525 did not answer the questions that were necessary to classify them as part of one of the drinking groups; and 22 stated they did not answer the items truthfully (de Haan et al., 2012b). From 6002 participants, n=2116 (35.3%) were male and n=3886 (64.7%) female.

Alcohol consumption

To assess alcohol consumption, items from the Quick Drinking Screen (Sobell et al., 2003) were adapted and measured in three possible drinking scenarios: consumption of just alcohol (i.e., beer or wine or unmixed liquor); consumption of alcohol mixed with energy drinks; and consumption of alcohol with other mixers (e.g., cola, juice etc.). Participants were asked to report number of standard drinks, with 250cc of beer, 100cc of wine, and 35cc of liquor equal to one standard drink. For this analysis, alcohol consumption data from all three scenarios were combined into pooled alcohol consumption data. For those who used alcohol, consumption over the previous month (yes/no) and the occurrence of binge drinking days (yes/no) in the past month, were extracted. Binge drinking was defined as consuming more than four (females) or five (males) alcoholic beverages in one day. Subjects were classified as either abstinent, drinker but non-binge drinker, or binge drinker.

Risk-taking behavior

The Risk Taking questionnaire-18 items (RT-18; de Haan et al., 2011) consists of 18 dichotomous 'yes' or 'no' items taken from the Impulsiveness-Venturesomeness-Empathy questionnaire (Eysenck et al., 1985), the novelty-seeking subscale of the Temperament and Character Inventory (Cloninger et al., 1993), and the impulsive-sensation-seeking subscale of the Zuckerman Kuhlman Personality Questionnaire (Aluja et al., 2006; Zuckerman, 2002). The RT-18 has two subscales: risk-taking and risk assessment (each subscale score consists of the sum of nine specific items, with three items reversely scored). Risk-taking scores are correlated with actual risk-taking behavior (i.e., engagement in risky behaviors), whereas a high score on risk assessment indicates a low level or less consideration of possible consequences (i.e., acting without thinking). Cronbach's alpha was calculated in this sample. Risk-taking and assessment had internal consistencies of 0.79, and 0.73, respectively.

Other measures

Demographic information was collected regarding sex, age, height and weight. Depression, anxiety and stress levels were assessed with the Depression Anxiety Stress Scales 21 items (DASS21; de Beurs et al., 2001; Lovibond and Lovibond, 1995) which is a quantitative self-report measure of depression, anxiety and stress. Example items include, "I found it hard to wind down" for the stress scale, "I was aware of dryness in my mouth" for the anxiety scale, and "I couldn't seem to experience any positive feeling at all" for the depression scale. Responses were based on a three-point Likert-scale related to feelings over the past week. Cronbach's alphas were 0.87, 0.76, and 0.85 for depression, anxiety and stress, respectively. Lifestyle was based on BMI scores (i.e., dividing weight in kilograms by squared height in meters), membership in a fraternity or sorority (yes/no), illicit drugs use in the previous year (yes/no), current medication use (yes/no), and tobacco use (yes/sometimes/no).

Data analysis

Data were gathered in Excel and prepared for analyses using R version 3.0.2 (RCoreTeam, 2014) with Hmisc, Psych and nnet packages. Sex differences were assessed through either independent t-tests or chi-square tests for age, weight, height, BMI, risk-taking, risk assessment, depression, anxiety, stress, fraternity or sorority membership, medication use, illicit drug use, tobacco use and alcohol use. The relation between risk-taking behavior and alcohol use was assessed in a hierarchical multinomial logistic regression model. Based on preliminary analysis where sex acted as an effect modifier, we stratified the analysis for sex. The crude model was corrected for possibly confounding variables in three steps. First, the crude model was corrected for age (model 1) (Barnes et al., 2002; Feil and Hasking, 2008). The second model was adjusted for age and lifestyle (model 2). Lifestyle comprises BMI, fraternity or sorority membership, tobacco use, medication use and illicit drug use, which all are known confounders in the literature (Barnes et al., 2002; Capone et al., 2007;

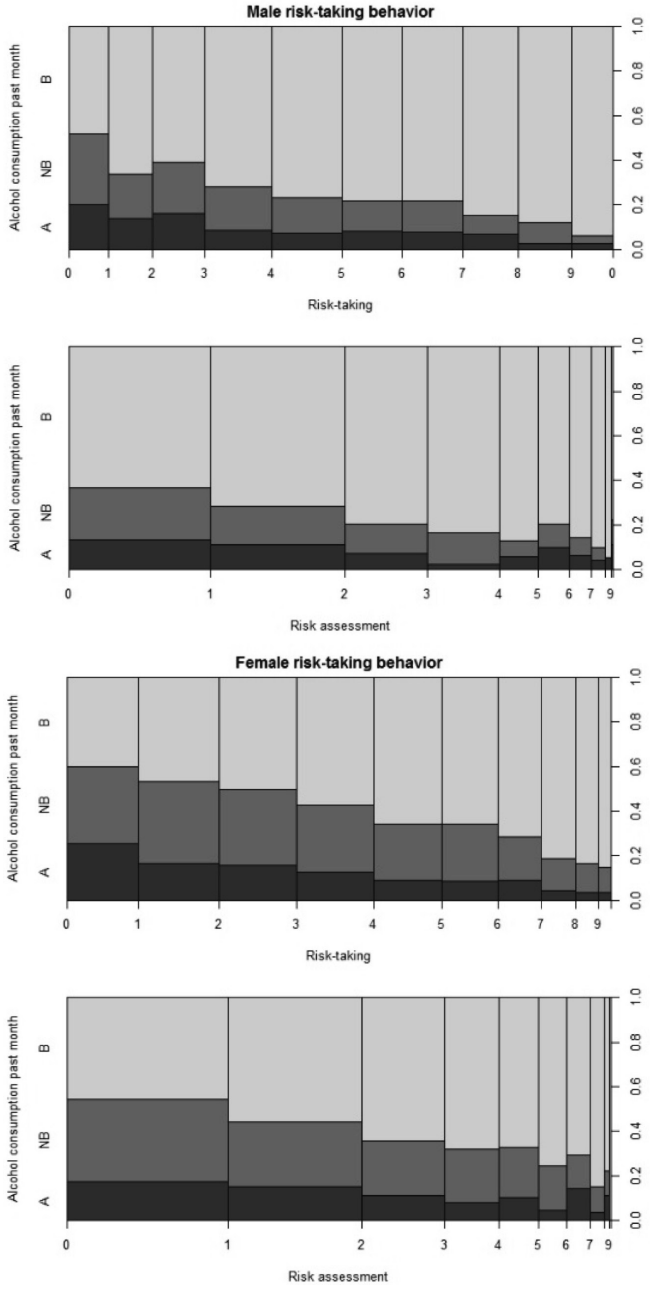
Kleiner et al., 2004; Reed et al., 2007). Third, the model was corrected for age, lifestyle, and DASS21 results (model 3) (Buckner et al., 2011; Feil and Hasking, 2008). Dummy variables were created where necessary. Effect sizes were expressed as odds-ratios with 95% confidence intervals (95%CI). A total of twelve determinants (including dummies) were included in the third model. This implies at least 12*15 = 180 observations were needed to fulfill the power requirement. Male abstinents (n = 180) represented the category with the least members. Therefore, we met the prerequisite threshold. All statistical tests were two-sided. Effects with $p < 0.05$ and confidence intervals that did not contain zero were considered significant.

Results

Sex differences are depicted in Table 1. Men were slightly older ($t(4259) = 4.16$, $p < 0.001$), heavier ($t(3920) = 42.90$, $p < 0.001$), taller ($t(3927) = 72.84$, $p < 0.001$), and had higher BMI scores ($t(4619) = 7.44$, $p < 0.001$). For RT-18 scores, the difference was largest for risk-taking ($t(4259) = 4.16$, $p < 0.001$) and substantially smaller for risk assessment ($t(4046) = 2.06$, $p = 0.04$). There were no significant differences for depression ($t(2325) = 1.80$, $p = 0.07$) and anxiety ($t(2424) = 1.18$, $p=0.24$). However, women had much higher stress scores ($t(2636) = -6.38$, $p < 0.001$). Sorority or fraternity membership yielded a small difference ($X2(1) = 5.54$, $p = 0.02$), whereas more women indicated medication use compared to men ($X2\ (1) = 241.47$, $p < 0.001$). Interestingly, more men reported tobacco ($X2\ (2) = 38.95$, $p < 0.001$) and illicit drug use ($X2\ (1) = 124.61$, $p < 0.001$). Men also reported more use of alcohol (91.5%, ($X2\ (1) = 20.56$, $p < 0.001$)) and 75.4% were classified as binge drinkers. A total of 87.6% of women reported alcohol use in the past month, and 59.5% were identified as binge drinkers, which was significantly lower percentage than that for men ($X2\ (2) = 154.99$, $p < 0.001$). Figure 1 shows the distribution of the RT-18 risk-taking and risk assessment scores for men and women in each of the three alcohol use categories. Table 2 summarizes the results of the hierarchical multinomial logistic regression for males. The regression coefficients and odds ratios for the three contrasts are shown, including non-binge drinkers compared to abstinents, binge drinkers compared to non-binge drinkers, and binge drinkers compared to abstinents.

A highly significant effect of risk-taking on alcohol use was found for binge drinkers versus abstinents, and the final model (i.e., corrected for age, lifestyle and the DASS21 subscales) yielded an OR of 1.17. Interestingly, risk assessment did not significantly influence this male specific model for alcohol use. Just a small difference between non-binge drinkers and abstinents (OR between 1.03 and 1.00 for all four models) was found, and the effect of risk-taking on binge drinkers versus abstinents (OR = 1.25 in the crude model) was almost as large as that of risk-taking on binge drinkers versus non-binge drinkers (OR = 1.21 crude model).

Figure 1. Stacked-bar-charts displaying the proportion of abstinents, no binge drinkers and binge drinkers across each risk-taking and risk assessment score for males and females



Note: A = abstinent group, NB = not binge drinking group, B = binge drinking group. Bar width indicates the relative number of observations on the specific score (i.e. 0-9) on the risk-taking behavior scales

Table 1. Descriptive statistics and sex differences

	Male n = 2116		Female n = 3886		
	M	**(SD)**	**M**	**(SD)**	**p**
Age in yrs	22.2	(2.6)	21.9	(2.5)	<0.001
Weight in kg	77.7	(11.5)	64.9	(10.2)	<0.001
Height in m	1.84	(0.1)	1.71	(0.1)	<0.001
BMI	22.9	(2.9)	22.3	(3.1)	<0.001
RT18					
Risk-taking	4.6	(2.7)	3.4	(2.4)	<0.001
Risk assessment	2.1	(2.0)	1.9	(2.0)	<0.05
DASS21					
Depression	2.9	(3.5)	2.6	(3.4)	0.07
Anxiety	2.3	(2.7)	2.2	(2.7)	0.06
Stress	3.4	(3.5)	4.3	(3.8)	<0.001
	n	(%)	n	(%)	p
Fraternity/sorority member					<0.05
No	1663	(78.6%)	3148	(81.2%)	
Yes	452	(21.4%)	729	(19.3%)	
Medication use					<0.001
No	1872	(88.5%)	2750	(70.8%)	
Yes	244	(11.5%)	1136	(29.2%)	
Illicit drug use					<0.001
No	1418	(67.0%)	3110	(80.0%)	
Yes	698	(33.0%)	776	(20.0%)	
Tobacco use					<0.001
No	1443	(68.2%)	2940	(75.7%)	
Sometimes	387	(18.3%)	533	(13.7%)	
Yes	286	(13.5%)	413	(10.6%)	
Alcohol use					<0.001
Abstinent	180	(8.5%)	481	(12.4%)	
Drinker, no binge	340	(16.1%)	1092	(28.1%)	
Binge drinker	1596	(75.4%)	2313	(59.5%)	

Therefore, it seems that risk-taking predicted binge drinking and risky alcohol consumption. In model 3, the effect of binge drinker versus abstinent and binge drinker versus non-binge drinker were equal, and both ORs were 1.17 after all adjustments were made.

The risk assessment showed a significant effect in males for binge drinking versus non-binge drinking. Neither the risk-taking nor the risk assessment scales showed any effect on the non-binge drinking versus abstinent contrast.

When looking at the female model (Table 3), a slightly different outcome became apparent. Risk-taking yielded significant effects on all three contrasts, with ORs of 1.11 for non-binge drinkers compared to abstinents, 1.12 for binge versus non-binge drinking, and 1.24 for binge drinking versus not drinking at all in the final corrected models. Risk assessment, however, had a significant effect on binge drinking versus abstinence, as well as on binge drinking versus non-binge drinking. The ORs for these relationships were 1.09 and 1.16, respectively.

Interestingly, a correction for age in model 1 versus the crude model did not seem to affect the relation between risk-taking or risk assessment and alcohol use. Controlling for lifestyle variables, BMI, smoking, illicit drug use, medication use and membership in a fraternity or sorority, however, exerted the largest effect on this relationship (i.e., model 2 versus 1). The final correction with depression, anxiety and stress added to the list of confounders resulted in a slight change of regression coefficients (model 3 versus 2), particularly for risk assessment.

In addition to controlling for several confounders, we explored possible moderating effects in an additional model that included age*risk-taking, illicit drug use*risk-taking, tobacco use*risk-taking, fraternity or sorority membership*risk-taking, age*risk assessment, illicit drug use*risk assessment, tobacco use*risk assessment, fraternity or sorority membership*risk assessment, and risk-taking*risk assessment. No significant modifying effects were found for men. We did find significant modifying effects for women, except for the risk assessment subscale. Risk-taking, however, was moderated in all three contrasts by the use of illicit drugs (non-binge drinker vs. abstinent: OR=1.67, 95%CI=1.05;2.67; binge drinker vs. non-binge drinker or abstinent: OR=1.62, 95%CI=1.03;2.56). Specifically, illicit drug use slightly increased the OR (non-binge drinker vs. abstinent: OR=1.82, 95%CI=1.09;3.05; binge drinker vs. non-binge drinker: OR=1.06, 95%CI=0.94;1.20; binge drinker vs. abstinent: OR=1.93, 95%CI=1.16;3.21). Sorority membership mediated the effect between risk taking and alcohol use for non-binge drinker vs. abstinent (OR=0.81, 95%CI=0.66;0.99). Specifically sorority membership increased the OR for the binge drinkers versus non-binge drinkers (OR=1.25, 95%CI=1.10;1.42). Non-sorority membership mediated the OR for risk-taking on all three alcohol consumption contrasts, but in different directions (non-binge drinker vs. abstinent: OR=1.14, 95%CI=1.07;1.23; binge drinker vs. non-binge drinker: OR=1.10, 95%CI=1.04;1.15; binge drinker vs. abstinent: OR=1.26, 95%CI=1.01;1.18).

Table 2. Hierarchical multinomial logistic regression model for risk-taking behavior and alcohol use, n= 2116 males

	No binge drinker vs. abstinent	Binge drinker vs. not binge drinker	Binge drinker vs. abstinent
	OR (95%CI)	**OR (95%CI)**	**OR (95%CI)**
Model crude			
Risk-taking	1.03 (0.96;1.12)	1.21 (1.15;1.26)	1.25 (1.17;1.34)
Risk assessment	0.97 (0.86;1.12)	1.17 (1.08;1.16)	1.25 (1.02;1.24)
Model 1; adjusted for age			
Risk-taking	1.03 (0.96;1.12)	1.21 (1.15;1.28)	1.26 (1.17;1.34)
Risk assessment	0.97 (0.86;1.09)	1.16 (1.08;1.26)	(1.02;1.24)
Model 2; adjusted for age and lifestyle*			
Risk-taking	1.01 (0.93;1.09)	1.16 (1.10;1.23)	1.17 (1.09;1.26)
Risk assessment	0.97 (0.87;1.10)	1.10 (1.01;1.19)	(0.97;1.18)
Model 3; adjusted for age, lifestyle*, depression, anxiety, and stress			
Risk-taking	1.00 (0.91;1.10)	1.17 (1.09;1.26)	1.17 (1.08;1.27)
Risk assessment	0.96 (0.83;1.11)	1.16 (1.05;1.29)	1.12 (0.99;1.26)

Note: Lifestyle comprises BMI, fraternity or sorority membership, tobacco use, medication use and illicit drug use

Table 3. Hierarchical multinomial logistic regression model for risk-taking behavior and alcohol use, n= 3886 females

	No binge drinker vs. abstinent	Binge drinker vs. not binge drinker	Binge drinker vs. abstinent
	OR (95%CI)	**OR (95%CI)**	**OR (95%CI)**
Model crude			
Risk-taking	1.12 (1.06;1.18)	1.18 (1.14;1.23)	1.32 (1.25;1.39)
Risk assessment	0.96 (0.90;1.03)	1.18 (1.12;1.23)	1.13 (1.07;1.21)
Model 1; adjusted for age			
Risk-taking	1.12 (1.06;1.18)	1.18 (1.14;1.22)	1.32 (1.25;1.39)
Risk assessment	0.96 (0.90;1.03)	1.18 (1.13;1.23)	1.14 (1.07;1.21)
Model 2; adjusted for age and lifestyle*			
Risk-taking	1.09 (1.03;1.16)	1.12 (1.08;1.17)	1.23 (1.16;1.30)
Risk assessment	0.94 (0.88;1.01)	1.12 (1.06;1.17)	1.05 (0.99;1.12)
Model 3; adjusted for age, lifestyle*, depression, anxiety, and stress			
Risk-taking	1.11 (1.04;1.19)	1.12 (1.06;1.17)	1.24 (1.17;1.32)
Risk assessment	0.94 (0.86;1.02)	1.16 (1.10;1.24)	1.09 (1.01;1.18)

Note: Lifestyle comprises BMI, fraternity or sorority membership, tobacco use, medication use and illicit drug use

Discussion

The aim of this study was to assess the relationship between risk-taking behavior, alcohol use and sex. Results showed risk-taking behavior to be significantly related to alcohol use in both sexes, even after controlling for age, lifestyle, depression, anxiety, and stress levels. More specifically, the odds of binge versus non-binge drinking or abstinence increased 4.12 times for males with the highest score on the risk-taking subscale. This difference was 2.77 in women. The odds of non-binge drinking versus abstinence was 2.56 times higher for high-risk takers. However this effect was only found for women.

Interestingly, the risk assessment subscale yields slightly weaker relations with the alcohol outcome of our model. When adjusted for age, lifestyle and the DASS-21 subscales, the odds of binge versus non-binge drinking) was 3.80 times higher for men with a high score on risk assessment (i.e., minimal consideration of the consequences of certain behavior). For women with high risk assessment scores, odds of binge versus non-binge drinking, and binge drinking versus abstinence, were 3.80 and 2.17, respectively.

The independent effects of risk-taking and risk assessment on alcohol use are small, but significant for one point increase on the RT-18 subscales. However, this ranges from zero to nine points across all subscales and the effects of risk-taking behavior on alcohol consumption become much clearer in the latter. Moreover, we found slight differences between sexes. These sex differences may be partially explained by double standards for alcohol use between males and females. Visser et al. (2012) found women modified their alcohol consumption patterns to maintain a desired gender identity because drinking in general tends to be perceived as a masculine activity. The literature on alcohol consumption and risk-taking behavior in men and women reports mixed evidence for involvement of risk-taking behavior in regard to men and women. Sub-traits of risk-taking behavior, such as behavioral under-control, impulsivity and sensation seeking, have been shown to relate to alcohol use and problems for men, but less consistently for women (Nolen-Hoeksema, 2004). In a longitudinal-epidemiological study, problems with behavioral control assessed at age 3 were found to correlate with alcohol-related problems at age 21 in men, but not women (Caspi et al., 1996). Behavioral under-control, assessed with the novelty-seeking subscale of the Tridimensional Personality Questionnaire and impulsiveness scale from the Eysenck Personality Inventory, was positively associated with heavy drinking in young adult men, but not in women (Rutledgeand Sher, 2001). Our finding that high levels of risk-taking and low levels of risk assessment significantly increase the risk of binge drinking over abstinence and non-binge drinking in men are in line with the literature. However, we also found a significant effect of risk-taking behavior on alcohol consumption in women. Although this is not in concordance with the above-mentioned studies, other studies found risk-taking behavior to increase the level of alcohol consumption in women. For example, Parent and Newman (1999) found sensation seeking to play a mediating role in the relation between alcohol use and associated risk-taking behavior in a small group of women aged 21-22 years (Parent and Newman, 1999).

The relationship between risk-taking behavior and alcohol use in women has not been widely studied. The combination of the large dataset, the proportion of females present, and adjustment for risk-taking and risk assessment confounders in our study lend support to the finding that risk-taking behavior plays a significant role in dangerous alcohol consumption patterns in females. This finding and the fact that the effects of risk-taking behavior on alcohol consumption differed in men and women could serve as a point of interest for alcohol prevention techniques. Risk-taking behavior exerts, even when corrected for numerous confounders, a solid independent effect on alcohol use, mainly increasing the odds of binge compared to non-binge drinking and abstinence for men and women, as well as increasing the odds of non-binge drinking versus abstinence for women.

A few limitations should be noted. First, this study depended solely on self-report, which may have limited reliability. However, research indicates that such data become more reliable as the level of anonymity increases (Buchanan and Smith, 1999). We have used data from the USS, an online survey that was completely anonymous. Further, we asked participants if they had truthfully responded to all items and deleted those participants who did not to maximize reliability. Another limitation was the use of cross-sectional data (the USS), preventing the ability to determine causality between risk-taking behavior and alcohol use. Furthermore, these analyses were performed on Dutch students from the university of Utrecht, potentially limiting the generalizability of our results (e.g., effect sizes). However, the relation between risk-taking behavior and alcohol use has been well established in the literature, and it is likely that these effects will be found in campus sites and similar settings across the western world. We have compared our descriptive data with that of the entire population of Utrecht Students. In 2011, 59% of first-year students at Utrecht University were female (Utrecht University, 2013). The characteristics of the current sample reflect those of the general student population at Utrecht University (de Haan et al., 2012). The Dutch Ministry of Education Culture and Science stated that in 2011, 48% of students in higher education in the Netherlands were male and 52% female (Onderwijs in cijfers [Education in numbers].2013). Therefore, our sample deviates from these percentages. Moreover, in 2011, just 40% of 25 to 34-year olds pursued higher education. We have no other data available to compare our data against the broader 18 to 30-year-old population in the Netherlands. However, if we compare our data to national alcohol consumption data from the National Health Monitor 2012 (NHM: van Laar et al., 2012), 86% of 19 to 30-year-olds reported alcohol consumption in the past 12 months nationwide, which resembles closely our percentage of 89%. According to the NHM's definition of heavy drinking (at least once a week consumption of six or more alcoholic beverages for men and four or more alcoholic beverages for women), 18.5% could be classified as heavy drinkers. We cannot directly compare this percentage to sample, as the definition we have used refers to more than 4 (for women) or 5 (for men) alcoholic beverages in the previous month. Another factor that might interfere with our estimation of the independent effect of risk-taking behavior on alcohol consumption is the inability to classify subjects as problematic drinkers or having an alcohol use disorder due to the monthly timeframe used in our study. Finally, we must note that when performing the effect modification analysis,

we did have sufficient power to detect any effect modification for the male abstinent group, for it consisted of n=180 abstinents. However, we needed 15* 23= 345 abstinent males. We did find a small significant modification effect for women. Therefore, this effect should be investigated using a larger abstinent male group.

In conclusion, risk-taking behavior has a small, but significant independent effect on alcohol use in a large sample of young adults. These results indicate different associations between risk-taking behavior and alcohol use for men and women. For men, risk-taking increases the likelihood of belonging to the binge versus non-binge drinking or abstinent group. Risk assessment was only significant for binge versus non-binge drinkers. For women, both risk-taking and risk assessment increased the likelihood belonging to the binge drinking category. Risk-taking also showed an effect on non-binge drinking versus abstinence in women.

References

Aluja, A., Rossier, J., García, L. F., Angleitner, A., Kuhlman, M., Zuckerman, M. (2006). A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to english, french, german, and spanish languages. Pers. Individ. Differ., 41, 619-628.

Ball, S. A. (2005). Personality traits, problems, and disorders: Clinical applications to substance use disorders. J. Res. Pers., 39, 84-102.

Barnes, G. M., Welte, J. W., & Hoffman, J. H. (2002). Relationship of alcohol use to delinquency and illicit drug use in adolescents: Gender, age, and racial/ ethnic differences.J. Drug Issues , 32, 153-178. Boden, J. M., & Fergusson, D. M. (2011). Alcohol and depression. Addict. , 106, 906-914.

Buchanan, T., & Smith, J. L. (1999). Using the internet for psychological research: Personality testing on the world wide web. Brit. J. Psychol., 90, 125-144.

Buckner, J. D., Ecker, A. H., & Proctor, S. L. (2011). Social anxiety and alcohol problems: The roles of perceived descriptive and injunctive peer norms.J. Anxiety Disord. , 25, 631-638.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychol. Bull., 125, 367-383.

Capone, C., Wood, M. D., Borsari, B., & Laird, R. D. (2007). Fraternity and sorority involvement, social influences, and alcohol use among college students: A prospective examination.Psychol. Addict. Behav. , 21, 316-327.

Caspi, A., Moffitt, T. E., Newman, D. L., & Silva, P. A. (1996). Behavioral observations at age 3 years predict adult psychiatric disorders: Longitudinal evidence from a birth cohort. Arch.s Gen. Psychiatry, 53, 1033-1039.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Arch. Gen. Psychiatry, 50, 975.

Dawson, D. A., & Archer, L. (1992). Gender differences in alcohol consumption: Effects of measurement. Brit. J. Addict., 87, 119-123.

de Beurs, E., Van Dyck, R., Marquenie, L. A., Lange, A., & Blonk, R. W. B. (2001). De DASS: Een vragenlijst voor het meten van depressie, angst en stress. Gedragstherapie, 34, 35-54.

de Haan, L., de Haan, H. A., van der Palen, J., Olivier, B., & Verster, J. C. (2012a). Effects of consuming alcohol mixed with energy drinks versus consuming alcohol only on overall alcohol consumption and negative alcohol-related consequences. Int.l J. of Gen. Med., 5, 953.

de Haan, L., de Haan, H., Olivier, B., & Verster, J. (2012b). Alcohol mixed with energy drinks: Methodology and design of the utrecht student survey. Int. J.Gen. Med., 5, 889-898.

de Haan, L., Kuipers, E., Kuerten, Y., van Laar, M., Olivier, B., & Verster, J. C. (2011). The RT-18: A new screening tool to assess young adult risk-taking behavior. Int. J. of Gen. Med., 4, 575-584. doi:10.2147/IJGM.S23603

Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010). Review: Understanding the construct of impulsivity and its relationship to alcohol use disorders. Addict. Biol., 15, 217-226.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. Pers. Individ. Dif., 6, 613-619.

Feil, J., & Hasking, P. (2008). The relationship between personality, coping strategies and alcohol use. Addict. Res. Theory, 16, 526-537.

Hittner, J. B., & Swickert, R. (2006). Sensation seeking and alcohol use: A meta-analytic review. Addict. Behav., 31, 1383-1401.

Ibáñez, M. I., Moya, J., Villa, H., Mezquita, L., Ruiperez, M., & Ortet, G. (2010). Basic personality dimensions and alcohol consumption in young adults. Pers..Individ. Dif., 48, 171-176.

Jaarverslag Universiteit Utrecht 2013 [Yearly Report Utrecht University 2013]. Retrieved from http://www.jaarverslaguu.nl/ at the 5th of June 2015.

Kleiner, K. D., Gold, M. S., Frostpineda, K., Lenzbrunsman, B., Perri, M. G., & Jacobs, W. S. (2004). Body mass index and alcohol use. J. Addict. Dis., 23, 105-118.

King, A. C., Bernardy, N. C., & Hauner, K. (2003). Stressful events, personality, and mood disturbance:: Gender differences in alcoholics and problem drinkers. Addict. Behav., 28, 171-187.

Van Laar, M. W., Cruts, A. A. N., van Ooyen-Houben, M. M. J., Meijer, R. F., Croes, E. A., & Ketelaars, A. P. M. (2012). Nationale drug monitor. Trimbos Instituut.

Lovibond, S.H., & Lovibond, P. F. (1995). Manual for the Depression Anxiety Stress Scales, (2nd ed.) . Sydney, Australia., Psychology Foundation Monograph University of New South Wales, NSW 2052. Available from The Psychology Foundation, Room 1005 Mathews BuildingMcLean, C. P., & Anderson, E. R. (2009). Brave men and timid women? A review of the gender differences in fear and anxiety. Clin. Psychol. Rev., 29, 496-505.

Nolen-Hoeksema, S. (2004). Gender differences in risk factors and consequences for alcohol use and problems. Clin.Psychol.Rev., 24, 981-1010.

Nolen-Hoeksema, S., & Girgus, J. S. (1994). The emergence of gender differences in depression during adolescence. Psychol. Bull., 115, 424.

Onderwijs in cijfers [Education in numbers]. (2015). Retrieved from http://www.onderwijsincijfers.nl/ at the 5th of June 2015.

Parent, E. C., & Newman, D. L. (1999). The role of sensation-seeking in alcohol use and risk-taking behavior among college women. J. Alcohol Drug Educ., 44, 12-28.

RCoreTeam. (2014). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.

Reed, M. B., Wang, R., Shillington, A. M., Clapp, J. D., & Lange, J. E. (2007). The relationship between alcohol use and cigarette smoking in a sample of undergraduate college students. Addict. Behav., 32, 449-464.

Rounsaville, B. J., Kranzler, H. R., Ball, S., Tennen, H., Poling, J., & Triffleman, E. (1998). Personality disorders in substance abusers: Relation to substance use. J Nerv. Ment. Dis., 186, 87-95.

Rutledge, P. C., & Sher, K. J. (2001). Heavy drinking from the freshman year into early young adulthood: The roles of stress, tension-reduction drinking motives, gender and personality. J. Stud. Alcohol Drugs, 62, 457.

Smarandescu, L., Walker, D., & Wansink, B. (2014). Mindless drinking: How gender and BMI relate to the consumption of alcohol. Int. J. Drug Policy, 25, 1131-1134.

Sobell, L. C., Agrawal, S., Sobell, M. B., Leo, G. I., Young, L. J., Cunningham, J. A., & Simco, E. R. (2003). Comparison of a quick drinking screen with the timeline followback for individuals with alcohol problems. J. Stud. AlcoholDrugs, 64, 858.

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. Dev.Psychol., 44, 1764.

de Visser, R.O & McDonnell, E.J. (2012). "That's OK. He's a guy": A mixed-methods study of gender double-standards for alcohol use. Psychol. Health, 27, 618-639.

Wechsler, H., Dowdall, G. W., Davenport, A., & Castillo, S. (1995a). Correlates of college student binge drinking. Ame. J. Public Health, 85, 921-926.

Wechsler, H., Dowdall, G. W., Davenport, A., & Rimm, E. B. (1995b). A gender-specific measure of binge drinking among college students. Am. J. Public Health, 85, 982-985.

World Health Organization. (2014). Global status report on alcohol and health-2014. World Health Organization.

Yanovitzky, I. (2006). Sensation seeking and alcohol use by college students: Examining multiple pathways of effects. J. Health Commun., 11, 269-280.

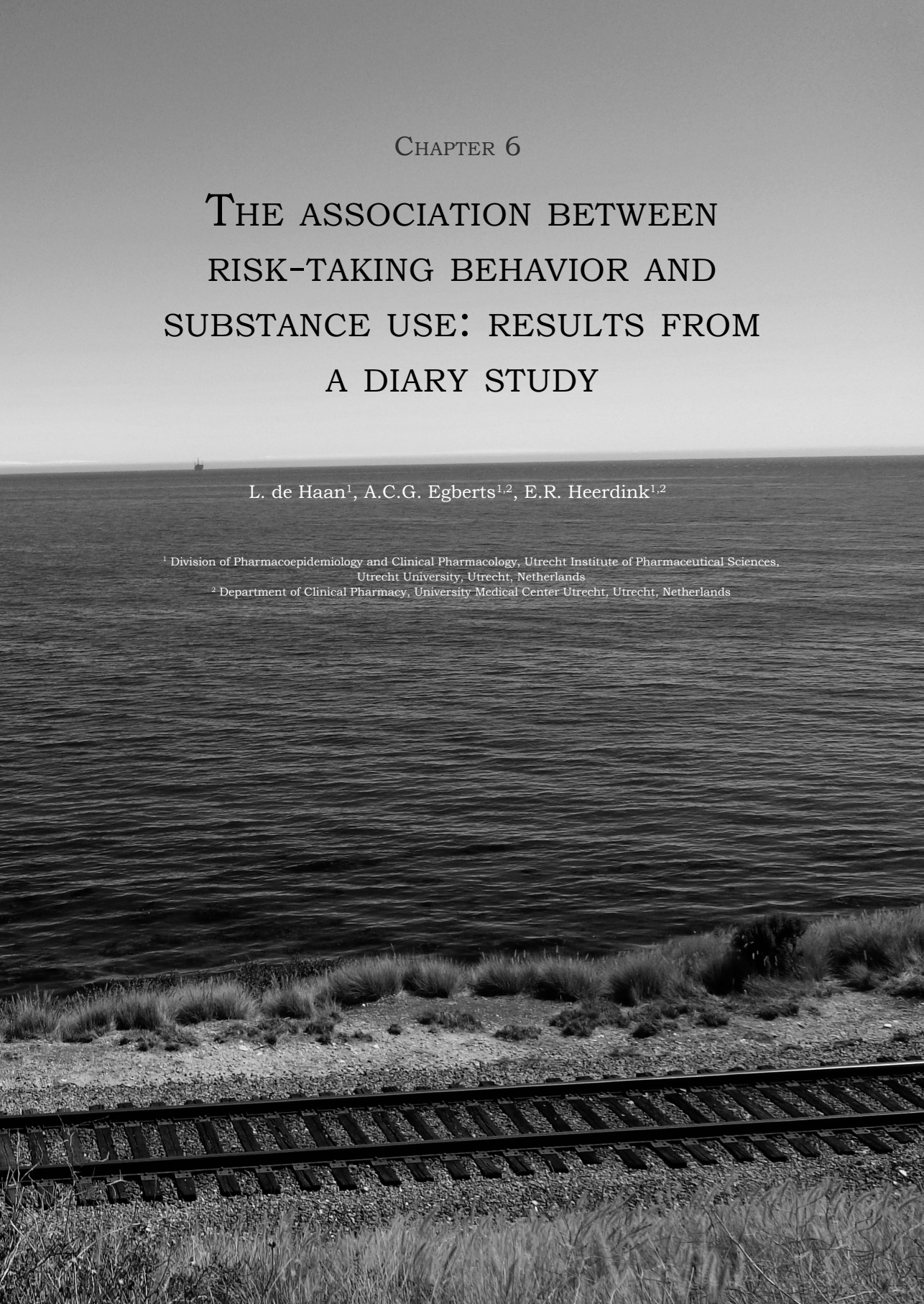
Zuckerman, M. (2002). Zuckerman-kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model, in de Raad, B., Peruginig, M. (Eds), Big Five Assessment,Hogrefe and Huber, Seatlle, WA,pp. 377-396.

Chapter 6

The association between risk-taking behavior and substance use: results from a diary study

L. de Haan[1], A.C.G. Egberts[1,2], E.R. Heerdink[1,2]

[1] Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, Netherlands
[2] Department of Clinical Pharmacy, University Medical Center Utrecht, Utrecht, Netherlands



Abstract

Objective. The present study examined the association of risk-taking behavior and substance use applying a longitudinal design in the format of a 31-day diary study.

Methods. Participants were 109 university students who made daily online diary entrees reporting their consumption of alcohol, tobacco, and illicit drugs. At the beginning and end of the diary study additional information was gathered regarding demographics, risk-taking behavior (RT-18), depression, anxiety and stress (DASS-21), and several other psychological instruments.

Results. In the multiple analysis for alcohol use, risk-taking was significantly associated with the outcome. However, when adjusted for risk assessment, gender, BMI, member, anxiety, and drug use, this effect was no longer significant. Risk assessment was not significantly associated with total alcoholic consumptions. Both risk-taking and risk assessment were significantly associated with illicit drug use. The increased odds of illicit drug use remained for risk-taking after adjusting for risk assessment, alcohol use, and tobacco use but the statistical significance of the effect for risk assessment was lost. Risk assessment was associated with tobacco use, but after adjustments for gender, stress, alcohol use, and drug use were made, neither risk-taking nor risk assessment were associated with tobacco use. When subgroups for risk behavior were created based on alcohol, tobacco and illicit drug use combined, the median risk-taking scores increased significantly as risk behavior increased, and the same happened for risk assessment scores.

Conclusion. The RT18 subscales associated with single health risk behaviors like alcohol use, illicit drug use, and tobacco use, albeit this association only remained significant for drug use after adjustments were made. Moreover, high scores on the RT18 significantly increased the odds of high-risk behavior, (i.e. combined more than 4 binge drinking days with tobacco and illicit drug use).

Introduction

Taking risks can be defined as the intentional or unintentional exposure to the possibility of injury or loss. Risk-taking behavior can be functional, necessary, and appropriate in some situations, but can also be inappropriate and dangerous in other situations. Inappropriate risk-taking behavior, including reckless driving, practicing unsafe sex, substance abuse, interpersonal aggression and criminal behavior, has a concerning impact on society.

Risk-taking behavior and related personality traits that can be seen as a sub-trait of risk-taking behavior (e.g. impulsivity and sensation seeking), have shown to be related with both the onset and the intensity of use of alcohol, tobacco, and illicit drugs (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Ball, 2005; Chambers, Taylor, & Potenza, 2014; de Haan et al., 2011; Dick et al., 2010; Hakkarainen & Metso, 2009; Hittner & Swickert, 2006; Ibáñez et al., 2010; Le Marchand, Evans, Page, Davidson, & Hahn, 2013; Steinberg, 2008; Zuckerman & Kuhlman, 2000). During lifetime, the level of risk-taking behavior is usually highest in adolescence and young adulthood. Young individuals that engage in one form of risk-taking behavior are more likely to also engage in additional forms (Childs & Sullivan, 2013). For example, a person that engages in binge drinking is more likely to engage in other risky behavior like illicit drug use or tobacco use. Such polysubstance use patterns are prevalent in many populations and alcohol contributes importantly to these patterns, whether it concerns addictive behaviors or more recreational use (Barrett, Darredeau, & Pihl, 2006; Hakkarainen & Metso, 2009; Staines, Magura, Foote, Deluca, & Kosanke, 2001). But also across different types of risk behaviors, poly risk behavior seems to be the case. In a cross-sectional study among 460 girl elite athlete students practicing a sliding sport (e.g. snowboard, skiing, parachuting,) were twice as likely to use cannabis, whereas boys practicing a sliding sport were four times as likely to use alcohol (Peretti-Watel et al., 2003). Students that were identified as problem gamblers in a study of 1,350 undergraduates, were significantly more likely to be heavy drinkers, to report negative consequences of alcohol consumption, and to be regular tobacco and marijuana users. Moreover problem gambling was related to binge eating and greater use of weight-control efforts (Engwall, Hunter, & Steinberg, 2004). A study by O'Hara et al. (2015) found positive bidirectional associations between the use of alcohol and sexual risk-taking behavior in 1867 adolescents.

The Risk Taking questionnaire 18 items (RT-18; de Haan et al., 2011) was developed to validly assess risk-taking behavior in minimal time. The RT-18 comprises two subscales: risk-taking and risk assessment. The risk taking subscale measures engagement of actual risk-taking behavior. The risk assessment subscale measures whether someone considers the potential consequences of certain behaviors or choices.

All previous research that involved the RT-18 was cross-sectional in nature from which design it is not possible to determine predictive validity. The aim of the present study was to assess the association between the RT-18 and recreational substance use using a longitudinal design.

Methods

Setting and Sample

Students were approached on the campus of Utrecht University (The Netherlands) by recruiters and asked to fill out a short survey inquiring gender and age, as well as alcohol, tobacco, illicit drug use and medication use, and their email address if they were interested in potentially participating in this study. Subsequently, eligible subjects were asked by email to participate in the study based on the following inclusion criteria: 18-30 years of age and alcohol consumption on a regular basis (at least one alcoholic consumption a week).

Ethical considerations

The study data were completely anonymized. Contact with the experimenters other than online communication was not required at any point during the study and participants were assigned an ID-number for all correspondence. On the first day of the diary entry, immediately after clicking the link received by email, the study aim, methods and other information was given to the participants. Informed consent was given by clicking on the button "I have read the information and agree to participate" after which the diary entry continued. In case subjects did not give their informed consent, participants were thanked for their time and effort after which the designated SurveyMonkey® internetpage shut down. Contact information was given, to make sure participants could reach the experimenter in case there were any questions (either by mail of by telephone). Approval for this study by a Medical Ethics Committee was deemed not necessary according to Dutch law on medical scientific research with humans (WMO), since the study did not directly address a medical question nor were the participants subjected to any kind of regiment or invasive or (mentally) stressful procedure. Incentive for participation was monetary (i.e. 30 euros upon completion of the study and additionally one iPad through raffle).

Survey outline and data collection

All participants started the 31-day diary on the 29th of December 2012. By choosing this specific date, that includes New Year's Eve, an occasion where consumption of substances is likely, we tried to ensure that enough "events" or consumption of substances took place to be able to perform our analyses. Using SurveyMonkey® (SurveyMonkey TM), respondents were asked to online make daily entries between 2 and 6 PM regarding their consumption of alcohol, drugs and tobacco of the previous day. In addition, level of sleepiness (The Karolinska Sleepiness Scale; (Åkerstedt & Gillberg, 1990) and items adapted from the risk-taking (risk-taking index, (Nicholson, Soane, Fenton-O'Creevy, & Willman, 2005) were assessed daily. On the first day, participants were asked to provide additional demographic variables. On the first and last day of the survey additional data collection of the RT-18 and other questionnaires as depicted in Figure 1 took place.

Demographic items

Participants were asked to provide their gender, age, weight, height, and fraternity or sorority membership (hereafter referred to as 'membership'). BodyMassIndex (BMI) was calculated after the data collection.

Alcohol, drug and tobacco consumption

Several questions regarding the age of onset of drinking alcohol were asked as well as the type of jobs students had next to their education. The alcohol consumption items examined the quantity of alcohol use of the previous day. Moreover, items were presented inquiring type of alcohol consumed, drinking location, drinking time and duration, and whether they drank alone or with others. Drug consumption items examined the types of drugs used, as well as quantity. Drug categories were adapted from those used in the Measurements in the Addictions for Triage and Evaluation (MATE: Schippers, Broekman, Buchholz, Koeter, & Van Den Brink, 2010), and were categorized in the following manner; cannabis, opiates, methadone, heroin, cocaine, stimulants, ecstasy, sedatives, gamma hydroxybutyric acid (GHB), or other. Furthermore, participants reported if they used the drug alone or with others. The nicotine consumption items inquired quantity, frequency, and type of tobacco used the previous day.

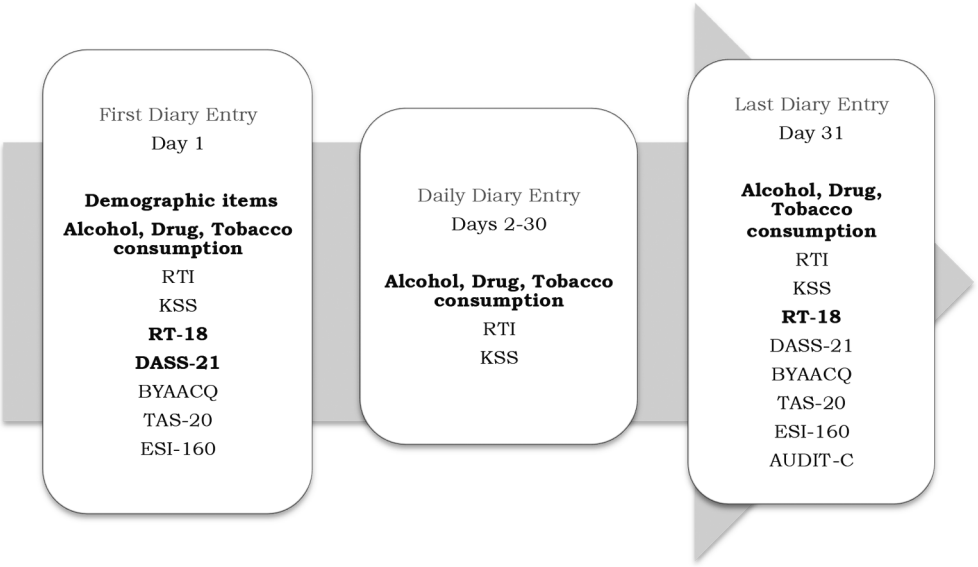
RT-18

The Risk Taking questionairre-18 items (de Haan et al., 2011) was developed from items of subscales on Impulsiveness and Venturesomeness from the IVE questionnaire (Eysenck, Pearson, Easting, & Allsopp, 1985). Novelty Seeking from the Temperament and Character Inventory (Cloninger, Svrakic, & Przybeck, 1993) and Impulsive Sensation Seeking from the Zuckerman Kuhlman Personality Questionnaire (Aluja et al., 2006; Zuckerman, 2002). Items can be answered 'yes' or 'no'. The RT-18 comprises two subscales 'risk-taking' and 'risk assessment'. Individuals scoring high on risk-taking can be characterized by a high level of actual risk-taking behavior (i.e. engagement in risky behaviors), whereas a high score on risk assessment indicates a low level or less consideration of possible consequences (i.e. acting without thinking). Scores are 0 or 1 point per question, adding up to a sum score ranging from 0 to 9 for each subscale. The RT18 has been thoroughly investigated. Recent research with the RT18 (de Haan et al., 2011) showed the RT18 to differentiate level of risk-taking behavior reported by social drinkers (N = 2646, mean score 7.80, 95% CI: 7.66-7.94) and recreational drug users (N = 4968, mean score 10.26, 95% CI: 10.15-10.36).

DASS-21

The DepressionAnxietyStressScales 21 items is a quantitative self-report measure that comprises three subscales of distress; depression, anxiety and stress (www.psy.unsw.edu.au/dass; (de Beurs, Van Dyck, Marquenie, Lange, & Blonk, 2001; Lovibond & Lovibond, 1995). It is not a categorical measure of clinical diagnosis. Subjects can respond to statements in the form of a zero to three point Likert- scale to indicate in what level the stated did apply to them in the past week.

Figure 1. Schematic oversight of the 31-day online diary study



Note: this figure shows the schematic outline of the complete online diary study with in bold the items used for this study. RTI: Risk Taking Index, KSS: Karolinska Sleepiness Scale, RT-18: Risk Taking questionnaire 18 items, BYAACQ: Brief Young Adult Alcohol Consequences Questionnaire, DASS-21: Depression Anxiety Stress Scale, TAS-20: Toronto Alexithymia Scale, ESI-160: Externalizing Spectrum Inventory

Other measures

Participants were also assessed on several other instruments, to answer secondary research questions. These instruments will be briefly discussed, but results outside the scope of this article will be discussed elsewhere. To study alcohol related negative consequences, the Dutch version of the Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) was included. The BYAACQ consists of 24 possible consequences of alcohol consumption that can be answered by 'yes' or 'no', depending on applicability to the subject in the previous year (Kahler, Strong, & Read, 2005; Verster, Herwijnen, Olivier, & Kahler, 2009). The AUDIT-C was designed to assess alcohol dependence risk in situations requiring a short alcohol questionnaire. The AUDIT-C consist of three questions regarding alcohol consumption (Dawson, Grant, Stinson, &

Zhou, 2005). The Toronto Alexithymia Scale (TAS-20) is a 20-item instrument that is one of the most commonly used measures of alexithymia (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994). Alexithymia refers to people who have trouble identifying and describing emotions and who tend to minimize emotional experience and focus attention externally. The US version of the Externalizing Spectrum Inventory (Krueger, Markon, Patrick, Benning, & Kramer, 2007) was translated and culturally adapted into a Dutch version, the ESI-190. The questionnaire contains 23 subscales that are organized around 3 higher order dimensions, reflecting general disinhibition, callous aggression, and substance abuse.The Karolinska Sleepiness Scale (Åkerstedt & Gillberg, 1990) is a 9 point verbally anchored scale to assess the level of sleepiness a participant experiences at the moment of the assessment. The Risk Taking Index (RTI) (Nicholson et al., 2005) measures overall risk propensity in six different domains (recreational, health, career, financial, safety, social) by asking respondent to rate both their current and past level of every day risk-taking within each of these domains on a 5-point Likert scale. We have adapted the items from the RTI by replacing the Likert-scale with a yes/no answer format, and asked participants at every daily entry to report if they had taken a risk within each of these domains.

Data cleaning and analyses

Results from SurveyMonkey® were imported into Excel, to be prepared for analysis in R version 3.0.2 (RCoreTeam, 2014); packages Hmisc and Psych. After cleaning of the data, n = 109 participants remained suitable for analyses (n =114 started on day one, 1 participant was excluded for not giving informed consent, 4 participants did not finish the study, i.e. they had at least 18 consecutive days of missing entries). From the n = 109, one subject missed two entries, and another five missed one entry. These missing values were handled as zeros (i.e. no consumption on that specific entry) during analysis.

Descriptive statistics were performed for all variables. Correlations (univariate analyses) were estimated, using Pearson's or Spearman's correlation coefficients as appropriate. Multiple linear regression models were built for three substance use outcomes (i.e. alcohol use, drug use, and tobacco use). In the first step of each model RT-18 risk-taking and risk assessment were inserted, and in the second step confounding variables were added (based on >10% change in either RT-18 risk-taking or risk assessment). The possible confounding variables, mostly based on previous research, were age, gender, BMI, fraternity or sorority membership (hereafter referred to as 'member'), the three DASS-21 subscales depression, anxiety, and stress, and finally alcohol, drug, or tobacco use, depending on the particular model. Depending on the normality of the residuals, the models were built with linear or, if this was not feasible, with logistic regression models.

In addition, participants were categorized as either participating in 1) low risk behavior, 2) medium risk behavior, and 3) high-risk behavior. Categories were based on median splits of the following variables; days of binge drinking, days of tobacco use and days of drug use. The low risk behavior group

consisted of participants with values below the medians of each of these three variables, whereas the high-risk behavior group was created with participants who had values above the median for binge days, tobacco days and drug days. The intermediate group comprised all other participants that had 1 or 2 values above the median for either binge, tobacco or drug days. A multinomial logistic regression was performed to investigate the role of the RT18 subscales risk-taking and risk assessment on these risk behavior categories. Boxplots were used to depict the risk-taking and risk assessment scores across the three categories of risk behavior.

All tests were two-tailed and p-values <0.05 or 95% confidence intervals (95%CI) that did not contain zero were considered statistically significant.

Results

Table 1 displays the descriptive statistics of the 109 participants. Mean age was 21 years; mean BMI was in the healthy range at a score of 22. Seventy percent of the sample was female. About a quarter of the subjects reported fraternity or sorority membership. Mean DASS21 scores for depression, anxiety, and for stress fell within the normal category of severity ratings based on Dutch normative scores (de Beurs et al., 2001). The average RT-18 risk-taking score fell in the middle of the scale, whereas the mean risk assessment score was located at the lower end of the scale (i.e. lower scores indicate more consideration of possible consequences or less acting without thinking).

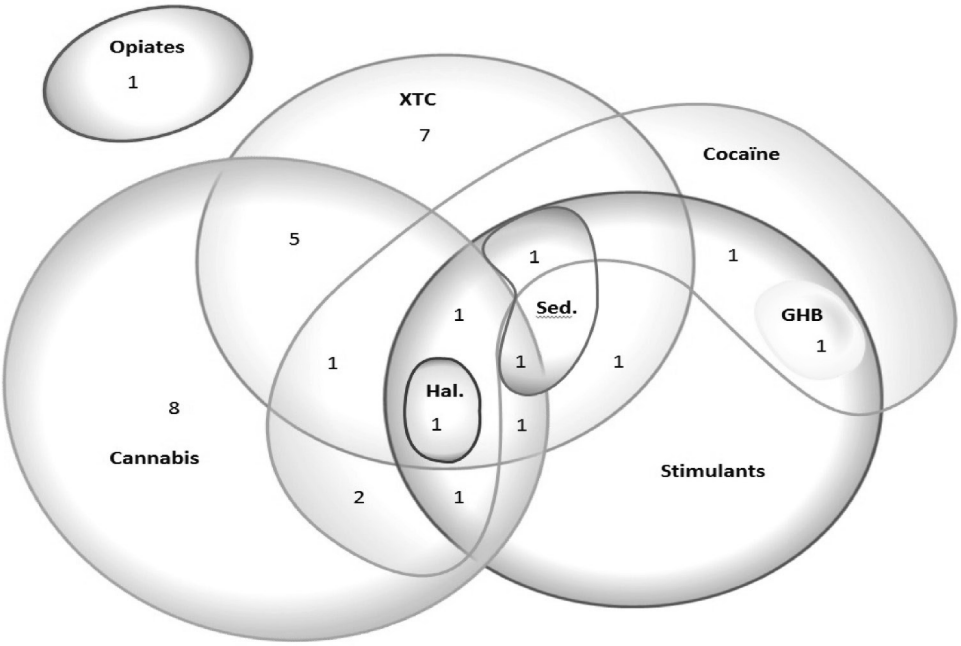
Alcohol consumption, expressed in the total number of alcoholic beverages consumed over the 31-day period, ranged from zero to a maximum of 264 consumptions, with a mean of 64.7 (i.e. approximately 2 per day). When expressed in number of days of alcohol consumption, the average was 12.1 days of alcohol use. None of the subjects reported zero days of alcohol use, and the maximum reported number of days was 28.

Table 1. Characteristics of the study population (n = 109)

	N	%
Gender		
Female	70	64.2
Male	39	35.8
Member		
No	79	72.5
Yes	30	27.5
	Median	Range
Age	21	18-29
BMI	22	17.2-30.0
DASS21		
Depression	1	0-13
Anxiety	1	0-12
Stress	3	0-14
RT-18		
Risk-taking	5	0-9
Risk assessment	2	0-8

Spearman correlations show that risk-taking is correlated to alcohol use and drug use, and risk assessment with drug use and tobacco use (See table 3). The highest correlations are found for drug and tobacco use (r=.58) and between gender and alcohol use (r = .59)

Figure 2. Type of drugs consumed and pattern of co-consumption (n = 33)



Binge drinking days were calculated, with more than four consecutive alcoholic consumptions for women, and more than five for men. The median number of days on which binge drinking took place was 4, with a reported maximum of 19 days.

About 50% of the subjects did not report any tobacco consumption. Median tobacco use for those who did smoke, expressed in the total number of cigarettes consumed in 31- days, was 14.5. Expressed in days of use, the median was 4.5 days of tobacco use. The maximum amount of days reported for tobacco use was 31.

A total of n = 33 or 31.3% reported any drug use. Recreational drug consumption was quantified in days, and yielded a median of 2 days of drug use for those who indicated to have used, and a maximum of 21 days. Type of drugs consumed and pattern of co-consumption are depicted in figure 2. In total 20 subjects reported marihuana use, 19 reported use of XTC, nine reported use of stimulant drugs, another nine reported to have used cocaine, sedative drugs were used by two subjects, GHB was reported by one subject, as well were opiate use, and hallucinogen use. None of the participants indicated methadone or heroine consumption. Single drug use was reported by 16, while polydrug use over the period of 31-days was reported by 17 (51.5%) participants.

Table 4 shows the linear and logistic regression models built for alcohol use, drug use, and tobacco use. Risk-taking was significantly associated with alcohol use (expressed in total consumptions over 31 days) only in the first step of the model. Both risk-taking and risk assessment were significantly associated with drug use (dichotomized to use or no use over 31 days), but when adjusted for alcohol use and drug use in step 2 of this model, only risk-taking remained significantly associated with the outcome. The third and last logistic regression model was built for tobacco use (dichotomized to use or no use over 31 days). Risk assessment was significantly associated with tobacco use in the first step of the model, but when adjusted for gender, DASS-s, alcohol use, and drug use, the statistical significance of this association was lost.

Finally, three risk behavior groups were created; median splits were at four or more alcohol binge days, one or more tobacco use days, and 1 or more drug use days. The low risk behavior group consisted of n = 36 (33.0%), medium risk behavior consisted of n = 52 (47.7%), and high-risk behavior consisted of n = 21 (19.3%) individuals. Figure 2 shows the dispersion of risk-taking and risk assessment scores across all three risk behavior groups. The median risk-taking score for the low risk behavior group was 3.5, for the medium risk behavior group it was 4.5, and for the high-risk behavior group it was 7 ($p(H) = 0.001$). Risk assessment median scores were 1,2, and 3 respectively ($p(H) < 0.001$). The multinomial logistic regression with risk-taking and risk assessment as predictors, yielded the following OR's for the medium versus low risk behavior contrast: an OR of 1.11 (95%CI = 0.91; 1.36, $p = 0.301$) for risk-taking, and an OR of 1.24 (95%CI = 0.95; 1.61, $p = 0.109$) for risk assessment. In the high versus low contrast the OR for risk-taking was 1.51 (95%CI = 1.13; 2.01, $p = 0.005$), and for risk assessment it was 1.57 (95%CI = 1.15; 2.15, $p = 0.005$). In the third contrast, high versus medium risk behavior, the OR for risk-taking was 1.36 (95%CI = 1.05; 1.76, $p = 0.021$), and the OR for risk assessment was 1.27 (95%CI = 0.99; 1.63, $p = 0.060$).

Table 3; Spearman correlations

	Alcohol use		Drug use		Tobacco use	
Risk-taking	0.27***	(0.16;0.49)	0.37*	(0.02;0.38)	0.23^	(-0.05;0.32)
Risk assessment	0.18^	(-0.03;0.33)	0.39**	(0.13;0.47)	0.42**	(0.06;0.42)
Age	0.41**	(0.07;0.42)	0.23	(-0.10;0.27)	0.16^	(-0.03;0.34)
Gender	0.59***	(0.46;0.71)	0.13*	(0.01;0.37)	0.13	(-0.19;0.19)
BMI	0.13	(-0.12;0.26)	0.12^	(-0.06;0.31)	0.23^	(-0.01;0.35)
Member	0.21*	(0.03;0.39)	0.12	(-0.19;0.19)	0.09	(-0.17;0.21)
Depression	-0.05	(-0.13;0.24)	0.042	(-0.18;0.20)	0.013	(-0.21;0.16)
Anxiety	0.19*	(0.02;0.38)	0.045	(-0.08;0.29)	0.18	(-0.1;0.27)
Stress	0.01	(-0.16;0.22)	0.086	(-0.19;0.19)	0.19	(-0.09;0.28)
Alcohol use	-	-	0.35^	(-0.02;0.35)	0.36	(-0.09;0.28)
Drugs use	0.35^	(-0.02;0.35)	-	-	0.58***	(0.03;0.60)
Tobacco use	0.36	(-0.09;0.28)	0.58***	(0.03;0.60)	-	-

Note: Alcohol use=total number of alcoholic consumptions over 31 days, Drug use = total days of drug use over 31 days, Tobacco use = total number of cigarettes used over 31 days. P-values; ^<0.20, *<0.05, **<0.01, ***<0.001. 95% CIs are shown in brackets

Figure 2; RT-18 Risk taking behavior scores across risk behavior groups

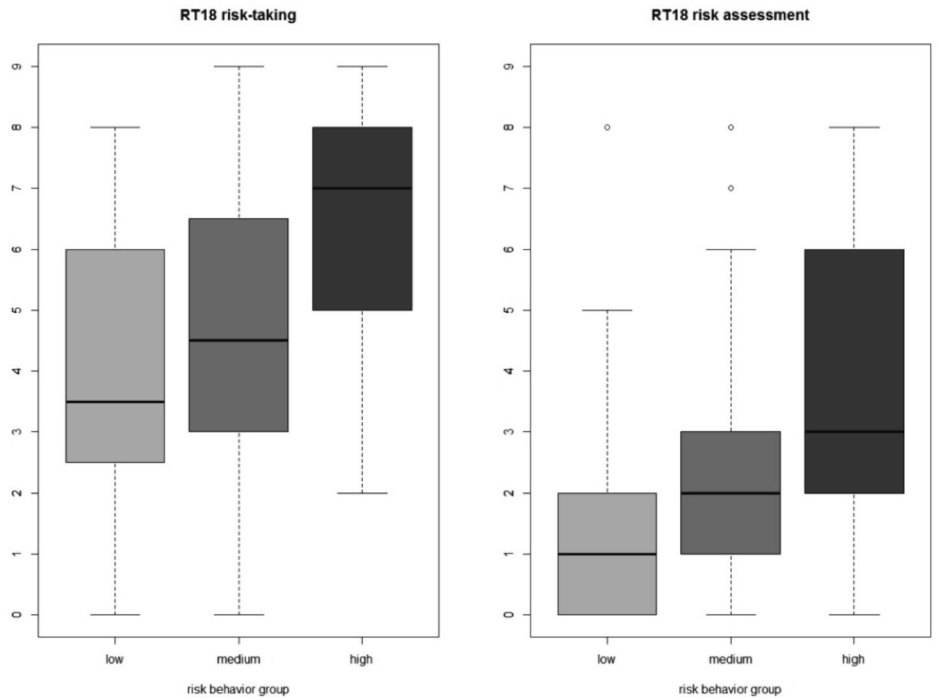


Table 4; Linear regression models for three substance use outcomes

(n=109)	Alcohol use (no. total glasses month)		Drug use (yes/no)		Tobacco use (yes/no)	
	B	(95%CI)	OR	(95%CI)	OR	(95%CI)
Step 1						
Risk-taking	7.65**	(3.05; 12.24)	1.40**	(1.13; 1.74)	1.09	0.92 1.31
Risk assessment	1.64	(-3.59; 6.87)	1.38**	(1.11; 1.73)	1.44**	1.14 1.81
Step 2						
Risk-taking	3.09	(-0.89; 7.07)	1.35*	(1.05; 1.75)	0.89	(0.71;1.11)
Risk assessment	-0.10	(-4.61; 4.41)	1.23	(0.93; 1.62)	1.26	(0.98;1.62)
Age	-	-	-	-	-	-
Gender-Male	62.52***	(43.50; 81.54)	-	-	1.27	(0.33;4.81)
BMI	-0.89	(-4.28; 2.50)	-	-	-	-
Member	15.22	(-3.59; 34.02)	-	-	-	-
DASS-D	-	-	-	-	-	-
DASS-A	1.13	(-2.95; 5.20)	-	-	-	-
DASS-S	-0.02	(-3.06; 3.02)	-	-	1.14	(0.98;1.33)
Alcohol use	-	-	1.01	(1.00; 1.02)	1.01	(1.00;1.02)
Drugs use	21.56	(-0.88; 44.00)	-	-	10.72***	(2.90;39.66)
Tobacco use	16.18	(-4.04; 36.40)	9.54***	(2.70; 33.74)	-	-

Note: Alcohol use = total number of glasses over 31 days, Drug use = use or no use over 31 days, Tobacco use = use or no use over 31 days. P-values; *<0.05, **<0.01, ***<0.001

Discussion

Purpose of this study was to assess the association between the RT-18 and alcohol, tobacco, and illicit drug use. Univariate analyses showed the RT-18 risk-taking scale to correlate with alcohol use and illicit drug use. The RT-18 risk assessment scale correlated with illicit drug use and tobacco use. In the multiple analysis for alcohol use, risk-taking was significantly associated with the outcome, in such a way that, a maximal score on the risk-taking scale, thus more risk behavior, is associated with 68.9 more total alcoholic consumptions over 31 days compared to a minimal score on this RT-18 scale. However, when adjusted for risk assessment, gender, BMI, member, anxiety, and drug use, this effect was no longer significant. Risk assessment was not significantly associated with total alcoholic consumptions.

Both risk-taking and risk assessment were significantly associated with illicit drug use (OR:1.40 and 1.38 respectively). The odds of illicit drug use once or more in 31 days were 1.35 for risk-taking, when adjusted for risk assessment, alcohol use, and tobacco use. Risk assessment increased the odds with 1.31, adjusted for risk-taking, alcohol use, and tobacco use, however, the statistical significance of this effect was lost.

Risk assessment was associated with tobacco use, but after adjustments for gender, DASS-s, alcohol use, and drug use were made, neither risk-taking nor risk assessment were associated with tobacco use.

Tobacco use was strongly associated with illicit drug use (OR: 10.72). This relationship between tobacco and illicit drug use was already apparent in the univariate analyses, where it yielded an strong correlation of rho=0.6, $p<0.001$. Alcohol use was not significantly correlated to tobacco use or drug use, which is in contrast with ideas from Hakkarainen & Metso (2009) who postulated alcohol to play an important role in polysubstance use patterns.

When subgroups for risk behavior were created based on alcohol, tobacco and illicit drug use combined, the median risk-taking scores increased significantly as risk behavior increased, and the same happened for risk assessment scores. A multinomial logistic regression showed every single point increase in risk-taking score to be accompanied with an significant increase of the odds high-risk behavior group (1 or more days tobacco use and illicit drugs use, and more than four binge drinking days) instead of low risk behavior (less than 4 binge drinking days and zero tobacco or illicit drug use days) of 1.51. The odds of high-risk behavior compared to medium risk behavior, was increased significantly by 1.36. Risk assessment only increased the odds significantly of high-risk behavior compared to low risk behavior with 1.57.

Taken together, these findings seem to partly verify the association of the RT-18 with high-risk behavior in terms of substance use. However, both risk-taking and risk assessment failed in this study to differentiate the low risk behavior group from the high-risk behavior group. Moreover, although both risk-taking and risk assessment correlated to all three substance use outcomes in univariate analyses, only risk-taking was significantly associated with drug use (after adjustments were made) in the multiple regression models.

Some limitations have to be noted here. First, due to our sampling method (i.e. not including students who reported less than one alcoholic consumption a week), our low risk behavior group consisted of individuals who reported no use of tobacco or illicit drugs, but did have less than four binge drinking days, which decreases the contrast between the low and medium risk behavior groups. Future studies should incorporate risk behavior other than substance use, for instance unsafe sex, practicing extreme sports, or illegal activity to create subgroups of increasing risk that are more reflective of the entire constellation of real world risk behaviors. Second, since this sample consisted of Dutch students from the Utrecht University Campus, the generalizability of the these results is limited. And third, it is possible that the study timeframe, that included new-year's eve, could have affected our findings.

In spite of the limitations, strengths of this study lies in the advances of a daily diary entry over retrospective self-reports over a longer period. The fact that this diary study was online, and participants were able to fill out their entries anywhere they wanted and at a for them convenient time decreased the study-related load of participation. Online studies increase the feeling of anonymity and could therefore lessen the level of underreporting (Barry, 2001).

In conclusion, this study showed the RT18 subscales to associate with single health risk behaviors like alcohol use, illicit drug use, and tobacco use, albeit this association only remained significant for drug use after adjustments were made. Moreover, high scores on the RT18 significantly increased the odds of high-risk behavior, (i.e. combined more than 4 binge drinking days with tobacco and illicit drug use). This implies the RT-18 to have promising screening properties for high-risk behavior individuals. Future research should implement other (health) risk behaviors, to assess the predictive validity of the RT-18 across a larger scheme of real world risk behaviors.

References

Åkerstedt, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. International Journal of Neuroscience, 52(1-2), 29-37.

Aklin, W. M., Lejuez, C., Zvolensky, M. J., Kahler, C. W., & Gwadz, M. (2005). Evaluation of behavioral measures of risk taking propensity with inner city adolescents. Behaviour Research and Therapy, 43(2), 215-228.

Aluja, A., Rossier, J., García, L. F., Angleitner, A., Kuhlman, M., & Zuckerman, M. (2006). A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to english, french, german, and spanish languages. Personality and Individual Differences, 41(4), 619-628.

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The 20-item toronto-alexithymia-scale .1. item selection and cross-validation of the factor structure. Journal of Psychosomatic Research, 38(1), 23-32.

Bagby, R. M., Taylor, G. J., & Parker, J. D. A. (1994). The 20-item toronto-alexithymia-scale .2. convergent, discriminant, and concurrent validity. Journal of Psychosomatic Research, 38(1), 33-40.

Barrett, S. P., Darredeau, C., & Pihl, R. O. (2006). Patterns of simultaneous polysubstance use in drug using university students. Human Psychopharmacology: Clinical and Experimental, 21(4), 255-263.

Ball, S. A. (2005). Personality traits, problems, and disorders: Clinical applications to substance use disorders. Journal of Research in Personality, 39(1), 84-102.

Barry, D. T. (2001). Assessing culture via the internet: Methods and techniques for psychological research. CyberPsychology & Behavior, 4(1), 17-21.

Chambers, R. A., Taylor, J. R., & Potenza, M. N. (2014). Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Archives of General Psychiatry, 50(12), 975.

Dawson, D. A., Grant, B. F., Stinson, F. S., & Zhou, Y. (2005). Effectiveness of the derived alcohol use disorders identification test (AUDIT-C) in screening for alcohol use disorders and risk drinking in the US general population. Alcoholism: Clinical and Experimental Research, 29(5), 844-854.

de Beurs, E., Van Dyck, R., Marquenie, L. A., Lange, A., & Blonk, R. W. B. (2001). De DASS: Een vragenlijst voor het meten van depressie, angst en stress. Gedragstherapie, 34(1), 35-54.

de Haan, L., Kuipers, E., Kuerten, Y., van Laar, M., Olivier, B., & Verster, J. C. (2011). The RT-18: A new screening tool to assess young adult risk-taking behavior. International Journal of General Medicine, 4, 575-584. doi:10.2147/IJGM.S23603

Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010). Review: Understanding the construct of impulsivity and its relationship to alcohol use disorders. Addiction Biology, 15(2), 217-226.

Engwall, D., Hunter, R., & Steinberg, M. (2004). Gambling and other risk behaviors on university campuses. Journal of American College Health, 52(6), 245-256.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. Personality and Individual Differences, 6(5), 613-619.

Hakkarainen, P., & Metso, L. (2009). Joint use of drugs and alcohol. European Addiction Research, 15(2), 113-120. doi:10.1159/000209244 [doi]

Hittner, J. B., & Swickert, R. (2006). Sensation seeking and alcohol use: A meta-analytic review. Addictive Behaviors, 31(8), 1383-1401.

Ibáñez, M. I., Moya, J., Villa, H., Mezquita, L., Ruiperez, M., & Ortet, G. (2010). Basic personality dimensions and alcohol consumption in young adults. Personality and Individual Differences, 48(2), 171-176.

Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The brief young adult alcohol consequences questionnaire. Alcoholism: Clinical and Experimental Research, 29(7), 1180-1189.

Krueger, R. F., Markon, K. E., Patrick, C. J., Benning, S. D., & Kramer, M. D. (2007). Linking antisocial behavior, substance use, and personality: An integrative quantitative model of the adult externalizing spectrum. Journal of Abnormal Psychology, 116(4), 645.

Le Marchand, C., Evans, J., Page, K., Davidson, P. J., & Hahn, J. A. (2013). Hazardous alcohol consumption among young adult IDU and its association with high risk behaviors. Drug and Alcohol Dependence, 127(1), 143-149.

Lovibond, S., & Lovibond, P. (1995). Manual for the depression anxiety stress scales psychological foundation of australia. Sydney, Australia,

Nicholson, N., Soane, E., Fenton-O'Creevy, M., & Willman, P. (2005). Personality and domain-specific risk taking. Journal of Risk Research, 8(2), 157-176.

Peretti-Watel, P., Guagliardo, V., Verger, P., Pruvost, J., Mignon, P., & Obadia, Y. (2003). Sporting activity and drug use: Alcohol, cigarette and cannabis use among elite student athletes. Addiction, 98(9), 1249-1256.

Schippers, G. M., Broekman, T. G., Buchholz, A., Koeter, M. W., & Van Den Brink, W. (2010). Measurements in the addictions for triage and evaluation (MATE): An instrument based on the world health organization family of international classifications. Addiction, 105(5), 862-871.

Staines, G. L., Magura, S., Foote, J., Deluca, A., & Kosanke, N. (2001). Polysubstance use among alcoholics. Journal of Addictive Diseases, 20(4), 57-73.

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. Developmental Review, 28(1), 78-106.

Verster, J. C., Herwijnen, J., Olivier, B., & Kahler, C. W. (2009). Validation of the dutch version of the brief young adult alcohol consequences questionnaire (B-YAACQ). Addictive Behaviors, 34(5), 411-414.

Zuckerman, M., & Kuhlman, D. M. (2000). Personality and Risk-Taking: Common bisocial factors. Journal of Personality, 68(6), 999-1029.

Zuckerman, M. (2002). Zuckerman-kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model. In B. De Raad, & M. Perugini (Eds.), Big five assessment (pp. 377-396). Seattle: Hogrefe and Huber Publishers.

Chapter 7

The association between risk-taking behavior and beliefs about medicines in adolescents

L. de Haan[1], E.S. Koster[1], A.C.G. Egberts[1,2], E.R. Heerdink[1,2]

[1] Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, Netherlands
[2] Department of Clinical Pharmacy, University Medical Center Utrecht, Utrecht, Netherlands

Abstract

Objective. The present study examined the association of risk-taking behavior and beliefs about medicines in adolescents.

Methods. Subjects were 777 adolescent boys and girls who participated in a cross-sectional study in the form of an online survey that was held between April 11th and July 1st of 2014 amongst secondary school students. To assess attitudes towards medicines the Beliefs about Medicines Questionnaire-general (BMQ) was used, and to assess risk-taking behavior the Risk Taking questionnaire 18 items (RT-18).

Results. None of the relations between both risk-taking behavior and attitudes towards medication scales were significant for girls. When we introduced medication use into the equation, the relation between risk assessment and general-harm was modified in such a way that girls who used any medication in the previous twelve months did show a weak but significant relation, and those who did not report medication use had no significant relation. Three out of four (i.e. risk-taking and general-harm excepted) relations between the RT-18 and BMQ subscales were significant for the boys. After adjustment for medication use, only the relations between risk assessment with both BMQ subscales remained significant, and became stronger.

Conclusion. risk-taking behavior is a good candidate to explore in future studies, when looking for factors that can be of influence on attitude towards medication and therefore medication adherence. Albeit small in magnitude, we have found some highly significant relations between risk-taking behavior and beliefs about medicines for boys but not for girls.

Introduction

Patient adherence to prescribed medication regimens is important for successful treatment outcomes. The clinical relevance of non-adherence depends –amongst others- upon the pharmacological profile of the drug and the severity of the treated condition. Medication adherence is often not satisfactory and has become a focus of clinical and research interest (Koster, Philbert, Winters, & Bouvy, 2015; Santer, Ring, Yardley, Geraghty, & Wyke, 2014; van Boven et al., 2014; Zwikker, van den Bemt, Bart J, Vriezekolk, van den Ende, Cornelia H, & van Dulmen, 2014). Numerous factors have been implied to be involved in medication adherence such as demographics, complexity of therapy, disease characteristics, and socioeconomic factors (Geers, Bouvy, & Heerdink, 2011; Osterberg & Blaschke, 2005). In addition, psychological factors such as the beliefs a patient holds towards medication (either their specific/personal medication or towards medication in general) can strongly influence adherence (Koster, Philbert, Winters, & Bouvy, 2014). Non-adherent patients perceive medication in general to be more harmful and more overused by medical doctors compared to adherent patients (Chapman, Horne, Chater, Hukins, & Smithson, 2014; De las Cuevas, Peñate, & Sanz, 2014; Koster, Philbert, de Vries, van Dijk, & Bouvy, 2015).

Costello et al. (2004) concluded in a literature review that treatment adherence is generally low in children, and particularly in adolescents (Costello, Wong, & Nunn, 2004). The majority of studies concerning drug adherence in adolescents show non-adherence reaching a peak, ranging from 10% to 96%, with most studies reporting adherence rates of about 50% (Staples & Bravender, 2002). Staples and Bravender (2002) reviewed modifiable risk factors for drug adherence and concluded that, alongside health beliefs, patient demographic factors, inherent disease, regimen factors, and the patient-provider dynamic, the changes in psyche and physique in adolescents play a great role. One of the many significant behavioral changes that happen during adolescence are heightened levels of risk-taking behavior. Risk-taking behavior is directly related to health and well-being (Eaton et al., 2012). Substance (ab)use, and unhealthy lifestyle (diet, exercise) are examples of health related risk-taking behavior. One could view intended nonadherence as a form of conscious risk-taking when one considers non adherence a risky behavior, whilst on the other hand unmindful or unintended nonadherence could be seen as an expression of acting without thinking or poor risk assessment. The higher level of risk taking behavior in adolescence is thought to be the product of increased reward seeking behavior on the one hand and immature control systems of the prefrontal cortex on the other (Steinberg, 2008). Taking risks can be very functional in this age period, for instance, it aids parental detachment and specifically for men it is proposed to be part of an evolutionary based mating strategy (Steinberg, 2008). Moreover, it also educates the individual about the specific negative consequences that can be involved with taking a particular risk. Levels of risk-taking behavior usually decline after maturation of the prefrontal cortex around the age of 25 to 30 (Steinberg, 2008). After reaching adulthood, some differences in individual levels of risk-taking behavior remain. For instance, men in general score higher on assessments on risk-taking behavior than women (Byrnes, Miller, & Schafer, 1999).

Aim of this study is therefore to examine the relation between risk-taking behavior and beliefs about medicines in adolescents (figure 1). We had no specific a priori hypotheses before conducting this analysis other than that we expected higher risk-taking behavior scores for boys (Byrnes et al., 1999; de Haan et al., 2011), and that medication use could be of influence on the relation between risk-taking behavior and beliefs about medicines.

Materials & Methods

Participants

Subjects were adolescent boys and girls who participated in a cross-sectional study in the form of an online survey that was held between April 11th and July 1st of 2014 amongst secondary school students. Main purpose of this survey was to assess substance (ab)use; alcohol, tobacco, and illicit drugs with a special focus on the illicit use of ADHD medication (Koster et al., 2015 in press). The secondary aim of this study was to assess risk-taking behavior and the attitudes towards medicines in general. From the 78 secondary schools in the province of Utrecht, the Netherlands that were approached to participate in this study, six accepted the invitation. A total of approximately 5,200 students were invited to take the survey through their school's email service or virtual learning system. Participation was voluntary and anonymous. Monetary incentive was offered in the form of a raffle; one tablet computer and three gift-cards of €15 were raffled among participants that completed the survey. The study protocol was approved by the Institutional Review Board of the Division of Pharmacoepidemiology & Clinical Pharmacology, Utrecht University.

Beliefs about medicines

To assess attitudes towards medicines the Beliefs about Medicines Questionnaire-general (BMQ) (Horne, Weinman, & Hankins, 1999) was used. The BMQ-general comprises two subscales that each consist of four items. The first subscale 'general-harm' assesses to what extent people believe medicines to be harmful and are addictive poisons, which should not be taken continuously, whereas the second subscale 'general-overuse' assesses the belief that medicines are too often used. Items are scored on a five-point Likert-scale and can be added up to obtain subscale scores ranging from four to 20, with higher scores indicating stronger beliefs that medicines are harmful or overused.

Risk-taking behavior

The Risk Taking questionnaire 18 items (RT-18: (de Haan et al., 2011) was developed to assess risk-taking behavior in minimal time, from items on impulsiveness and venturesomeness (i.e. adventurousness) from the Impulsiveness-Venturesomeness-Empathy questionnaire (Eysenck, Pearson, Easting, & Allsopp, 1985); items on novelty-seeking from the Temperament and Character Inventory (Cloninger, Svrakic, & Przybeck, 1993), and items on impulsive sensation seeking from the Zuckerman Kuhlman Personality Questionnaire (Aluja et al., 2006; Zuckerman, 2002). The RT-18 comprises two subscales 'risk-taking' and 'risk assessment'. Individuals scoring high on risk-taking can be characterized by a high level of actual risk-taking behavior (i.e. engagement in risky behaviors), whereas a high score on risk assessment indicates a low level or less consideration of possible consequences (i.e. acting

without thinking). All items can be answered with 'yes' or 'no'. Subjects receive either zero or one point per question, and item-scores can be added up, with the exception of three reverse scored items, into subscale scores that consists nine items each.

Other measures

Socio-demographic questions included gender, age, ethnic background and educational level in secondary school. Students were also inquired about their medication, illicit drug, tobacco, and alcohol use of the past 30 days and the past 12 months. Substance use categories were classified according to the Measurements in the Addictions for Triage and Evaluation (Schippers, Broekman, Buchholz, Koeter, & Van Den Brink, 2010). Other information (e.g. motives for use, ADHD medication use without prescription) that was collected to answer the primary aim of the online survey, illicit use of ADHD medication, will be discussed elsewhere (Koster et al., 2015 in press).

Data analysis

Data were collected using Lime Survey and exported to Excel for data cleaning. From the n = 5200 secondary school students that were invited, n = 1376 students opened the link to the survey and n = 793 completed the survey, resulting in a 15.3% response rate. Data cleaning excluded 16 entries due to self-reported dishonesty, untrustworthy answers or missing data points. The final dataset comprised a total of n = 777 students. Analyses were performed using R version 3.0.2 (RCoreTeam, 2014); packages Hmisc, Psych, gmodels, ggplot2 and nnet. Based on findings from previous research, that showed men to significantly score higher on the RT-18 (de Haan et al., 2011), analyses were a-priori stratified for gender.

Descriptive statistics were calculated for boys and girls separately. Gender differences were assessed with independent t-tests and chi-square tests when appropriate. Differences in RT18 risk-taking or risk assessment scores for several subgroups (visiting a medical doctor, disease, specific medication use) were assessed with either ANOVA or Kruskall-Wallis.

Linear regression was used to examine the relation between the two RT18 subscales risk-taking and risk assessment and both BMQ subscales general-harm and general-overuse for boys and girls as well as for medication users and non-users (based on past twelve-month self-reported medication use). Subsequently, subgroup analyses for each gender were performed to explore the possible influence of medication use on the relationship between risk-taking behavior and beliefs about medicines.

All tests were two-tailed and p-values <0.05 were considered statistically significant.

Results

Descriptive statistics and gender differences

The study population consisted of 60.0% girls and mean age was 14.9 (±1.65) (Table 1). More diseases were reported by the girls than boys (36.3% vs 21.5%, p <0.001). From the 20 categories of self-reported diseases, significantly more girls indicated to have a mood-disorder (7.1% versus 0.6%, p = 0.000), suffer from neck and/or back complaints (8.2% versus 2.6%, p = 0.002), and other diseases (3.6% versus 0.3%, p = 0.005). From the girls that indicated to have a disease, 74.0% reported a visit to a doctor, 20.1% did not see a doctor, and 5.9% reported not knowing whether they had seen a doctor for this disease. A total of 53.7% of the boys that reported any disease consulted a doctor, 32.8% did not, and 13.4% did not know this. Girls also reported more use of medication in the past twelve months (84.5% versus 63.0%, p = 0.000). Significant gender differences, with girls reporting more use, are found for analgesics (72.7% versus 40.2%, p = 0.000), and as expected, oral contraceptives (5.8% versus 0.0%, p = 0.000). More boys, however, indicated to have used ADHD medication (8.4% versus 4.3%, p = 0.028). A similar pattern was found for self-reported medication use of the past 30 days (see table 1). No difference was found for alcohol or illicit drug consumption within the past twelve months between boys and girls. Tobacco use did differ, with more boys reporting use in the past twelve months (24.1% versus 16.3%, p = 0.010). Dyslexia, level of secondary school education, and ethnic background were also equally dispersed amongst girls and boys.

BMQ and RT-18 scores

The beliefs about medicine subscale general-harm differed significantly between boys and girls (Table 2), with girls scoring somewhat higher than boys on average (10.1 versus 9.6, p = 0.006). The general-overuse subscale did not differ (11.4 versus 11.3, p = 0.724), nor did the risk-taking behavior subscales (risk assessment: 2.7 versus 2.7, p = 0.655). Risk-taking was hypothesized to be higher in the boys, but the difference was not significant in our dataset (4.1 versus 4.5, p = 0.056).

Relation between BMQ and RT-18 for boys and girls

The relations between risk-taking behavior and both BMQ subscales are depicted in Figure 2. The first panel (upper-left) shows the relation of risk-taking with the general-harm subscale. Simple regression yielded non-significant relations for both gender with b = 0.05, p = 0.381, adjusted R-squared = 0.00 for boys, and b = 0.03, p = 0.503, adjusted R-squared = 0.00 for girls. The second panel (upper-right) shows the relation of risk-assessment with general-harm. The simple regression that was performed did result in a significant relation with b = 0.22, p = 0.002, adjusted R-squared = 0.03 for boys, however it was not significant for girls (b = 0.06, p = 0.260, adjusted R-squared = 0.00).

The third panel (lower-left) shows the significant relation of risk-taking with general-overuse for the boys with b= 0.14 and a p-value of 0.025, adjusted R-squared = 0.01. This effect was not significant for girls (b = 0.02, p = 0.627, adjusted R-squared = 0.00). The fourth and final panel (lower-right) shows the relation of risk assessment with general-overuse. Again, there is a significant relation (b = 0.23, p = 0.002, adjusted R-squared = 0.03) for boys, and not for girls (b = 0.00, p = 0.937, adjusted R-squared = 0.00).

Relation between BMQ and RT-18 for medication users and non-users

Figure 3 shows the relations between the two RT-18 subscales and BMQ subscales for those who did report any medication use during the previous twelve months (n= 590) and those who did not (n= 167). BMQ scores are lower for the medication group (colored black in figure 3) in all four panels.

Influence of medication use on the relation between BMQ and RT-18 for boy and girls

Subgroup analyses based on self-reported medication use in the past twelve months, indicated medication use did not confound nor mediate the relation between risk-taking and general-overuse in boys (b = 0.14, p = 0.221, adjusted R-squared = 0.04). However, the relations between risk-taking and general-harm (b = 0.10, p = 0.358, adjusted R-squared = 0.03), between risk assessment and general-overuse (b = 0.28, p = 0.044, adjusted R-squared = 0.05), and between, risk assessment and general-harm in boys (b = 0.41, p = 0.002, adjusted R-squared = 0.06), were all confounded by medication use in the past twelve months, but none of the interaction terms were significant.

For girls all four relationships were confounded by past twelve month medication use; risk-taking and general-overuse (b = -0.16, p = 0.230, adjusted R-squared = 0.04), risk-taking and general-harm (b = -0.15, p = 0.244, adjusted R-squared = 0.00), risk assessment and general-overuse (b = -0.01, p = 0.956, adjusted R-squared = 0.00), and risk assessment and general-harm (b = -0.25, p = 0.07, adjusted R-squared = 0.02). Only this last relationship was also mediated by medication use such a way that using medication yielded a relation of b = 0.11, p = 0.03, adjusted R-squared = 0.01 between risk assessment and general-harm and not using medication yielded a relation of b = -0.25, p = 0.136, adjusted R-squared = 0.02 between risk assessment and general-harm.

Table 1. Descriptive statistics

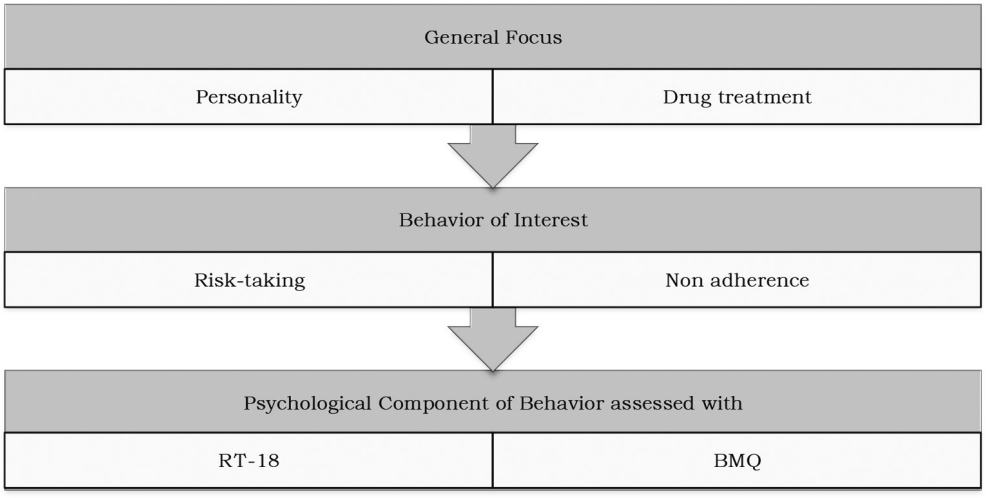
	Girls n=466		Boys n=311		
	Mean	**(SD)**	**Mean**	**(SD)**	**p(T)**
Age	14.9	(1.6)	14.8	(1.7)	0.268
BMI	19.8	(2.9)	19.5	(3.0)	0.184
	N	(%)A	n	(%)A	p(X2)
Dyslexia					0.255
No	406	(87.1)	260	(83.6)	
No, but difficulty reading	20	(4.3)	13	(4.2)	
Yes	40	(8.6)	38	(12.2)	
Secondary School Education level					0.052
VMBO	126	(27.0)	104	(33.4)	
VMBO/HAVO	7	(1.5)	9	(2.9)	
HAVO	121	(26.0)	60	(19.3)	
HAVO/VWO	16	(3.4)	6	(1.9)	
VWO	196	(42.1)	311	(42.4)	
Ethnic background					0.428
Native Dutch	449	(96.4)	297	(89.7)	
Non-western foreigner	7	(1.5)	8	(2.6)	
Western foreigner	0	(0.0)	0	(0.0)	
Unknown	10	(2.1)	6	(1.9)	
Disease					0.000
No	297	(63.7)	244	(78.5)	
Yes	169	(36.3)	67	(21.5)	
Mood Disorder	33	(7.1)	2	(0.6)	0.000
Autism Spectrum Disorder	17	(3.6)	16	(5.1)	0.405
Attention Deficit Disorder	14	(3.0)	16	(5.1)	0.184
Eating Disorder	4	(0.9)	0	(0.0)	0.260
Other Psychological Disorder	3	(0.6)	0	(0.0)	0.408
Behavioral Disorder	2	(0.4)	3	(1.0)	0.648
Migraine	19	(4.1)	6	(1.9)	0.146
Sleep Complaints	3	(0.6)	0	(0.0)	0.408
Epilepsy	0	(0.0)	2	(0.6)	0.312
Allergy	24	(5.2)	15	(4.8)	0.971
Asthma	19	(4.1)	10	(3.2)	0.669
Hair and/or Skin Condition	15	(3.2)	7	(2.3)	0.564
Inflammation and/or Infection	10	(2.1)	3	(1.0)	0.331
Neck and/or back Complaints	38	(8.2)	8	(2.6)	0.002
Other[B]	17	(3.6)	1	(0.3)	0.005

Injury	8	(1.7)	4	(1.3)	0.857
Gastrointestinal Complaints	7	(1.5)	3	(1.0)	0.744
Hearing Impairment	6	(1.3)	1	(0.3)	0.179
Heart disease	3	(0.6)	2	(0.6)	1.000
Diabetes	1	(0.2)	0	(0.0)	1.000
Medication used past 12 months					0.000
No	63	(13.5)	104	(34.4)	
I do not know	9	(1.9)	11	(2.6)	
Yes	394	(84.5)	196	(63.0)	
AD(H)D medication	20	(4.3)	26	(8.4)	0.028
Antidepressants & Thyroid Hormone	8	(1.7)	1	(0.3)	0.192
Analgesic medication	339	(72.7)	125	(40.2)	0.000
Sleep medication	25	(5.4)	10	(3.2)	0.215
Allergy medication	71	(15.2)	36	(11.6)	0.246
Asthma medication	35	(7.5)	15	(4.8)	0.178
Antibiotics	33	(7.1)	15	(4.8)	0.259
“Common Cold” medication	21	(4.5)	8	(2.6)	0.230
Skin medication	6	(1.3)	5	(1.6)	0.440
Gastrointestinal medication	28	(6.0)	14	(4.5)	0.454
Oral contraception	27	(5.8)	0	(0.0)	0.000
Other	19	(4.1)	7	(2.3)	
Medication used past 30 days					0.000
No	114	(24.4)	164	(52.7)	
I do not know	11	(2.4)	7	(2.3)	
Yes	341	(73.2)	140	(45.0)	
AD(H)D medication	18	(3.9)	24	(7.7)	0.030
Antidepressants & Thyroid Hormone	6	(1.3)	0	(0.0)	0.258
Analgesic medication	256	(54.9)	70	(22.5)	0.000
Sleep medication	12	(2.6)	6	(1.9)	0.732
Allergy medication	55	(11.8)	26	(8.4)	0.148
Asthma medication	23	(4.9)	13	(4.2)	0.751
Antibiotics	16	(3.4)	7	(2.3)	0.302
“Common Cold” medication	8	(1.7)	4	(1.3)	0.857
Skin medication	3	(0.6)	2	(0.6)	1.000
Gastrointestinal medication	17	(3.6)	8	(2.6)	0.532
Oral contraception	19	(4.1)	0	(0.0)	0.001
Other	10	(2.1)	3	(1.0)	0.331
Alcohol used past 12 months					0.834
No	270	(57.9)	177	(56.9)	
Yes	196	(42.1)	134	(43.1)	

Tobacco used past 12 months					0.01
No	390	(83.7)	236	(75.9)	
Yes	76	(16.3)	75	(24.1)	
Illicit drugs used past 12 months					0.188
No	437	(93.8)	283	(91.0)	
Yes	29	(6.2)	28	(9.0)	

Note: A = percentages are within gender. B = Comprises homeopathic remedies, dietary supplements and vitamins, withdrawal medication, and motion sickness medication.

Figure 1. Focus pathway of current study



Note: RT-18 = Risk Taking questionnaire 18 items, BMQ = beliefs about medicines questionnaire

Table 2. Risk-taking behavior (RT-18)and Beliefs about medicines (BMQ)

	Girls N = 466		Boys N = 311		
	Mean	**(SD)**	**Mean**	**(SD)**	**p(T)**
BMQ					
General-harm	10.1	(2.4)	9.6	(2.7)	0.006
General-overuse	11.4	(2.5)	11.3	(2.8)	0.724
RT-18					
Risk-taking	4.1	(2.4)	4.5	(2.6)	0.056
Risk assessment	2.7	(2.3)	2.7	(2.1)	0.655

Discussion

Aim of this study was to examine the relation between risk-taking behavior and general beliefs about medicines in adolescents. An interesting pattern emerged when we investigated the relationships between both risk-taking behavior and attitudes towards medication.

None of these relations were significant for girls. However, when we introduced medication use into the equation, the relation between risk assessment and general-harm was modified in such a way that girls who used any medication in the previous twelve months did show a weak but significant relation, and those who did not report medication use had no significant relation.

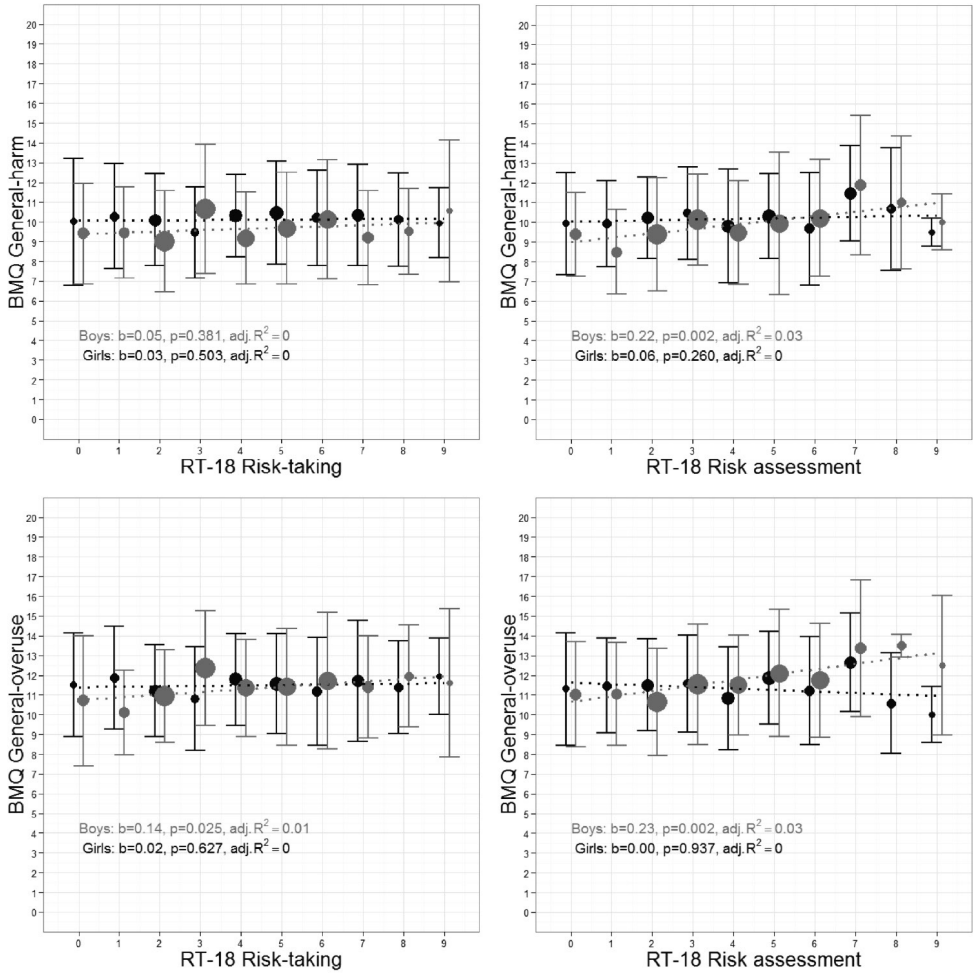
Interestingly, three out of four (i.e. risk-taking and general-harm excepted) relations between the RT-18 and BMQ subscales were significant for the boys. All three relations were of similar strength, with regression coefficients ranging between 0.14 and 0.23, with the latter translating into the following: a boy scoring maximally on risk-assessment (i.e. very impulsive) scores in general 2.1 points (or 13.1%) higher on the BMQ general-overuse scale. On a scale that ranges from four to 20 points, it is questionable whether a difference of 2.1 is clinically relevant. After adjustment for medication use, only the relations between risk assessment with both BMQ subscales remained significant, and became stronger. A maximal score on risk assessment was accompanied by 3.7 points or a 23.1% increase in general-harm score, when compared to a minimal score on risk assessment, which makes this difference certainly clinically relevant.

To our knowledge, just a handful of studies have coupled risk-taking behavior or similar personality constructs to attitudes towards medicines or medication adherence. (Liraud & Verdoux, 2001) reported higher levels of Zuckerman's sensation seeking to be associated with poor medication adherence in patients with psychotic or mood disorders. And Kahler et al. (2009) found sensation seeking to be negatively associated with adherence to nicotine replacement therapy. A more recent study by Margetić et al. (2011) showed Cloninger's novelty seeking construct to be associated with medication non-adherence. In addition, some studies have indicated health risk behaviors like fighting, school expulsion, and substance use to be associated with poor adherence (Hovell et al., 2003; Precht, Keiding, & Madsen, 2003). Bender (2006) describes these health risks behaviors "not surprising", for the author states "..Treatment nonadherence is yet another risk behavior reflecting a general disregard for personal health…". However, we think that high levels of risk-taking behavior might be the underlying common factor that is expressed through both medication non-adherence as other health risk behaviors like alcohol, tobacco and marihuana consumption. So far, our findings that in boys risk-taking behavior is associated with beliefs about medicines is in line with the marginal literature regarding this subject. The explanation for the finding that risk-taking behavior and beliefs about medicines were not associated in girls, remains unclear. It might very well be that the aetiology of poor medication adherence is (partly) different for each gender (Ediger et al., 2007).

Some limitations have to be noted. Since this study relied completely on self-report, as do most personality-related studies, it could very well be that some behaviors or other information is under or over reported. On the other hand, by conducting this survey online, a private and more anonymous situation is created that enhances the motivation of respondents to give true answers and decreases underreporting. Moreover, we have used the RT18 for the first time in adolescents, without changing any of the items, and it could be that some of the items were nor relevant or maybe not even understood by the youngest children. Additional research should point out if an additional version of the RT18 especially adapted to younger respondents (12-16) is beneficial to comprehension of the items. Another limitation comes from the fact that we have used the BMQ subscales general-harm and general-overuse as proxy measures for medication adherence. Future research should investigate the relationship between risk-taking and medication adherence measured with other methods. Although we have used a large sample (n=777), collected almost equally across all secondary school education levels, this sample consisted almost entirely of native Dutch students (96.4% of the girls and 89.7% of the boys were native Dutch students), thereby limiting the generalizability if these findings. Finally, since we have employed a cross-sectional correlational design, our ability to make causal assumptions is very limited.

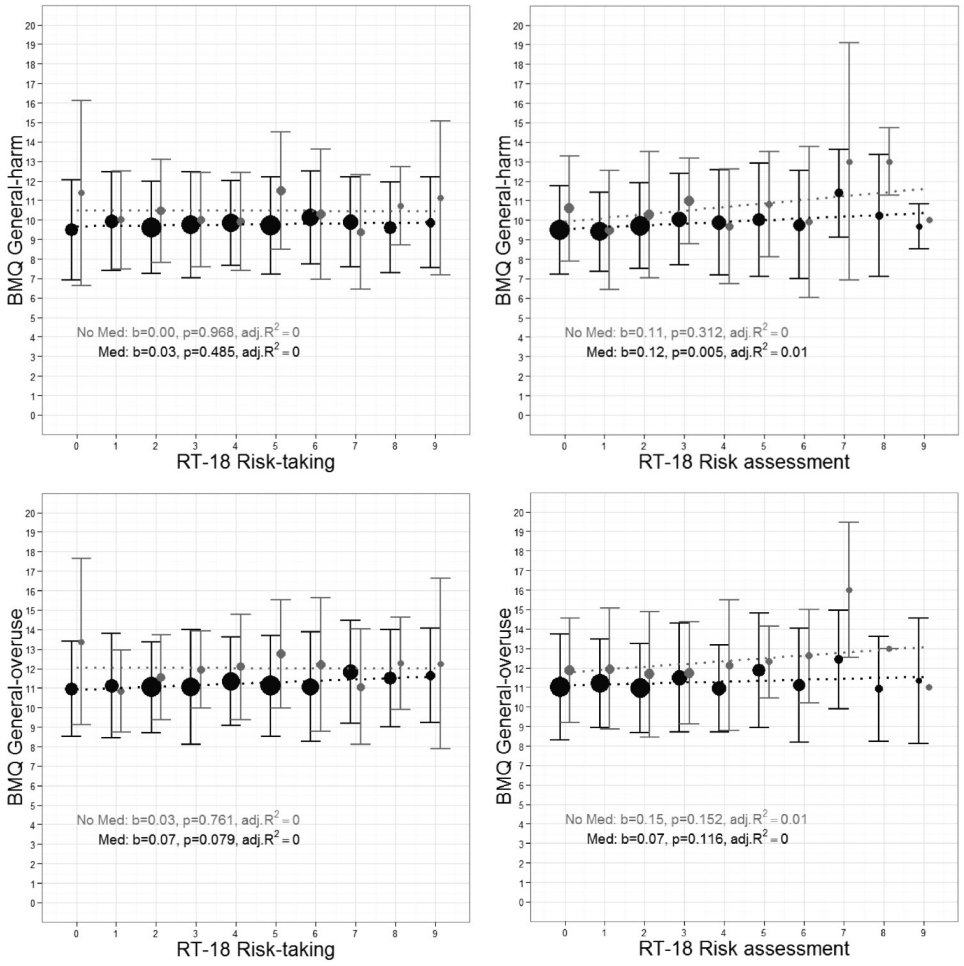
From our findings, it seems that risk-taking behavior is a good candidate to explore in future studies, when looking for factors that can be of influence on attitude towards medication and therefore medication adherence. Albeit small in magnitude, we have found some highly significant relations between risk-taking behavior and beliefs about medicines for boys but not for girls.

Figure 2. Relation between risk-taking behavior and beliefs about medicines for boys (n = 311) and girls (n = 466)



Note: Male values are grey, female values in black. For each possible RT18 subscale score, the mean BMQ subscale score is depicted as a circle. Whiskers accompanying the circle depict one standard deviation above and below the mean. The size of the circle indicating the mean score varies in size based on the relative number of observations. Dotted lines are simple linear regression lines. Regression coefficients (b) and accompanying p-values and adjusted R^2 (proportion) values are given within each panel for boys and girls

Figure 3. Relation between risk-taking behavior and beliefs about medicines for no medication used in past twelve months (n = 167) and medication used in past twelve months (n = 590)



Note: No medication used in grey, medication used values in black. For each possible RT18 subscale score, the mean BMQ subscale score is depicted as a circle. Whiskers accompanying the circle depict one standard deviation above and below the mean. The size of the circle indicating the mean score varies in size based on the relative number of observations. Dotted lines are simple linear regression lines. Regression coefficients (b) and accompanying p-values and adjusted R^2 (proportion) values are given within each panel for the no medication used group and the medication used group

References

Aluja, A., Rossier, J., García, L. F., Angleitner, A., Kuhlman, M., & Zuckerman, M. (2006). A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to english, french, german, and spanish languages. Personality and Individual Differences, 41(4), 619-628.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychological Bulletin, 125(3), 367-383.

Chapman, S., Horne, R., Chater, A., Hukins, D., & Smithson, W. (2014). Patients' perspectives on antiepileptic medication: Relationships between beliefs about medicines and adherence among patients with epilepsy in UK primary care. Epilepsy & Behavior, 31, 312-320.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Archives of General Psychiatry, 50(12), 975.

Costello, I., Wong, I., & Nunn, A. (2004). A literature review to identify interventions to improve the use of medicines in children. Child: Care, Health and Development, 30(6), 647-665.

de Haan, L., Kuipers, E., Kuerten, Y., van Laar, M., Olivier, B., & Verster, J. C. (2011). The RT-18: A new screening tool to assess young adult risk-taking behavior. International Journal of General Medicine, 4, 575-584. doi:10.2147/IJGM.S23603

De las Cuevas, C., Peñate, W., & Sanz, E. J. (2014). Risk factors for non-adherence to antidepressant treatment in patients with mood disorders. European Journal of Clinical Pharmacology, 70(1), 89-98.

Eaton, D. K., Kann, L., Kinchen, S., Shanklin, S., Flint, K. H., Hawkins, J., . . . Wechsler, H. (2012). Youth risk behavior Surveillance—United states, 2011. Morbidity and Mortality Weekly Report, Centers for Disease Control and Prevention, 61(4), 1-162.

Ediger, J. P., Walker, J. R., Graff, L., Lix, L., Clara, I., Rawsthorne, P., . . . Deering, K. (2007). Predictors of medication adherence in inflammatory bowel disease. The American Journal of Gastroenterology, 102(7), 1417-1426.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. Personality and Individual Differences, 6(5), 613-619.

Geers, H. C., Bouvy, M. L., & Heerdink, E. R. (2011). Influence of therapeutic complexity on medication adherence in the netherlands. Archives of Internal Medicine, 171(9), 864-865.

Horne, R., Weinman, J., & Hankins, M. (1999). The beliefs about medicines questionnaire: The development and evaluation of a new method for assessing the cognitive representation of medication. Psychology and Health, 14(1), 1-24.

Hovell, M. F., Sipan, C. L., Blumberg, E. J., Hofstetter, C. R., Slymen, D., Friedman, L., . . . Vera, A. Y. (2003). Increasing latino adolescents' adherence to treatment for latent tuberculosis infection: A controlled trial. American Journal of Public Health, 93(11), 1871-1877.

Koster, E. S., Philbert, D., de Vries, T. W., van Dijk, L., & Bouvy, M. L. (2015). "I just forget to take it": Asthma self-management needs and preferences in adolescents. Journal of Asthma, in press.

Koster, E. S., Philbert, D., Winters, N. A., & Bouvy, M. L. (2014). Adolescents' inhaled corticosteroid adherence: The importance of treatment perceptions and medication knowledge. Journal of Asthma, (0), 1-6.

Koster, E. S., Philbert, D., Winters, N. A., & Bouvy, M. L. (2015). Medication adherence in adolescents in current practice: Community pharmacy staff's opinions. International Journal of Pharmacy Practice, 23(3), 221-224.

Liraud, F., & Verdoux, H. (2001). Association between temperamental characteristics and medication adherence in subjects presenting with psychotic or mood disorders. Psychiatry Research, 102(1), 91-95.

Osterberg, L., & Blaschke, T. (2005). Adherence to medication. New England Journal of Medicine, 353(5), 487-497.

Precht, D. H., Keiding, L., & Madsen, M. (2003). Smoking patterns among adolescents with asthma attending upper secondary schools: A community-based study. Pediatrics, 111(5), e562-e568.

Santer, M., Ring, N., Yardley, L., Geraghty, A. W., & Wyke, S. (2014). Treatment non-adherence in pediatric long-term medical conditions: Systematic review and synthesis of qualitative studies of caregivers' views. BMC Pediatrics, 14, 63-2431-14-63. doi:10.1186/1471-2431-14-63 [doi]

Schippers, G. M., Broekman, T. G., Buchholz, A., Koeter, M. W., & Van Den Brink, W. (2010). Measurements in the addictions for triage and evaluation (MATE): An instrument based on the world health organization family of international classifications. Addiction, 105(5), 862-871.

Staples, B., & Bravender, T. (2002). Drug compliance in adolescents. Pediatric Drugs, 4(8), 503-513.

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. Developmental Review, 28(1), 78-106.

van Boven, J. F., Chavannes, N. H., van der Molen, T., Rutten-van Mölken, M. P., Postma, M. J., & Vegter, S. (2014). Clinical and economic impact of non-adherence in COPD: A systematic review. Respiratory Medicine, 108(1), 103-113.

Zuckerman, M. (2002). Zuckerman-kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model. Big Five Assessment, , 377-396.

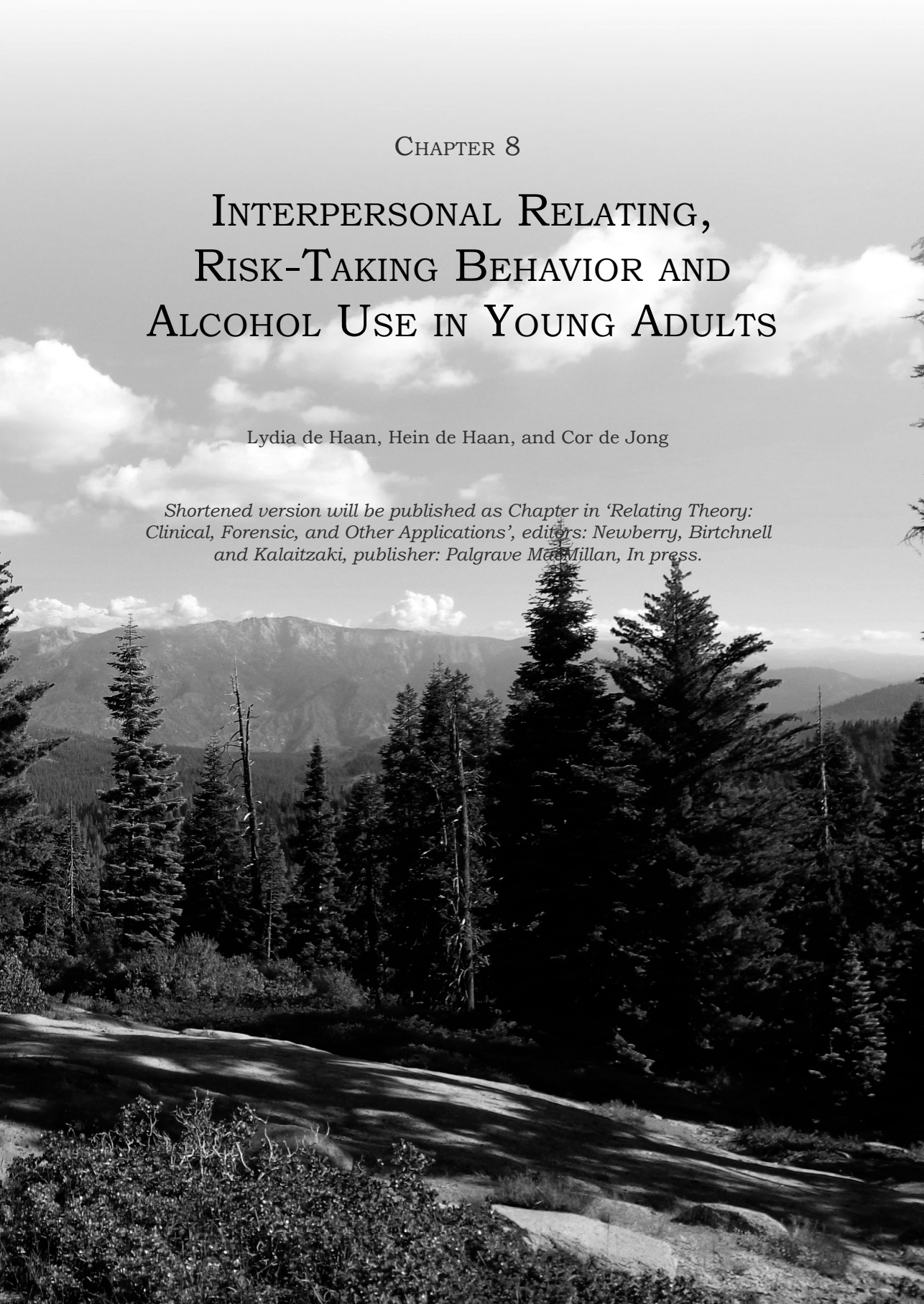
Zwikker, H. E., van den Bemt, Bart J, Vriezekolk, J. E., van den Ende, Cornelia H, & van Dulmen, S. (2014). Psychosocial predictors of non-adherence to chronic medication: Systematic review of longitudinal studies. Patient Preference and Adherence, 8, 519.

Chapter 8

Interpersonal Relating, Risk-Taking Behavior and Alcohol Use in Young Adults

Lydia de Haan, Hein de Haan, and Cor de Jong

Shortened version will be published as Chapter in 'Relating Theory: Clinical, Forensic, and Other Applications', editors: Newberry, Birtchnell and Kalaitzaki, publisher: Palgrave MacMillan, In press.



OVERVIEW

Research continues to seek to understand potential underlying mechanisms for alcohol use and problematic patterns of drinking. This chapter explores the association between interpersonal relating (Person's Relating to Others Questionnaire; Birtchnell, et al, 2013) and binge drinking in young adults, and examines the mediating role of risk-taking behavior (Risk-Taking Questionnaire-18 items; de Haan et al., 2011). Participants (n=2962) were drawn from the online Utrecht Student Survey (de Haan, de Haan, Olivier, & Verster, 2012). For men, LC, LD, and ND decreased, whereas UC and UD increased the odds of binge drinking. For women ND decreased and UD increased the odds. These effects were mediated by risk-taking behavior. Gender differences found in this study could lead towards understanding risky alcohol consumption in young adults.

INTRODUCTION

Problematic alcohol use like binge drinking, defined by the World Health Organization (WHO, 2014) as consumption of four or more standard drinks for females and five or more standard drinks for males on one single occasion) remains a persistent problem in adolescents and young adults. The WHO (2014) also reported that in Europe, in 2010, 69.5% of the 15 to 19 year olds could be classified as 'current drinkers' and an additional 14.5% as 'former drinkers'. An alarming 31.2% reported that they engaged in heavy episodic drinking (HED; defined by the WHO in 2014 as consumption of about six or more standard drinks, i.e. 60 or more grams of pure alcohol, on a one single occasion at least monthly). Comparing this percentage to the prevalence of HED (16.5%) across the total European population aged 15 and over, it is clear that HED and binge drinking are a serious problem in adolescents and young adults (World Health Organization, 2014). Adolescence is a period of increased vulnerability to many psychiatric disorders, including depression, schizophrenia, violent delinquency, alcohol and substance abuse (Steinberg, 2005; Witt, 2010). The pattern of alcohol consumption at this age is associated with consumption levels later in life and it seems that heightened consumption in adolescence is presaging alcohol problems in adulthood (McCambridge, McAlaney, & Rowe, 2011; Stautz & Cooper, 2013).

Research seeks to define and understand potential underlying mechanisms for alcohol use and specific problematic patterns of drinking (e.g. HED, binge drinking) including starting points that may help identify at-risk youth. Numerous factors have been implicated, such as gender, age, ethnicity, socio-economic status, and familial risk factors (Anda et al., 2014; Donovan, 2004; Sher, Grekin, & Williams, 2005; World Health Organization, 2014). However, most of these factors are not suitable as targets for prevention or therapy purposes for they can hardly be modified. Of special interest are personality characteristics that may relate to alcohol consumption, for they can, to some extent, be altered. Sher, Bartholow and Wood (2000) suggested that since personality traits are associated with consistent patterns of cognition, affect, and behavior, elevated levels of certain personality traits may predispose an individual to alcohol problems. Adolescence is characterized by heightened levels of risk-taking behavior and related (sub)constructs like impulsivity, sensation seeking, venturesomeness, and novelty seeking (Steinberg, 2008). Heightened levels of risk-taking behavior have been identified as a risk factor for excessive and problematic alcohol use, particularly during adolescence when impulsive behavior is elevated and alcohol use is often initiated (Stautz & Cooper, 2013). During adolescence establishing peer relationships becomes increasingly important. Peer influences (e.g., modeling behavior, provision of alcohol, and encouraging use) are considered to be of major importance in initiating alcohol use (Newcomb & Bentler, 1989). Yanovitzky (2006) showed that sensation-seeking influenced alcohol use in college students directly, but also indirectly by shaping interactions between peers, in such a way that high sensation seekers were motivated to associate more frequently with alcohol-using peers. Moreover, strong similarities in drinking patterns have been found between heterosexual partners, implying that interpersonal relations can influence alcohol use (Nolen-Hoeksema, 2004). Mohr et al. (2001) found that

individuals tended to drink more in a solitary setting at home after negative interpersonal experiences and in social contexts after positive interpersonal experiences.

Despite all the work in this field of research, there are still significant gaps in our understanding of the etiology and consequences of heavy adolescent drinking (Hermens et al., 2013; Witt, 2010). Since interpersonal relating is interconnected with both interactions with peers as well as risk-taking behavior, it might be that this new angle of interest could fill some of the gaps in our knowledge. Therefore, the aim of this study was to explore the association between interpersonal relating and binge drinking in young adults and to examine whether risk-taking behavior plays a mediating role in this relationship. Gender differences have been reported in levels of alcohol consumption, with men typically displaying higher consumption levels (WHO, 2014), in risk-taking behavior, with men being more likely to engage in risk-taking behaviors and women being more risk-aversive (Byrnes, Miller, & Schafer, 1999; Eriksson &Simpson, 2010). Besides, women need to consume less alcohol to reach the same state of inebriety as men due to their average lower body weight, a smaller liver capacity to metabolize alcohol, and a higher proportion of body fat (Smarandescu, Walker, & Wansink, 2014; World Health Organization, 2014). Gender differences have been reported in interpersonal relating too. Therefore, we hypothesized that different outcomes would be anticipated across genders.

METHODS

Participants

Participants (N=6002) had completed the online Utrecht Student Survey (USS; de Haan, de Haan, Olivier, & Verster, 2012) in June 2011. One of the aims of the USS was to assess personality characteristics and the level of risk-taking behavior and their relationship with alcohol consumption. Participants were 18-30 years old (mean age=22.1, SD=2.5), provided online informed consent, and stated that they had answered all questions truthfully. The local Medical Ethical Review Board Twente reviewed the study protocol as appropriate according to Dutch law.

Measures

Interpersonal relating

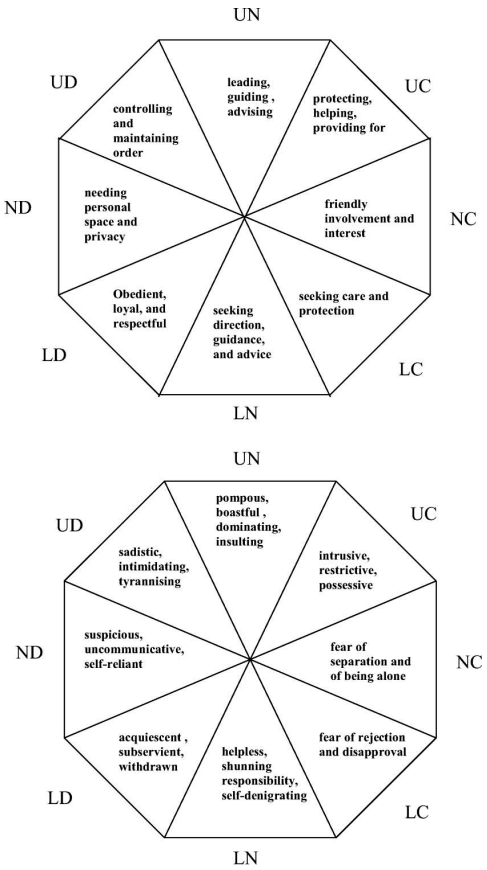
The Person's Relating to Others Questionnaire (PROQ3; Birtchnell, Hammond, Horn, De Jong, & Kalaitzaki, 2013) was used to measure interpersonal relating. The PROQ3 comprises 48 items contributing to eight scales which correspond to each octant of the interpersonal octagon (Birtchnell, 1994; see Figure 1). The scales of the PROQ3, named after the octants of the interpersonal octagon, are called upper neutral (UN), upper close (UC), neutral close (NC), lower close (LC), lower neutral (LN), lower distant (LD), neutral distant (ND) and upper distant (UD). Of the six items for each scale, one refers to positive relating and is unscored, and the other five refer to negative or maladaptive relating. The respondent rates each item using a 4-point Likert scale ('Nearly always true', 'Quite often true', 'Sometimes true', 'Rarely true') which carry a score of 3, 2, 1 and 0, respectively. Thus each scale has a score range of 0–15. Scale scores are obtained by adding up specific item scores. The Dutch version of the PROQ3 has shown adequate reliability and its proposed eight-factor structure and octagonal order were supported (Birtchnell, Hammond, Horn, De Jong, & Kalaitzaki, 2013).

Risk-taking behavior

The Risk Taking Questionnaire-18 items (RT-18; de Haan et al., 2011) was used as a screening tool to differentiate levels of risk-taking behavior. It was developed from items of the impulsiveness and venturesomeness subscales of the Impulsiveness-Venturesomeness-Empathy questionnaire (Eysenck & Eysenck, 1978; Eysenck, Pearson, Easting, & Allsopp, 1985) items of the novelty-seeking subscale of the Temperament and Character Inventory (Cloninger, Svrakic, & Przybeck, 1993), and items of the impulsive sensation-seeking subscale of the Zuckerman Kuhlman Personality Questionnaire (Aluja et al., 2006; Zuckerman, 2002). The RT-18 items are rated on a 'yes'/'no' scale, which receive either zero or one point per question. Three items are reverse-scored, scores are summed up. The RT-18 examines two factors:

risk-taking and risk assessment, of nine items each. Individuals scoring high on risk-taking can be characterized by a high level of actual risk-taking (i.e. engagement in risky behaviors), whereas a high score on the risk assessment subscale indicates a low level or less consideration of possible consequences (i.e. acting without thinking). Throughout this analysis the terms risk-taking behavior and risk-taking will be used; risk-taking refers to one of the two RT-18 scales, whereas risk-taking behavior comprises both subscales and therefore the entire constellation of behavior involved in taking or avoiding risks. The psychometric properties of the RT-18 have been assessed in three studies and adequate internal consistency (α=0.89), test-retest reliability (r=0.94), convergent validity (i.e., significant correlations with the Cambridge Gambling Task and Stimulating-Instrumental Risk Inventory), discriminant validity (i.e., significant differences across genders) have been reported (de Haan et al., 2011).

Figure 1. Octagon of the relating theory.



Note: Positive (upper diagram) and negative (lower diagram) forms of relating. The pairs of initial letters are abbreviations for the full names of the octants given in the text: UN, upper neutral; UC, upper close; NC, neutral close; LC, lower close; LN, lower neutral; LD, lower distant; ND, neutral distant; UD, upper distant. These diagrams first appeared in Birtchnell, J. (1994). The interpersonal octagon: An alternative to the interpersonal circle. Human Relations, 47, pp. 518 and 524. © The Tavistock Institute, 1994. Reproduced with permission from SAGE Publications

Alcohol consumption

To assess real-world risk-taking behavior alcohol consumption data from the USS were used. Items from the Quick Drinking Screen (Sobell et al., 2003) were assessed in three possible drinking scenarios; consumption of just alcohol (i.e., beer or wine or unmixed liquor), consumption of alcohol mixed with energy drinks, and consumption of alcohol with other mixers (e.g. cola, juice etc.). For this study we have combined alcohol consumption data from all three scenarios into pooled alcohol consumption data. Typical alcohol consumption per occasion was extracted, and the subjects who indicated that they drink alcohol also reported the number of days that they engaged in binge drinking during the previous month (with a binge drinking day defined as consuming more than four -for females- or five –for males- alcoholic drinks consecutively on one occasion). Participants were classified, based on both self-reported alcohol measures, as belonging to one of five groups: (1) abstinent; (2) typical non binge drinker who did not report any binge drinking days in the past month; (3) typical non binge drinker who did report at least one binge drinking day in the past month; (4) typical binge drinker who did not report any binge drinking days in the past month, or (5) typical binge drinker who did report at least one binge drinking day in the past month. For this study groups 3 and 4 were omitted and only those in the three groups were used (abstinent, non-binge drinkers, that is not reporting binge drinking in the past month, and binge drinkers, that is reporting binge drinking in the past month), for they could be clearly distinguished as belonging to one of the groups of interest, namely abstinent, non-binge drinker or binge drinker. Groups 3 and 4 will be omitted in this study.

Data analysis

Data was recorded in Excel and prepared for analysis using the R version 3.0.2 (RCoreTeam, 2014).

We examined how both interpersonal relating and risk-taking behavior related to the alcohol outcome (i.e. abstinent, non-binge or binge consumption). In order to examine which of the eight PROQ3 and which of the two RT-18 subscales means differed across the three alcohol groups, ANOVA (or Kruskall-Wallis tests, as appropriate), were conducted. With the aim of examining correlations between the PROQ3 and RT-18 subscales, Pearson or Spearman correlation coefficients, as appropriate, were conducted. The scales that differed across the alcohol outcome groups, were entered into a multivariate model.

The relationship between the PROQ3 scales, alcohol use, and RT-18 subscales was then examined using a multiple multinomial logistic regression model. Because of known gender differences in both RT-18 scores and alcohol use, an a priori stratified logistic regression model of three steps was used. The crude model contained only age, which is also known to confound alcohol consumption and/or risk-taking behavior (Steinberg et al., 2008). Then, model 1 contained age and the PROQ3 scales that differed significantly across the alcohol outcome categories, whereas the final model (i.e. model 2) added the

risk-taking behavior scales that were significantly different across the outcome categories. Odds-ratios and their 95%CI's were examined, as well as model fit was assessed with chi-square likelihood ratio tests and the so called pseudo-R2 statistics. Since there is little consensus as to which pseudo-R2 measure is most appropriate, McFadden's (1973), Cox and Snell's(1989), and Nagelkerke's (1991) pseudo-R2 were reported. Chi-square likelihood ratio tests for nested models were conducted to compare the models. In case of confounding of the PROQ3 scale effects on alcohol use by risk-taking behavior, this effect was examined in an additional moderator analysis to test for possible effect modification.

Finally, a path analysis was conducted to examine the relationship between the PROQ3 scales that were significantly related to alcohol use, and the role that risk-taking behavior may play in this relationship. This analysis was based on the final models from the multinomial logistic regression analyses. Structural equation modeling (SEM) examined both the direct effect of the PROQ3 scales on alcohol use (i.e. ordered variable with categories; abstinent, non-binge drinker and binge drinker) and the indirect effect through risk-taking behavior. All statistical tests were bi-directional, the level of significance was set at $p<.05$, and confidence intervals that did not contain zero were considered significant.

RESULTS

From the total sample (N = 6002) who completed the first part of the USS, 3566 participants continued to part two. From these participants, 2962 participants (83.1%) were eligible for analysis (e.g. no missing data on the study variables). From these, 515 participants were classified as abstinent (17.4%), 484 as non-binge drinkers (16.3%), and 1963 as binge drinkers (66.3%). A Kruskal-Wallis test for age (KW-X2(12) = 16.46, p = 0.171) and a chi-squared test for gender dispersion (X2(1) = 1.38, p = 0.240) showed no significant difference between our study sample and the omitted respondents (3040).

Table 1 depicts mean age, PROQ3 and RT-18 scale scores for both men and women, grouped by level of alcohol use. The three alcohol use groups for men did not differ significantly in terms of age, but it did for women. For men, all the PROQ3 scale means except for the upper neutral (UN) and neutral close (NC) scales were significantly different across the three alcohol use groups. For women just three of the eight scales were significantly different (lower neutral, LN; neutral distant, ND; and upper distant, UD).RT-18 subscale means for risk-taking and risk assessment were significantly different for both men and women across the three alcohol use groups.

The Spearman correlation coefficients between the PROQ3 and the RT-18 scales can be seen in Table 2. For men, seven of the eight PROQ3 scales were significantly correlated with risk-taking, although most correlations were weak. LN, LD, and UD showed the strongest correlations. When risk assessment was examined alone there were significant correlations with UC, NC, and UD. When examining the correlations for women, a different pattern emerged, where only risk-taking was significantly correlated with UN, LN , LD, and UD, whereas risk assessment was significantly correlated with all PROQ scales except for LC and ND.

Table 3 and Table 4 present the results of multinomial logistic regression analysis for males and females, respectively. All models were significantly better than the null-models, and for both genders, successive models significantly improved. For men Chi-square likelihood ratio tests for nested models yielded model 1 vs crude: X2(12) = 63.89, p<0.001 and model 2 vs model 1: X2(4) = 88.02, p<0.001. For women Chi-square likelihood ratio tests for nested models yielded model 1 vs crude: X2(6) = 58.64, p<0.001 and model 2 vs model 1: X2(4) = 209.03, p<0.001.The effects of the predictors showed some distinct differences for each of the three contrasts when looking at both tables for both males and females.

Table 1. Means (and standard deviations) for PROQ3 and RT-18 scores across alcohol use groups by gender

	Males					Females				
	Abstinent	NB Drinker	B drinker			Abstinent	NB Drinker	B Drinker		
	N=144 (14.1%)	N= 133 (13.0%)	N= 745 (72.9%)	KW-X2	p-value	N= 371 (19.1%)	N=351 (18.1%)	N=1218 (62.8%)	KW-X2	p-value
Age	22.0(2.7)	22.4(2.7)	22.2(2.5)	2.4	0.297	22.1(2.7)	22.3(2.5)	21.8(2.4)	8.2	0.016
PROQ3-UN	6.9(3.4)	6.8(3.4)	7.1(3.1)	1.2	0.536	5.9(3.3)	6.2(3.2)	6.3(3.1)	5.1	0.077
PROQ3-UC	3.4(2.8)	2.9(2.8)	3.7(2.8)	11.1	0.004	2.6(2.7)	2.5(2.6)	2.7(2.6)	2.5	0.291
PROQ3-NC	3.9(2.7)	4.1(2.7)	4.0(2.5)	0.2	0.886	3.9(2.8)	4.0(2.7)	4.1(2.7)	1.6	0.452
PROQ3-LC	5.4(3.5)	5.0(3.4)	4.5(3.1)	8.2	0.017	5.3(3.8)	5.3(3.4)	5.1(3.5)	1.5	0.465
PROQ3-LN	5.5(3.5)	5.3(3.1)	4.7(2.8)	9.7	0.008	4.9(3.3)	4.8(2.8)	4.5(3.0)	7.4	0.024
PROQ3-LD	4.7(3.0)	5.0(3.0)	4.0(2.6)	16.6	0.000	5.2(3.3)	5.3(3.1)	4.9(2.9)	5.8	0.055
PROQ3-ND	6.2(3.2)	6.6(3.3)	5.6(3.1)	13.4	0.001	5.8(3.6)	4.8(2.8)	4.9(3.1)	20.2	0.000
PROQ3-UD	4.5(3.5)	4.6(3.3)	5.4(3.1)	16.6	0.000	3.0(2.8)	2.9(2.6)	3.5(2.8)	22.6	0.000
RT18-RT	3.2(2.4)	3.4(2.3)	5.1(2.7)	96.3	0.000	2.2(2.1)	2.6(2.1)	4.0(2.5)	188.7	0.000
RT18-RA	1.3(1.7)	1.3(1.6)	2.3(2.1)	59.0	0.000	1.4(1.8)	1.3(1.6)	2.3(2.2)	113.9	0.000

Note: NB Drinker = non-binge drinker, B Drinker = binge drinker, PROQ3= Person's Relating to Others Questionnaire, UN = upper neutral, UC = upper close, NC = neutral close, LC = lower close, LN = lower neutral, LD = lower distance, ND = neutral distance, UD = upper distance, RT-18 = Risk Taking Questionnaire-18 items, RT = risk-taking, RA = risk assessment, KW-X2 = Kruskal-Wallis test

Table 2. Spearman correlations for risk-taking behavior (RT-18) and interpersonal relating (PROQ3) by gender

	RT	RA	UN	UC	NC	LC	LN	LD	ND	UD
RT18-RT	-	.41***	.06*	.03	.07*	-.06*	-.16***	-.14***	-.09**	.22***
RT18-RA	.38***	-	.027	.09***	.12***	.04	-.06	-.01	-.04	.18***
PROQ3-UN	.10***	.06**	-	.43***	.28***	.29***	-.08	.12***	.27***	.54***
PROQ3-UC	.02	.04*	.46***	-	.60***	.45***	.24***	.34***	.28***	.41***
PROQ3-NC	.02	.06***	.33***	.59***	-	.49***	.32***	.37***	.17***	.31***
PROQ3-LC	-.03	.00	.33***	.49***	.53***	-	.40***	.54***	.49***	.22***
PROQ3-LN	-.08***	-.10***	-.03	.25***	.34***	.40***	-	.53***	.28***	.00
PROQ3-LD	-.09***	-.08**	.21***	.35***	.41***	.57***	.55***	-	.38***	.00
PROQ3-ND	-.01	-.03	.28***	.31***	.22***	.49***	.32***	.41***	-	.29***
PROQ3-UD	.19***	.20***	.51***	.44***	.28***	.25***	.02	.06	.29***	-

Note: Above the diagonal are the Spearman correlations coefficients for males, below the diagonal are the Spearman correlation coefficients for females. * p<0.05, **p<0.01, and ***p<0.001. PROQ3 = Person's Relating to Others Questionnaire, UN = upper neutral, UC = upper close, NC = neutral close, LC = lower close, LN = lower neutral, LD = lower distance, ND = neutral distance, UD = upper distance, RT-18 = Risk Taking Questionnaire-18 items, RT = risk-taking, RA = risk assessment

Table 3. Multinomial Logistic regression model for males

	Non binge drinker vs abstinent		Binge drinker vs non binge drinker		Binge drinker vs abstinent	
	OR (95%CI)	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
Model crude						
Age	1.06 (0.97;1.16)	0.198	0.97 (0.90;1.04)	0.363	1.03 (0.96;1.10)	0.444
Model 1						
Age	1.04 (0.95;1.15)	0.360	0.98 (0.91;1.05)	0.572	1.02 (0.95;1.10)	0.544
PROQ3-UC	0.92 (0.83;1.03)	0.140	1.16 (1.07;1.27)	0.001	1.07 (0.99;1.16)	0.089
PROQ3-LC	0.93 (0.84;1.03)	0.161	0.99 (0.92;1.08)	0.903	0.93 (0.86;1.00)	0.050
PROQ3-LN	0.96 (0.87;1.05)	0.390	0.99 (0.92;1.07)	0.884	0.95 (0.89;1.03)	0.204
PROQ3-LD	1.11 (0.99;1.24)	0.085	0.89 (0.81;0.98)	0.013	0.98 (0.90;1.08)	0.724
PROQ3-ND	1.05 (0.96;1.15)	0.317	0.90 (0.84;0.97)	0.006	0.95 (0.88;1.01)	0.119
PROQ3-UD	1.04 (0.95;1.14)	0.342	1.06 (0.99;1.14)	0.111	1.11 (1.03;1.19)	0.004
Model 2						
Age	1.05 (0.95;1.15)	0.337	0.97 (0.90;1.05)	0.466	1.02 (0.94;1.10)	0.636
PROQ3-UC	0.92 (0.83;1.03)	0.148	1.16 (1.06;1.27)	0.001	1.07 (0.99;1.17)	0.102
PROQ3-LC	0.94 (0.85;1.03)	0.183	0.99 (0.91;1.07)	0.782	0.93 (0.86;1.00)	0.050
PROQ3-LN	0.96 (0.88;1.06)	0.432	1.01 (0.93;1.09)	0.812	0.97 (0.90;1.05)	0.456
PROQ3-LD	1.11 (0.99;1.24)	0.082	0.90 (0.82;0.99)	0.025	0.99 (0.91;1.09)	0.877
PROQ3-ND	1.05 (0.96;1.15)	0.316	0.92 (0.86;1.00)	0.039	0.97 (0.90;1.04)	0.391
PROQ3-UD	1.04 (0.95;1.13)	0.456	1.01 (0.94;1.09)	0.804	1.04 (0.97;1.12)	0.230
RT18-RT	1.04 (0.94;1.16)	0.433	1.20 (1.11;1.31)	0.000	1.25 (1.16;1.36)	0.000
RT18-RA	0.99 (0.84;1.16)	0.861	1.20 (1.06;1.36)	0.004	1.19 (1.05;1.34)	0.005

Note: Significant effects are shown in bold text. Model crude R2 = 0.00 (McFadden), 0.00 (Cox & Snell), 0.00 (Nagelkerke), X2 (2) = 1.29. Model 1 R2 = 0.04 (McFadden), 0.06 (Cox & Snell), 0.08 (Nagelkerke), X2 (14) = 65.18***. Model 2 R2 = 0.10 (McFadden), 0.14 (Cox & Snell), 0.18 (Nagelkerke), X2 (18) = 153.20***. * p<0.05, **p<0.01, and ***p<0.001. PROQ3 = Person's Relating to Others Questionnaire, UN = upper neutral, UC = upper close, NC = neutral close, LC = lower close, LN = lower neutral, LD = lower distance, ND = neutral distance, UD = upper distance, RT-18 = Risk Taking Questionnaire-18 items, RT = risk-taking, RA = risk assessment

For men, there were no significant predictors found for non-binge drinking vs abstinents, and age did not play a significant role in any of the models. In model 1 for the binge drinker vs non-binge drinker, three PROQ3 scales (UC, LD, and ND) were significant contributors to the model. When risk-taking and risk assessment were added to the model (i.e. model 2), they yielded significant effects, along with the three relating scales(LD, UC, ND),. At the final contrast (i.e., binge drinker vs. abstinent) different predictors were significant (LC and UD) for model 1. When adjusted for risk-taking behavior, the effect of LC remained, but the UD effect was no longer statistical significant, indicating clear confounding of this PROQ3 scale with one or both of the RT-18 subscales. Moderator analysis did not reveal any significant interaction terms of the risk-taking behavior subscales with the PROQ3 UD scale for men.

As presented in Table 4, ND was a highly significant predictor of the no binge drinking vs abstinent contrast for women (model 1), that remained unaltered in the second model, and was joined by the risk-taking subscale. For binge vs. non-binge drinkers, age was significant in all three models. The UD scale was the only PROQ3 predictor of alcohol use in model 1, but, when adjusted for risk-taking behavior, this effect was lost. Moderator analysis revealed no significant interaction terms. Examining the binge drinkers vs abstinents contrast in women, age was only significant in model1. Both ND and UD were significant in model 1, and these effects remained after adjusting for risk-taking behavior in model 2. Again the UD scale confounded with risk-taking behavior, but no effect was found in the moderator analysis.

Based on the logistic regression models, a path analysis was performed with the PROQ3 scales that were initially significant predictors of alcohol use in model 1, but decreased or even lost their effect after adjusting for risk-taking behavior. This was the UD scale in the binge drinker vs abstinent contrast for men and in the binge drinker vs non-binge drinker and binge drinker vs abstinent contrasts for women. Figure 2 depicts both the direct effects of the PROQ3 UD scale on alcohol use and the indirect effects through either risk-taking or risk assessment. By adding the direct and indirect effect, the total effect was obtained. All the direct and indirect as well as all the total effects were similar and close to zero, indicating that the UD scale had a significant but small association with alcohol use, and approximately half of the total effect could be explained as a direct effect of UD on alcohol use, and the other half could be explained as an indirect effect exerted through risk-taking behavior.

DISCUSSION

This study examined the relationship between interpersonal relating and binge drinking in young adults and the mediating role of risk-taking behavior. Gender differences were also explored.

The model for males showed that a somewhat complex pattern of PROQ3 scales predicted alcohol consumption, specifically for binge drinking compared to non-binge drinking. The UC scale increased the risk of binge drinking in such a way that the odds of belonging to the binge drinker group, even after adjusting for age and the PROQ3 scales LC, LN, LD, ND, and UD, increased 1.16 points for every point increase on the UC scale.

Table 4. Multinomial Logistic regression model for females

	Non binge drinker vs abstinent		Binge drinker vs non binge drinker		Binge drinker vs abstinent	
	OR (95%CI)	**p-value**	**OR (95%CI)**	**p-value**	**OR (95%CI)**	**p-value**
Model crude						
Age	1.03 (0.97;1.09)	0.336	0.93 (0.89;0.98)	0.004	0.96 (0.91;1.00)	0.083
Model 1						
Age	1.02 (0.96;1.08)	0.423	0.93 (0.89;0.98)	0.003	0.95 (0.90;0.99)	0.050
PROQ3-LN	1.03 (0.98;1.09)	0.228	0.97 (0.93;1.01)	0.110	1.00 (0.96;1.04)	0.894
PROQ3-ND	0.90 (0.85;0.95)	0.000	0.99 (0.95;1.04)	0.785	0.89 (0.86;0.93)	0.000
PROQ3-UD	1.03 (0.97;1.09)	0.360	1.09 (1.04;1.14)	0.001	1.12 (1.07;1.18)	0.000
Model 2						
Age	1.03 (0.97;1.09)	0.350	0.93 (0.89;0.98)	0.004	0.96 (0.91;1.01)	0.081
PROQ3-LN	1.04 (0.98;1.09)	0.177	0.98 (0.94;1.03)	0.439	1.02 (0.98;1.06)	0.401
PROQ3-ND	0.90 (0.85;0.94)	0.000	1.00 (0.96;1.05)	0.862	0.90 (0.86;0.94)	0.000
PROQ3-UD	1.03 (0.97;1.10)	0.353	1.02 (0.97;1.08)	0.366	1.05 (1.00;1.11)	0.040
RT18-RT	1.10 (1.02;1.19)	0.010	1.21 (1.14;1.28)	0.000	1.33 (1.25;1.41)	0.000
RT18-RA	0.93(0.84;1.02)	0.109	1.23 (1.14;1.33)	0.000	1.14 (1.06;1.22)	0.001

Note: Significant effects are shown in bold text. Model crude R2 = 0.00 (McFadden), 0.01(Cox & Snell), 0.01(Nagelkerke), X2 (2) = 10.14**. Model 1 R2 = 0.02 (McFadden), 0.03 (Cox & Snell), 0.04(Nagelkerke), X2 (8) = 68.77***. Model 2 R2 = 0.08 (McFadden), 0.13 (Cox & Snell), 0.16(Nagelkerke), X2 (12) = 277.80***. * p<0.05, **p<0.01, and ***p<0.001. PROQ3 = Person's Relating to Others Questionnaire, UN = upper neutral, UC = upper close, NC = neutral close, LC = lower close, LN = lower neutral, LD = lower distance, ND = neutral distance, UD = upper distance, RT-18 = Risk Taking Questionnaire-18 items, RT = risk-taking, RA = risk assessment

This effect was not influenced by risk-taking behavior. Both the LD and ND scales attenuated the odds of being a binge drinker instead of a non-binge drinker. When comparing binge drinking to abstinence, the PROQ3 UD scale predicted increasing odds for binge drinking. However, risk-taking behavior confounded UD scale scores. Interestingly, the LC scale significantly affects male alcohol consumption in such a way that when adjusted, the odds of belonging to the binge drinking group decreases .93 points for every point increase in the score on this subscale. Both RT-18 risk-taking and risk assessment scores exerted highly significant effects on alcohol consumption level. The heightened odds for binge drinking vs abstinence, attributable to UD, are clearly confounded by risk-taking behavior. The strongest correlations were between these risk-taking behavior scales and UD ($r = .22$ and $r = .18$, respectively), indicating that the more sadistic, intimidating and tyrannizing an individual perceives his / her relating to others, the more likely is that he/she engages in risk-taking behaviors and thinks less about the consequences of these choices. We must note that these correlations, albeit highly significant, were weak. A path analysis conducted to explore the direct effect of UD on alcohol use and the indirect effect via RT-18 risk-taking or risk assessment, showed that both were very close to zero. Therefore, we conclude that for the males, the UD scale exerted no clinically relevant influence on alcohol use, but that the UD scale shares some variance with both RT-18 subscales, and must therefore measure a part of the same construct. Taken together, it seems that the PROQ3 subscales exerted independent and opposite effects on alcohol consumption, whereas UC increased the odds of binge drinking and LC, LD, and ND decreased these odds.

A different pattern of effects emerged for the females. Where there was no effect of interpersonal relating on the non-binge drinking versus abstinent contrast in men, there was a highly significant one for women. The ND scale decreased the odds of belonging to the non-binge drinkers versus abstinents, and this effect remained after adjusting for risk-taking and risk assessment. There were no significant correlations between either of the risk-taking behavior scales and ND which confirms the finding that there is no confounding in this particular case. The UD scale increased the odds of binge drinking compared to non-binge drinking, similarly to men, but this effect was lost when the risk-taking behavior scales were introduced. The odds of being a binge drinker instead of being abstinent were also significantly influenced by UD and ND, even after adjusting for risk-taking behavior, except for UD which indicates confounding with risk-taking and risk assessment. So, as with the men, UD (i.e. perceiving oneself as being sadistic and intimidating) increases the odds of binge drinking, and is positively related with both risk-taking and risk assessment. Similarly to the models for men, path analysis showed that the total effect of the PROQ3 UD scale was very close to zero. Interestingly, the ND scale (perceiving oneself as being suspicious, uncommunicative and self-reliant when relating to others), was predictive for two contrasts, decreasing the odds of alcohol consumption per se without distinguishing between non-binge and binge drinking. This effect was not confounded by risk-taking behavior, and both risk assessment and risk-taking significantly increased the odds of binge drinking, similar to the pattern found for men, with the exception that risk-taking also increased the odds of non-binge drinking versus abstinence.

The UD scale correlated the most with risk-taking behavior, when assessed as a personality trait using the RT-18, but not when assessed with real world risk behavior like (risky) alcohol consumption. The men scored significantly higher than females on the UD scale across all alcohol consumption levels. The ND scale seems to be related to alcohol use but decreases the odds of (risky) alcohol consumption. Interestingly, the LC and LD scales decreased the odds of binge drinking but only for men. Birtchnell et al. (2009) reported that prisoners scored significantly higher on the PROQ2 (the previous longer version) and PROQ3 than non-imprisoned men (those in a medium secure psychiatric hospital), especially on the LC, and ND scales. Scores on the UD scale were higher for prisoners than the non-prisoners as measured with the PROQ2, but not with PROQ3 (Birtchnell et al, 2009). Another study (Newberry & Birtchnell, 2011) reported higher UN, LN and ND scores for offenders compared to non-offenders, and the UD scale differentiated between the type of offences, with, for instance, violent offenders, dishonest offenders, and robbers scoring higher on UD than homicide and sex offenders. ND did not differentiate offence type. Kalaitzaki, Birtchnell, & Kritsotakis (2010) have shown that the PROQ2 upper scales (i.e., UN, UC, and UD) differentiate between the perpetrators of aggression in dating relationships from those who were neither aggressors nor victims of aggression by their dating partners. Moreover, Birtchnell (1997) proposed the interpersonal octagon as the framework in which personality disorders can be defined, and later, Birtchnell and Shine (2000) empirically examined the placement of personality disorders on the octagon. Antisocial personality disorders should to be located upon the UD scale. There is a clear link between antisociality and alcohol use disorders, and men are more likely to show symptoms of antisociality and delinquency than females (Nolen-Hoeksema, 2004). It could be speculated that the PROQ3 UD scale and the RT-18 risk-taking behavior scales tap into a source of shared variance, and this source could very well be the very broad concept of behavioral disinhibition. High levels of the perception of negative relating, risk-taking behavior and (risky) alcohol consumption can all be seen as expressions of behavioral disinhibition, for they are genetically linked (Krueger, Markon, Patrick, & Iacono, 2005). Moreover, Young et al. (2009) reported behavioral disinhibition in adolescence to be a risk factor for developing externalizing spectrum disorders. The negative association between the PROQ3 LC, LD, and ND scales with alcohol consumption is something that we did not expect to find since LC appears to be the most clear-cut indicator of psychopathology; it was correlated with almost all of the DSM-IV personality disorders (Birtchnell & Shine, 2000).

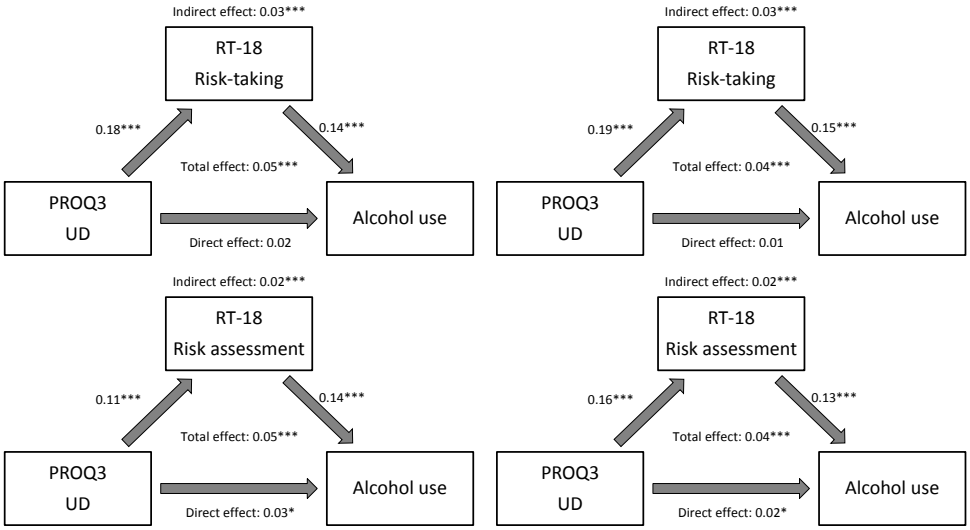
Several limitations with this study should be acknowledged. First, this study, like many others in this field, relied on self-report measures. It might be that there are discrepancies in how an individual perceives and reports his/her behavior, and this applies to all measures used in this study (i.e. interpersonal relating, risk-taking behavior, and alcohol use). Second, only students from Utrecht University were assessed, which limits the generalizability of these results. Third, since this was an exploratory study, the relationship between interpersonal relating, risk-taking behavior, and alcohol use was examined without any prior hypotheses. The effects found in this analysis should be replicated in studies with clear hypotheses regarding this triangular relationship to obtain more insight.

In conclusion, it seems that the PROQ3 UD scale shows some overlap with the risk-taking behavior subscale of the RT-18. However, we cannot explain why the PROQ3 LC, LD and ND scale scores decreased the odds of drinking alcohol or binge drinking. Moreover, we found some distinct differences between males and females which could be a relevant lead towards understanding risky alcohol consumption in young adults. However, more research is needed to further explore the relationships between negative interpersonal relating and risk-taking behaviors.

ACKNOWLEDGEMENTS

For this study data from the Utrecht Student Survey was used. The Utrecht Student Survey was supported by a grant from Red Bull GmbH (Fuschl am See, Austria). Red Bull GmbH was not involved in the design and implementation of the study; collection, management, analysis, interpretation of the data, or the preparation of the manuscript.

Figure 2. Path analysis for interpersonal relating, risk-taking behavior and alcohol use by gender



Note: The left panels depict effects for males and the right panels depict effects for females. *p <0.05, **p <0.01, and ***p <0.001. PROQ3 = Person's Relating to Others Questionnaire, UD = upper distance, RT-18 = Risk Taking Questionnaire-18 items

REFERENCES

Aluja, A., Rossier, J., García, L. F., Angleitner, A., Kuhlman, M., & Zuckerman, M. (2006). A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to English, French, German, and Spanish languages. Personality and Individual Differences, 41(4), 619-628.

Anda, R. F., Whitfield, C. L., Felitti, V. J., Chapman, D., Edwards, V. J., Dube, S. R., & Williamson, D. F. (2002). Adverse childhood experiences, alcoholic parents, and later risk of alcoholism and depression. Psychiatric Services, 53(8), 1001-1009.

Birtchnell, J., & Shine, J. (2000). Personality disorders and the interpersonal octagon. Psychology and Psychotherapy: Theory, Research and Practice, 73(4), 433-448.

Birtchnell, J. (1997). Attachment in an interpersonal context. British Journal of Medical Psychology, 70(3), 265-279.

Birtchnell, J., Hammond, S., Horn, E., De Jong, C., and Kalaitzaki, A. (2013). A Cross-National Comparison of a Shorter Version of the Person's Relating to Others Questionnaire. Clinical Psychology & Psychotherapy, 20(1), 36-48.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychological Bulletin, 125(3), 367-383.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Archives of General Psychiatry, 50(12), 975-990.

Cox, D. R., & Snell, E. J. (1989). Analysis of binary data. USA: CRC Press.

de Haan, L., de Haan, H., Olivier, B., & Verster, J. (2012). Alcohol mixed with energy drinks: Methodology and design of the Utrecht student survey. International Journal of General Medicine, 5, 889-898.

de Haan, L., Kuipers, E., Kuerten, Y., van Laar, M., Olivier, B., & Verster, J. C. (2011). The RT-18: A new screening tool to assess young adult risk-taking behavior. International Journal of General Medicine, 4, 575-584.

De Jong, C.A.J., Van den Brink, W., & Jansma, A. (2000). ICL-R: Manual for the revised Dutch version of the interpersonal checklist (ICL). [Handleiding bij de vernieuwde Nederlandse versie van de Interpersonal Checklist (ICL)]. Sint Oedenrode: Novadic.

Donovan, J. E. (2004). Adolescent alcohol initiation: A review of psychosocial risk factors. Journal of Adolescent Health, 35(6), 529- 529.

Eriksson, K., & Simpson, B. (2010). Emotional reactions to losing explain gender differences in entering a risky lottery. Judgment and Decision Making, 5(3), 159-163.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985).Age norms for impulsiveness, venturesomeness and empathy in adults. Personality and Individual Differences, 6(5), 613-619.

Eysenck, S. B., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. Psychological Reports, 43(3f), 1247-1255.

Hermens, D. F., Lagopoulos, J., Tobias-Webb, J., De Regt, T., Dore, G., Juckes, L., Latt, N., & Hickie, I. B. (2013). Pathways to alcohol-induced brain impairment in young people: A review. Cortex, 49(1), 3-17.

Harman, H.H. (1976) Modern factor analysis. Chicago, IL: University of Chicago Press.

Kalaitzaki, A.E., Birtchnell, J. & Kritsotakis, E. (2010). The associations between negative relating and aggression in the dating relationships of students from Greece. Partner Abuse: New Directions in Research, Intervention, and Policy, 1(4), 420-442.

Krueger, R. F., Markon, K. E., Patrick, C. J., & Iacono, W. G. (2005). Externalizing psychopathology in adulthood: A dimensional-spectrum conceptualization and its implications for DSM-V. Journal of Abnormal Psychology, 114(4), 537- 550.

McCambridge, J., McAlaney, J., & Rowe, R. (2011). Adult consequences of late adolescent alcohol consumption: A systematic review of cohort studies. PLoS Medicine, 8(2), e1000413.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. NewYork: Academic Press.

Mohr, C. D., Armeli, S., Tennen, H., Carney, M. A., Affleck, G., & Hromi, A. (2001). Daily interpersonal experiences, context, and alcohol consumption: Crying in your beer and toasting good times. Journal of Personality and Social Psychology, 80(3), 489-500.

Nagelkerke, N. J. (1991). A note on a general definition of the coefficient of determination. Biometrika, 78(3), 691-692.

Newcomb, M. D., & Bentler, P. M. (1989).Substance use and abuse among children and teenagers. American Psychologist, 44(2), 242-248.

Nolen-Hoeksema, S. (2004).Gender differences in risk factors and consequences for alcohol use and problems. Clinical Psychology Review, 24(8), 981-1010.

RCoreTeam. (2014). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.

Rogers, R. D., Owen, A. M., Middleton, H. C., Williams, E. J., Pickard, J. D., Sahakian, B. J., & Robbins, T. W. (1999). Choosing between small, likely rewards and large, unlikely rewards activates inferior and orbital prefrontal cortex. The Journal of Neuroscience, 19(20), 9029-9038.

Sher, K. J., Bartholow, B. D., & Wood, M. D. (2000). Personality and substance use disorders: A prospective study. Journal of Consulting and Clinical Psychology, 68(5), 818-829.

Sher, K. J., Grekin, E. R., & Williams, N. A. (2005). The development of alcohol use disorders. Annual Review of Clinical Psychology, 1, 493-523.

Sobell, L. C., Agrawal, S., Sobell, M. B., Leo, G. I., Young, L. J., Cunningham, J. A., & Simco, E. R. (2003). Comparison of a quick drinking screen with the timeline followback for individuals with alcohol problems. Journal of Studies on Alcohol and Drugs, 64(6), 858-861.

Stautz, K., & Cooper, A. (2013). Impulsivity-related personality traits and adolescent alcohol use: A meta-analytic review. Clinical Psychology Review, 33(4), 574-592.

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. Developmental Review, 28(1), 78-106.

Steinberg, L. (2005). Cognitive and affective development in adolescence. Trends in Cognitive Sciences, 9(2), 69-74.

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., &Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. Developmental Psychology, 44(6), 1764-1778.

Witt, E. D. (2010). Research on alcohol and adolescent brain development: Opportunities and future directions. Alcohol, 44(1), 119-124.

World Health Organization.(2014). Global status report on alcohol and health-2014. Luxembourg: World Health Organization.

Young, S. E., Friedman, N. P., Miyake, A., Willcutt, E. G., Corley, R. P., Haberstick, B. C., & Hewitt, J. K. (2009). Behavioral disinhibition: Liability for externalizing spectrum disorders and its genetic and environmental relation to response inhibition across adolescence. Journal of Abnormal Psychology, 118(1), 117-130.

Zaleskiewicz, T. (2001). Beyond risk seeking and risk aversion: Personality and the dual nature of economic risk taking. European Journal of Personality, 15(S1), S105-S122.

Zuckerman, M. (2002). Zuckerman-Kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model, In B.E. de Raad, & M.E. Perugini (Eds.) Big five assessment (377-396). Ashland: Hogrefe & Huber Publishers.

Chapter 9

Summary & General Discussion

Healthcare is built on decisions. In order to make a decision, the potential benefits and risks need to be judged. Some individuals seem inclined to take more risk, where others come across as risk averse. Such a general predisposition towards risks (e.g. risk-taking or risk-avoiding) can have great impact on the decisions made and the behavior displayed by that individual, whether it concerns a healthcare professional or a patient. This thesis focused on individual differences in risk-taking behavior by assessing the underlying psychological component as well as the actual expressed risk behavior. A better understanding of risk behavior in a medical setting could be beneficial. For instance, patients with a very high or very low preference for risk can be identified and (pharmacological) treatment can be adjusted to improve treatment-outcome.

Risks can in general be categorized as financial, social, legal, physical or psychological. This thesis focused on the physical and psychological risk domains. We assume that individuals with a preference for risk-taking, are more likely to engage in risk behavior (e.g., reckless driving, practicing extreme sports, unhealthy eating, practicing unsafe sex, substance use), and thus place themselves more at-risk for physical and or psychological harm. Besides risk behaviors that have the potential to directly influence an individuals' health and well-being in general, the risk-taking behavior construct is also thought to exert a substantial influence on the (risk) behavior of patients, especially in the case of medication non-adherence.

We argue that risk-taking behavior is an expression of a personality construct as is postulated by the emotional research field. Moreover, impulsivity, venturesomeness, novelty seeking and sensation seeking, can be combined into one overarching personality trait, that we have referred to as risk-taking behavior. Risk-taking behavior is thought to be a more general predisposition that is relatively stable over time (Dahlbäck, 1990), and is hypothesized to be a continuous personality trait with high levels of risk-taking at one end and risk averseness at the other.

Certain groups of individuals have been identified, that display more risk behaviors than others. Men, individuals practicing certain professions or sports that require a risk-accepting attitude, adolescents, young adults, and certain psychiatric patient-groups are known to take –on average- more risks (Fineberg et al., 2010).

Taken together, one's specific constitution of risk-taking behavior lies at the basis of many health related decisions and risk behaviors. We have therefore developed a new instrument, the Risk-Taking questionnaire 18 items (RT-18) to measure the postulated personality trait of risk-taking behavior at an individual level.

The aim of this thesis was two-fold:

1. To develop and psychometrically validate a new instrument (RT-18) to assess risk-taking behavior
2. To assess the association between RT-18 and various expressions of risk-taking behavior

In this general discussion we will summarize and discuss our findings regarding the development and validity of the RT-18 and the associations we found between the risk-taking behavior assessed with the RT-18 and risk behavior. In addition, we will give directions for future research and implications for (pharmaceutical) care. Finally, we will conclude the main outcomes of this thesis.

Development of the Risk-Taking questionnaire 18 items

The new instrument is presented in Chapter 2. The RT-18 assesses risk-taking behavior at an individual level. The final form of the RT-18 was derived from combining items from three widely used personality assessment instruments; the novelty-seeking dimension (TCI-ns) from Cloninger's Temperament and Character Inventory (Cloninger, Svrakic, & Przybeck, 1993), the impulsiveness (IVE-i) and venturesomeness (IVE-v) subscales from the Impulsiveness-Venturesomeness-Empathy (IVE) questionnaire (S. B. G. Eysenck, Pearson, Easting, & Allsopp, 1985), and the impulsive sensation seeking scale (ZKPQ-ImpSS) from the Zuckerman Kuhlman Personality Questionnaire Cross-cultural 50-item version (Aluja et al., 2006; Zuckerman, 2002). So, instead of defining a completely new set of items, we have chosen to combine items from existing instruments that measure what we think are "sub-traits" of risk-taking behavior, in a data driven manner. In other words, the idea behind the RT-18 is that novelty-seeking, impulsivity, venturesomeness, and sensation seeking all measure a certain aspect of the overarching risk-taking behavior personality trait.

Rather than combining all items from these four validated scales (i.e., 65 in total) into a very long, not easily implemented instrument, we have narrowed down the items to those that together could predict 90% of the outcome on the entire list of 65 items. We have also slightly altered the response format of the original 65 items to achieve more coherence within the new set of items and to prevent subjects getting confused by different response formats. The RT-18 now comprises 18 dichotomous yes/no statements, instead of some items with a true/false format. Although we have based the RT-18 response format on the original dichotomous response formats of the four subscales providing the items, it might be that such a forced choice is frustrating subjects that feel neither answers apply to them (Arnett, 1994). It seems a worthwhile endeavor to explore the possibilities of other response formats for the RT-18 in the future, such as the five-point Likert scale, that allows for a more gradual differentiation in responses to the items. A Likert scale response format also facilitates most statistical analyses, from factor analysis to regression analyses, for the simple fact that it introduces more variance in the data (i.e. the item-responses are more spread across a range instead of belonging to one of just two groups).

However, the dichotomous response format and the fact that we have reduced the instrument to only 18 items, do allow for a rapid completion by subjects. We have experienced that on average 2-5 minutes are sufficient to fill out the RT-18. This relatively short duration decreases the requested effort from the subject or patient. As pointed out by Allen et al. (2009), brief and easy-to-score measures facilitate standardized assessment procedures (Allen, Donohue, Sutton, Haderlie, & Lapota, 2009). Moreover, by keeping the questionnaire as short as possible, subject boredom is avoided, thereby increasing the chance of completion, which is, in the case of highly impulsive subjects, a major advantage.

In Chapter 2 we discovered through the use of exploratory factor analysis that the RT-18 could be best divided into two factors or subscales of nine items each. We have attempted to explain this division by concentrating on the content of the items that aggregated. The first subscale, risk-taking, comprises items mainly assessing actual risk-taking behavior. Sample items are; "I sometimes do crazy things just for fun", "I sometimes like to do things that are a little frightening", and "I enjoy getting into new situations where you can't predict how things will turn out". Whereas the second subscale, risk assessment, comprises items regarding risk assessment (i.e. thinking about the potential consequences of risky behaviors or choices); "I often follow my instincts, hunches, or intuition without thing through all the details", "I usually think about all the facts in detail before I make a decision", and "Do you mostly speak before thinking things out?". From the contents of the items in each of the two factors we have deduced the following: a high score on the risk-taking subscale reflects a high level of actual risk-taking behavior of an individual and a high score on the risk assessment subscale indicates a low level or less consideration of possible consequences (i.e. 'not thinking something trough'). From these two factors it follows that risk-taking behavior does not only constitute actual risk-taking, but also risk avoidance, and how consciously we make the decision of taking the risk or avoiding it. Smith and Combs state that distinguishing among the different processes leads to more homogeneous measures of personality risk for impulsive action and that when a single score is used to represent multiple processes that correlate only modestly with each other, the meaning of individual differences in such scores is unclear; the result is theoretical imprecision and scientific uncertainty (Dick et al., 2010; Smith & Combs, 2010). To that extent, we have chosen to drop the use of the total score of the RT-18 and to continue using only the two factor or subscale scores.

When we compare our two RT-18 factors to other factors and or scales of instruments measuring risk-taking behavior or similar constructs in the vast amount of existing literature, we observe some theoretic or methodological overlap with other instruments. In a review describing varieties of impulsivity, several instruments and accompanying hypothetical constructs are mentioned that assess impulsivity related traits (Evenden, 1999). From these instruments the RT-18 seems to have a reasonable overlap in construct with for instance a multifactorial concept of impulsivity postulated within the EASI Temperament Survey by Buss and Plomin that consists of four factors; inhibitory/impulse control, lack of persistence, decision time, and boredom/sensation seeking (Buss & Plomin, 1975; Plomin, 1976). Some items also show a considerable amount of similarity especially with RT-18 items derived from the TCI-ns. For

instance “I like to spend my money right away rather than save it for long-range goals” from the EASI impulse control items is very similar to the RT-18 risk assessment items “I enjoy saving money more than spending it on entertainment or thrills” and “often spend money until I run out of cash or get into debt from using too much credit”. The same goes for the EASI Decision time items, for instance “Before I do something I like to have every detail spelled out”, which is almost synonymous with the RT-18 risk assessment item “I usually think about all the facts in detail before I make a decision”.

Other scales like the impulsivity scale (i.e. acting on the spur of the moment, non-planning, preference for speed rather than accuracy, and care-freeness. Item example: “I usually ‘talk before I think”) and the monotony avoidance/sensation seeking scale (i.e. avoiding routine, thrill seeking, and need for change and action. Item example: “I am always keen on trying out things that are all new”) from the Karolinska Scales of Personality (af Klinteberg, Magnusson, & Schalling, 1986), also show overlap with the RT-18 items. And overlap is also present with item-content and theoretical concepts of the Barratt Impulsiveness Scales (BIS; see (Stanford et al., 2009) for a comprehensive review). This is also evident from the fact that the (ideo) motor impulsivity (i.e. acting without thinking), cognitive impulsivity (i.e. making quick cognitive decisions) and careful planning (i.e. paying attention to details) scales from the BIS significantly correlated with impulsiveness (IVE-i), but not with venturesomeness (IVE-v)(Barratt, 1985; Luengo, Carrillo-De-La-Pena, & Otero, 1991). Interestingly, the IVE from Eysenck and Eysenck was created after Eysenck and Zuckerman investigated the relation between their scales, impulsivity and sensation seeking (S. B. Eysenck & Eysenck, 1978). Impulsivity was thought to be defined by three factors; narrow impulsivity, risk-taking, and non-planning. Sensation seeking was defined by four factors; thrill-and-adventure-seeking, experience seeking, disinhibition, and boredom susceptibility. Some of these concepts overlapped considerably in theoretical construct, as was noted by Eysenck and Zuckerman. Furthermore, Barratt concluded that narrow impulsivity was similar to motor impulsiveness, and that non-planning was similar to the Eysencks’ factor of the same name. The Eysencks’ risk-taking factor was regarded as more akin to sensation-seeking than to impulsiveness (Barratt, 1985; Luengo et al., 1991). Eysenck and Zuckerman performed a factor analysis on all items from both scales together, however, it did not result in the expected 7 factors, but yielded two larger factors. These were labelled impulsiveness (i.e. doing and saying things without thinking) and venturesomeness (i.e. corresponding to the risk-taking and thrill- and adventure-seeking items) (S. B. Eysenck & Eysenck, 1978; Luengo et al., 1991). These two factors, impulsivity and venturesomeness also seem to have a great deal of overlap in their theoretical constructs with both RT-18 scales risk-taking and risk assessment. Our risk assessment factor is constructed from three venturesomeness items (IVE-v), five ImpSS items and one TCI-ns item. Based on the item content, we have described this factor as actual risk-taking behavior. And the second RT-18 factor, risk-assessment (i.e. thinking about the potential consequences of risky behaviors or choices), that consists of three impulsivity items (IVE-i), one ImpSS item and five TCI-ns items, seems to be measuring the exact same thing as the Impulsivity factor from Eysenck, albeit that we have interpreted this concept slightly different, and logically

feel that our interpretation of both factors is a better fit to the item-content. Moreover, we feel that our two factors make more sense as a theory underlying risk-taking behavior, but this remains speculation for personality traits remain latent concepts and can therefore not be true or untrue, they can only be useful or useless (S. B. Eysenck & Eysenck, 1978).

To determine whether the RT-18 indeed measures risk-taking behavior as it was intended to, and to assess whether the two factor-analytical derived subscales, risk-taking and risk assessment, indeed represent a "real world behavior", the validity of the RT-18 needed to be studied.

Validation of the RT-18

To establish the validity and reliability of the RT-18 as a new measure of risk-taking behavior, the following research questions needed to be answered; 1) do the items measure the same construct, 2) can (individual) scores be replicated over time and testing situations, 3) does it differentiate groups known to be high or low in risk-taking, 4) does it converge with similar measures or other methods assessing risk-taking behavior, and 5) does it predict future risk-taking and risk behaviors (i.e. clinical validation) (John & Benet-Martinez, 2000)? Key point of these questions is whether the measurements obtained with the RT-18 are generalizable? Or in other words, to what extent can results obtained with the RT-18 be transferred (i.e. generalized) to people or situations other than those originally studied? If not, it makes no sense trying to predict future risk behavior, and the utility of the RT-18 can be doubted.

The first question -do the items measure the same construct- refers to the internal consistency of both RT-18 scales. Measures of internal consistency reflect the coherence of the components or items; internal consistency is low, when items are heterogeneous in content and lack content saturation (John & Benet-Martinez, 2000). The internal consistency of a scale can be expressed as Cronbach's alpha. In Chapters 2, 3 and 4, we found Cronbach's alpha to be satisfactory for the risk-taking subscale (ranging from 0.69-0.84). The risk assessment subscale yielded similar ranges of internal consistency (0.69-0.79). Values between 0.70 and 0.90 are widely accepted as sufficient (De Vet, Terwee, Mokkink, & Knol, 2011). Bland and Altman, however, define two sets of criteria for the Cronbach's alpha: for scales which are used as research tools to compare groups, alpha may be less than in the clinical situation, when the value of the scale for an individual is of interest. For comparing groups, alpha values of 0.7 to 0.8 are regarded as satisfactory. For the clinical application, much higher values of alpha are needed. The minimum is 0.90, and alpha=0.95, is desirable (Bland & Altman, 1997). Some discrepancies in the literature regarding the optimal values of alpha exist, for Tavakol and Dennink state that values of alpha above 0.90 may suggest redundancies and show that the test length should be shortened (Tavakol & Dennick, 2011). Although it is a widely used measure of reliability, Cronbach's alpha is an approximation of the internal consistency and is known to underestimate the reliability (Cortina, 1993).

Moreover, Cronbach's alpha is positively influenced by the number of items of a scale (i.e. the more items, the higher α becomes) (Cortina, 1993). Hence, a high coefficient alpha does not always mean a high degree of internal consistency.

Another way to look at unidimensionality is to calculate inter-item correlations. Unpublished results showed that the mean tetrachoric inter-item correlation was 0.47 (±0.11) for risk-taking, and 0.44 (±0.14) for risk assessment, based on n=5525 from the online Utrecht Student Survey (de Haan, de Haan, Olivier, & Verster, 2012). Taken together (i.e., the Cronbach's alphas and the inter-item correlations), this gives a good indication that the RT-18 possesses sufficient internal consistency in that it does not have highly redundant items and the items of each subscale measure a similar construct. However, we did not replicate the inter-item correlations in other samples, and since ideally these values should be somewhat lower, we could have researched if certain items can be replaced in such a way that inter-item correlations are lowered. So, the internal consistency is sufficient, but there is room for improvement.

Besides from determining whether the items in a subscale measure the same construct, it might also be that we have "missed" out on items necessary to validly measure that construct. When more than 15% of the respondents achieve the lowest or highest possible score on a particular instrument, we can speak of a floor or ceiling effect, respectively. If floor or ceiling effects are present, it is likely that extreme items are missing in the lower or upper end of the scale, indicating limited content validity (Terwee et al., 2007). We have calculated the dispersion of scores across both RT-18 subscales in the Utrecht Student Survey sample (unpublished results) and did not find any indication of floor or ceiling effects for the risk-taking subscale (from n=5525 11.0% had a minimal score, whereas 4.3% scored maximal). For the risk assessment subscale, however, we found a floor effect: 28.3% scored zero. There was no ceiling effect present (0.4% scored the maximal nine points). This floor effect found for risk-taking could perhaps be fixed, either by using a different response format (like a five-point Likert scale) or by adding or more preferably changing items, so that the entire range of natural occurring scores on risk assessment is represented in the RT-18. We feel that such a floor effect is not a fatal flaw, but since practically one third of the scores were clustered as being similar, it is certainly worthwhile to improve sensitivity for "thinking everything through" within the RT-18 risk assessment scale. Or put more simply, items need to be replaced or new items need to added that ensure a better measurement range within the risk assessment scale, especially on the lower end. So more items are needed that evaluate subjects that are non-impulsive, well planned, and make thorough risk assessments thereby considering all details.

We assessed the second question -whether scores can be replicated over time and testing situations-, by examining the test-retest reliability (intra-rater reliability) of the RT-18 in two samples (see Chapter 3). The first sample comprised 109 students that completed the RT-18 twice, with 31 days in between and the second sample were 60 students who completed the RT-18 for the second time on average 25 (±14.6) days later. IntraClassCorrelations were calculated and ranged for risk-taking from 0.82 to 0.96. For risk assessment this range was 0.76-0.93. Often 0.70 is recommended as a minimum standard for reliability (Terwee et al., 2007). The time period between the repeated

administrations should be long enough to prevent recall and short enough to ensure that 'real' change in the personality construct has not occurred (Terwee et al., 2007). We assumed the RT18 to measure a temporal stable construct. Since we have used assessment intervals ranging from 2-3 weeks to 4-6 weeks, and it is argued that a 2-3 month period might be long enough for behavior to change (Chmielewski & Watson, 2009; Roberts, Walton, & Viechtbauer, 2006), we think this assumption was not violated.

We have to note that, since we chose to base our risk-taking behavior measure on self-report, this might limit the reliability of the RT-18. Self-report is a fast, cheap and easily implementable method (Cyders & Coskunpinar, 2011). However, self-report also has some disadvantages that we will briefly discuss here. Self-report relies heavily on the ability and willingness of the subject to provide a valid report (John & Benet-Martinez, 2000). Several 'systematic errors' have been described to confound self-report, usually placed under the umbrella-term 'response bias'. Examples are acquiescence, disaquiescence, recall bias and response extremeness (Coughlin, 1990; John & Benet-Martinez, 2000; Podsakoff, MacKenzie, & Podsakoff, 2012). We were aware of this issue and when possible, our samples were obtained through online assessments (USS, diary), hence no physical tester-participant interactions were needed. Research indicates that self-report becomes more reliable as the level of anonymity increases (Barry, 2001; Buchanan, 2002) (Buchanan and Smith, 1999). Further, if feasible, we asked participants whether they had truthfully responded to all items and deleted those participants who did not, to maximize reliability. When tester-participant interactions were necessary, for instance in the sample used in Chapter 4, we have sought to achieve maximal (feeling of) anonymity for our subjects. However, these methods are attempts to improve reliability, but do not guarantee good or improved reliability.

To answer the third question – whether the RT18 differentiates groups known to be high or low in risk-taking - we have found evidence across multiple studies that this is the case. For instance, sex-differences in risk-taking behavior are well known; men typically are more likely to engage in risky behavior than women (Byrnes, Miller, & Schafer, 1999). In Chapter 2, men scored higher on all individual items of the RT-18 (n=7834 partygoers), apart from items 1, 9, and 12, all three belonging to the risk assessment subscale. These findings are partly confirmed in Chapter 4, where men scored higher on risk-taking (significant median difference of 1.0 points), but not on risk assessment (non-significant median difference of 1.0 points) in a sample of 109 students. In the fifth chapter gender differences on RT-18 scores were assessed using a sample of 2116 males and 3886 females, men scored significantly higher on risk-taking (mean difference of 1.2) and risk assessment (mean difference of 0.2). Although the observed effects are in line with the expected effects (i.e. men score higher than females), the smallest detectable change (SDC) was calculated in Chapter 3 to be between 2.5-2.8 points for risk-taking and between 2.7-3.1 for risk assessment. These are rather large values when taking into account that both scales range from 0 to 9 points. Despite these large SCD values, we think this does not affect our judgment about the validity of the RT18 in these samples, for the simple reason that the RT18 was intended as an instrument to screen for risk-taking behavior rather than an instrument capable of measuring change over time very precisely. To that extent, the SDC is something to keep in mind, but not of the utmost importance when determining the reliability of the RT18.

Moreover, RT-18 total scores were significantly different between abstinent individuals (mean=7.11), social drinkers (mean=7.80) and recreational drug users (mean=10.26) in the 7834 partygoers of Chapter 2. Chapter 5 (male n=2116, female n=3886) showed that both risk-taking and risk assessment increased the odds of binge drinking versus non-binge drinking. More specifically, the odds of binge versus non-binge drinking or abstinence increased 4.1 times for males with the highest score on the risk-taking subscale. This difference was 2.8 in women. The odds of binge versus non-binge drinking were 3.8 times greater for men with a high score on risk assessment. For women with high risk assessment scores, odds of binge versus non-binge drinking, and binge drinking versus abstinence, were 3.8 and 2.2, respectively. Moreover, risk-taking also increased the odds of non-binge drinking versus abstinence, but this effect was only present in females. The odds of non-binge drinking versus abstinence were 2.6 times greater for high risk-taking females.

The fourth question was the notion of construct validity. Construct validity refers to the extent to which scores on a particular instrument relate to other measures in a manner that is consistent with theoretically derived hypotheses concerning the concepts that are being measured (Terwee et al., 2007). Convergence with other measures and methods assessing risk-taking behavior is explored in several stages. We have compared scores on the RT-18 subscales to scores on the four subscales that provided the items for the RT-18 in Chapter 4. As expected we found high correlations, with risk-taking correlating highest with the ZKPQ-ImpSS scores (ϱ=0.89), and the IVE-v (ϱ=0.75). Risk assessment showed the strongest correlations with the IVE-i (ϱ=0.85) and the TCI-ns (ϱ=0.76). This finding confirms that both RT-18 scales represent related but distinct aspects of the risk-taking behavior construct.

RT-18 scores were also compared to four other questionnaires measuring risk-taking behavior through self-report in Chapter 4 using a sample of 109 students. Some of these instruments focus more on the personality construct risk-taking behavior underlying all risk-taking and risk avoiding behaviors, and others have their focus more on quantifying the individual level of expression of (specific) risk behaviors. The Domain Specific Risk-Taking Scale (DOSPERT; (Blais & Weber, 2006; Weber, Blais, & Betz, 2002) comprises two assessments very similar in concept to the RT-18; risk-taking and risk perception. RT-18 risk-taking was correlated to both DOSPERT scales, as was RT-18 risk assessment. The Evolutionary Valid domain-Specific Risk-Taking Scale (EVDSRTS; (Kruger, Wang, & Wilke, 2007)) that assesses risk-taking in a different format (i.e., the types of challenges that humans faced during their evolutionary history), also correlated with the two RT-18 subscales. Both the Risk Scenario Questionnaire (RSQ; (Rohrmann, 2002; Rohrmann, 2005)) and Risk Propensity Questionnaire (RPQ; (Rohrmann, 2002; Rohrmann, 2005)) correlated with the RT-18 subscales. These correlations ranged from ϱ=0.23 to ϱ=0.71, which proofs convergent validity of the RT-18 with instruments of the same method (i.e. questionnaire-based self-report). In Chapter 2, using a sample of 903 students, RT-18 risk-taking correlated with the stimulating risk-taking scale (r=0.59) and the instrumental risk-taking scale (r=0.25) of the Stimulating-Instrumental Risk Inventory (SIRI; (Zaleskiewicz, 2001)). RT-18 risk assessment also correlated with stimulating risk-taking (r=0.36), and with instrumental risk-taking (r=0.08).

At the moment, there is no gold standard available for assessing the risk-taking behavior construct despite the variety of available measures that range from self-report measures to gambling tasks (Appelt, Milch, Handgraaf, & Weber, 2011). In general, instruments assessing risk-taking behavior can be divided in two categories; questionnaires and laboratory tasks or performance based tasks. Despite the nominal similarity between the concepts addressed by questionnaires and performance-based data on risk-taking, relatively little research has explored the relationships between measurement of these constructs (Skeel, Pilarski, Pytlak, & Neudecker, 2008). A meta-analysis of the available research (27 published research studies) examining the relationship between self-report measures and behavioral lab tasks found a significant but very small overall relation of r=0.097, indicating very little overlap in nomothetic span (Cyders & Coskunpinar, 2011). In Chapter 4 (n=109 students), we have compared RT-18 scores to performance on three laboratory tasks, the Driving Game (Mather, Gorlick, & Lighthall, 2009), the Balloon Analogue Risk Task (BART; (Lejuez et al., 2002), and the Cambridge Gambling Task (CGT; (Rogers et al., 1999);(Owen, Downes, Sahakian, Polkey, & Robbins, 1990). No correlations were found for the BART. RT-18 risk-taking correlated with one outcome of the Driving Game (ϱ=0.27), and two outcomes of the CGT; ϱ=0.28 with CGT Overall proportion bet and ϱ=0.25 with CGT Risk-taking. What must be noted here is the striking correlation between CGT overall proportion bet and CGT risk-taking (ϱ=0.99), indicating both outcomes measure practically the same construct. The RT-18 risk assessment scale only correlated with CGT Overall proportion bet (ϱ=0.24) and CGT Risk adjustment (ϱ= -0.36). These results do not entirely match the results we had found earlier in Chapter 2 (n=79 students), where RT-18 risk-taking correlated with several CGT outcomes (Deliberation time: r=0.25, Overall proportion bet: r=0.32, Risk adjustment: r= -0.27, and Risk-taking: r=0.30), as did the RT-18 risk assessment scale (Overall proportion bet: r=0.44, Risk adjustment: r= -0.20, and Risk-taking: r=0.45). These results are very promising, for as we have stated above, there is not much evidence on correlations between questionnaire and laboratory tasks measures in this field of research. This also evokes the question whether these behavioral tasks tap into the same underlying construct, and if so, which construct? And what does the portion of variance shared with the RT-18 exactly represent?

The fifth and final question, to assess the clinical validity of the RT-18, regards the ability of the RT-18 scores to predict or associate with the level of engagement in risk-behaviors (e.g. unsafe sex, substance abuse, practicing extreme sports). In Chapter 6 we have assessed the association between the RT-18 and recreational substance use in a longitudinal design. Results of univariate relations showed that the RT-18 risk-taking scale correlated with alcohol use and illicit drug use, and that the RT-18 risk assessment scale correlated with illicit drug use and tobacco use measured over the next 31 days in 109 students. In the multiple analysis for alcohol use, risk-taking was significantly associated with the outcome, in such a way that, a maximal score on the risk-taking scale, thus more risk behavior, is associated with 68.9 more total alcoholic consumptions over 31 days compared to a minimal score on this RT-18 scale. However, when adjusted for risk assessment, gender, BMI, fraternity or sorority membership, anxiety, and drug use, this effect was no longer significant. Risk assessment was not significantly associated with total alcoholic consumptions.

Both risk-taking and risk assessment were significantly associated with illicit drug use (OR:1.40 and 1.38 respectively). The odds of illicit drug use once or more often in 31 days were 1.35 for risk-taking, when adjusted for risk assessment, alcohol use, and tobacco use. Risk assessment increased the odds with 1.31, adjusted for risk-taking, alcohol use, and tobacco use; however, the statistical significance of this effect was lost. Risk assessment was associated with tobacco use, but after adjustments for gender, stress, alcohol use, and drug use were made, neither risk-taking nor risk assessment were associated with tobacco use. When subgroups for risk behavior were created based on alcohol, tobacco and illicit drug use combined, the median risk-taking scores increased significantly as risk behavior increased, and the same happened for risk assessment scores. A multinomial logistic regression showed the that every single point increase in risk-taking score to be accompanied with a significant increase of the odds high-risk behavior group (1 or more days tobacco use and illicit drugs use, and more than four binge drinking days) instead of low risk behavior (less than 4 binge drinking days and zero tobacco or illicit drug use days) of 1.51. The odds of high-risk behavior compared to medium risk behavior, was increased significantly by 1.36. Risk assessment only increased the odds significantly of high-risk behavior compared to low risk behavior with 1.57. Taken together, these findings seem to partly verify the association of the RT-18 with high-risk behavior in terms of substance use. However, both risk-taking and risk assessment failed in this study to differentiate the low risk behavior group from the high-risk behavior group. And although both risk-taking and risk assessment correlated to all three substance use outcomes in univariate analyses, only risk-taking was significantly associated with drug use (after adjustments were made) in the multiple regression models.

In Chapter 8, we explored the association between interpersonal relating and binge drinking in 2962 young adults (from the Utrecht Student Survey sample) and examined whether risk-taking behavior plays a mediating role in this relationship. Both risk-taking and risk assessment scores were significantly higher for binge drinkers compared to abstinents and non-binge drinkers, and this effect was present for men and women. Risk-taking and risk assessment showed the strongest correlations with the PROQ-UD scale (females: r=.19 and r=.20, males: r=.22 and r=.18, respectively), indicating that the more sadistic, intimidating and tyrannizing an individual perceives his/her relating to others, the more likely is that he/she engages in risk-taking behaviors and thinks less about the consequences of these choices. A path analysis conducted to explore the direct effect of UD on alcohol use and the indirect effect via RT-18 risk-taking or risk assessment, showed that both were very close to zero. Therefore, we concluded that the UD scale exerted no clinically relevant influence on alcohol use, but that the UD scale shares some variance with both RT-18 subscales, and must therefore measure a part of the same construct. Prisoners scored higher on the UD scale than non-prisoners as measured with the PROQ2, but not with PROQ3 (Birtchnell et al, 2009). Another study (Newberry & Birtchnell, 2011) reported that the UD scale differentiated between the types of offences, with, for instance, violent offenders, dishonest offenders, and robbers scoring higher on UD than homicide and sex offenders. Kalaitzaki, Birtchnell, & Kritsotakis (2010) have shown that the PROQ2 UD scale differentiates between the perpetrators of aggression in

dating relationships from those who were neither aggressors nor victims of aggression by their dating partners. Moreover, Birtchnell (1997)/ Birtchnell and Shine (2000) proposed the interpersonal octagon as the framework in which personality disorders can be defined, and located antisocial personality disorders upon the UD scale. There is a clear link between antisociality and alcohol use disorders, and men are more likely to show symptoms of antisociality and delinquency than females (Nolen-Hoeksema, 2004). It could be speculated that the PROQ3 UD scale and the RT-18 risk-taking behavior scales tap into a source of shared variance, and this source could very well be the very broad concept of behavioral disinhibition. High levels of the perception of negative relating, risk-taking behavior and (risky) alcohol consumption can all be seen as expressions of behavioral disinhibition, for they are genetically linked (Krueger, Markon, Patrick, & Iacono, 2005). Moreover, Young et al. (2009) reported behavioral disinhibition in adolescence to be a risk factor for developing externalizing spectrum disorders.

In Chapter 7, we examined the relation between risk-taking behavior and beliefs about medicines (BMQ) in 777 adolescents. Psychological factors such as the beliefs a patient holds towards medication can strongly influence medication adherence (Koster, Philbert, Winters, & Bouvy, 2014). One could view intended nonadherence as a form of conscious risk-taking when one considers non adherence a risky behavior, whilst on the other hand unmindful or unintended nonadherence could be seen as an expression of acting without thinking or poor risk assessment. None of the relations between the two RT-18 scales and the two BMQ scales were significant for girls. However, when we introduced medication use into the equation, the relation between risk assessment and BMQ general-harm was modified in such a way that girls who used any medication in the previous twelve months did show a weak but significant relation, and those who did not report medication use had no significant relation. Interestingly, three out of four (i.e. risk-taking and BMQ general-harm excepted) relations between the RT-18 and BMQ subscales were significant for the boys. All three relations were of similar strength, with regression coefficients ranging between 0.14 and 0.23, with the latter translating into the following: a boy scoring maximally on risk-assessment (i.e. very impulsive) scores in general 2.1 points (or 13.1%) higher on the BMQ general-overuse scale. On a scale that ranges from four to 20 points, it is questionable whether a difference of 2.1 is clinically relevant. After adjustment for medication use, only the associations between risk assessment and both BMQ subscales remained significant, and became stronger. A maximal score on risk assessment was accompanied by 3.7 points or a 23.1% increase in general-harm score, when compared to a minimal score on risk assessment, which makes this difference certainly clinically relevant.

When we add the results of these three chapters, it becomes evident the RT-18 is related to some specific risk behaviors. However, the magnitudes of these associations are lower than anticipated and thus somewhat disappointing. It is difficult to disentangle this finding; our findings might be biased? And if so, which type bias interfered in estimating these effects? Or does the RT-18 not measure actual risk-behavior as we hypothesized it to do? Maybe we should not expect to find a one-to-one relationship between the RT-18 risk-taking behavior construct and actual behavior, for no behavior is completely dependent on just

one single personality trait. And to what extent is behavior solely dependent on personality? It is much more likely numerous environmental and social factors play a role in establishing a certain behavior. But, then again, if we cannot expect high correlations between risk-taking behavior and actual risk behaviors, the RT-18 would lose its usefulness in predicting risk behaviors, and it is the latter we are interested in.

To assess the predictive validity of the RT-18, generalizability, or the ability to properly transfer findings to populations and situations other than those originally studied, is of utmost importance. We have mainly used convenience samples due to time and cost restraints. Most of our samples consist of 18 to 30 year old students recruited at the Utrecht University. Hence most samples had some specific demographic characteristics; a high level of education and in general a high level of alcohol consumption, it can also be assumed most of them are not bound by social influences like marriage or parenthood nor have they experienced a large number of other life events. Since age is known to influence risk-taking behavior, for instance adolescents take more reckless risks than pensioners, our limited age range is a major disadvantage when it comes to generalizability. On top of the fact that we do not know if and how the RT-18 relates to risk behaviors in subjects older than 30, several specific RT-18 items might also be age-bound. For the items 'I like wild uninhibited parties' and 'Would you enjoy parachute jumping?' one could question if these are appropriate to assess risk-taking behavior in the elderly, or younger children. And if so, would age differences in these items reflect a true age-related difference in risk-taking behavior, or would it be a projection of age differences in physical strength and stamina (Arnett, 1994)? Assessing a risk and deciding upon subsequent action is largely influenced by learning and experiences. It is not hard to assume that we would over- or underestimate an unfamiliar risk, and adjust our judgment once we have experienced a certain outcome. We feel that besides age, experience, sometimes in the form of life events, also has a large influence on risk-taking behavior, and we expect in particular on risk assessment. For instance, we think it is plausible that a subject who becomes a (chronically) ill patient will have a different attitude towards risk behavior like non-adherence compared to when the subject was not ill. So, the generalizability of the RT-18 can be greatly improved by examining the validity of the RT-18 in other target-groups, and of special interest here are elderly and patients. Moreover, all our samples were obtained Utrecht, a large city in the center of the Netherlands, which limits the cross-cultural validity of our results. And another factor limiting the predictive validity of our results, is that all samples –except for one- were cross-sectional in nature. This limits our ability to determine causality. We hypothesized risk-taking behavior to be a personality characteristic that influences risk behavior. This directional hypothesis can only be addressed in longitudinal study designs. However, as discussed above, Chapter 6 demonstrated the RT-18 to show some association with substance use measured over 31 days after the RT-18 assessment took place. But this can only be seen as a small first positive step towards proving predictive validity, let alone determining causality.

Directions for future research & (pharmaceutical) care

So far, we have established that the RT-18 seems to be a valid measure of risk-taking behavior. We will now discuss some directives for future research. As noted in the limitations, our results should first of all be replicated, and preferably also in other countries, samples not consisting solely of students, and other age groups to establish generalizability. This will offer more specific psychometric details of the RT-18 and add to our body of evidence regarding the validity of the RT-18.

There are three sets of factors known to influence decision-making; decision features, situational factors, and individual differences (Appelt et al., 2011). Of these three, decision features, which are characteristics of the decision itself, are probably understood best (Appelt et al., 2011). By developing the RT-18, we tried to gain more insight in the individual differences in decision-making. Future research should establish how the risk-taking behavior construct relates to or is moderated by decision features and situational factors.

Besides gathering more insight in the validity of the RT-18 and how decision features and situational factors associate with risk-taking behavior, research into the relation of risk-taking behavior with other personality constructs might also be a worthwhile endeavor. Based on our assumption that risk-taking behavior is defined firstly by risk assessment and, based on this assessment, the actual engagement in risk behavior, one could argue that personality traits and states like anxiety affect risk-taking behavior. It has been shown that high trait-anxious individuals have an attentional bias toward threatening information, which in turn, produces a biased risk perception (Gasper & Clore, 1998; MacLeod & Cohen, 1993). Trait anxiety, anxiety sensitivity, and sensation seeking are found to be associated with "risky" reasons (i.e., coping, conformity, and/or enhancement) for adolescent alcohol, cigarette, and marijuana use (Comeau, Stewart, & Loba, 2001).

Moreover, future research should incorporate risk behaviors other than substance use as outcomes, for instance unsafe sex, practicing extreme sports, or illegal activities. This facilitates the assessment of subgroups engaging in risk behaviors that are more reflective of the entire constellation of real world risk behaviors. Hence, it would also add evidence to the validity of the RT-18, and establish whether the RT-18 has sufficient quality to detect specific individuals expressing risk-taking behavior of interest.

Of particular interest for future research is the relation between risk-taking behavior as measured by the RT18 and non-adherence to (pharmaceutical) treatment as we introduced in the general introduction. The Dutch Royal Association for the Advancement of Pharmacy (KNMP) reported in 2012 the following:

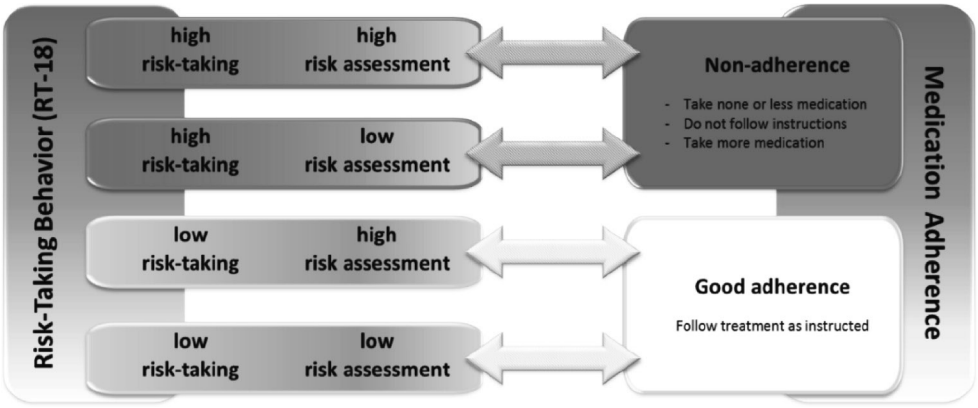
"…Non-adherence to therapy is a common and persistent problem in health care. Our health care system is more focused on identifying health problems and selecting the most appropriate treatment, than on ensuring that prescribed therapies are followed-up appropriately. In research literature there are many examples of diseases programs focused on improving medication adherence. They show a variety of interventions, such as education, monitoring, proactive follow-up, counseling or innovations in packaging. These interventions may have specialists, GPs, nurses or pharmacists in the lead. Disease programs where pharmacists are in the lead are shown to be effective in improving therapy adherence. Therapy adherence is associated with lower hospitalization risk on the short term, and in the long term, it also reduces the likelihood of complications (few peer reviewed studies quantify this effect)…"

This testifies the size and impact of the problem of non-adherence. Most research efforts have focused on identifying factors that predict or are associated with non-adherence. More than 200 variables have been studied since 1975, but none of them can be considered as consistently predicting adherence: neither socio-economic nor pathology-related factors (Vermeire, Hearnshaw, Van Royen, & Denekens, 2001). As we argued in the general introduction, we think a behavioral construct is one of the factors of non-adherence, that involves complex actions, intentions, emotions, and phenomena that may not be directly observable (Kyngäs, Kroll, & Duffy, 2000). Since risk-taking behavior involves weighing risks and benefits, combined with a certain individual preference for risk in general, the active decision not to adhere to a prescribed medication regiment can be seen as a specific form of risk behavior.

The term non-adherence refers to a wide range of more specific behaviors that all result in inappropriate medication use. DiMatteo et al. (2012) described 'unintentional non-adherence' as referring to patients whom (incorrectly) believe that they are adhering, and 'intentional nonadherence' for cases in which individuals choose to dismiss treatment recommendations entirely or to modify their prescribed regimens (DiMatteo, Haskard-Zolnierek, & Martin, 2012). We argue that certain risk-taking behavior profiles obtained with RT-18 assessment could relate in a distinct manner with forms of non-adherence. This hypothesis needs further exploration.

As can be seen on the left hand in Figure 1, four risk-taking behavior profiles can be obtained, based on extreme scores on both the risk-taking and the risk assessment subscales of the RT-18. We hypothesize that individuals or patients who score high on risk-taking and high on risk assessment, and therefore can be characterized as impulsive or not thinking things trough combined with high level of engagement in risk behavior (for a more detailed explanation of the interpretation of subscale score see Chapter 2), might be those patients who do not adhere to their medication instructions. Also individuals who score high on risk-taking and low on risk assessment, thus individuals who give a lot of thought to a decision and then actively decide to engage in risk behavior, might be of interest here.

Figure 1; profiles of risk-taking behavior and their hypothesized relation with medication adherence



Thus, we think high scores on risk-taking might relate to non-adherence, but future research should examine this relation. Moreover, future research should investigate the role of risk assessment in non-adherence and whether extreme scores on this subscale might relate to specific forms of non-adherence (i.e., intentional or unintentional). It seems plausible that patients who are unintentionally non-adherent might, for instance, forget to take their medication for they are more impulsive and have given les thought to the possible consequences of that action. On the other hand, patients who actively withdraw or intentionally alter their medication use, seem to have given thought to this action and might therefore be those who score high on risk assessment.

But how could assessing risk-taking behavior lead to a possible solution for the non-adherence problem? Since personality is relatively stable across the life-span, setting personality change as a goal for treatment may be unrealistic (Ferguson, 2010). Research indicates that treatment effectiveness for personality change is much lower than for treatment of individual symptoms (de Maat, de Jonghe, Schoevers, & Dekker, 2009; Ferguson, 2010).

Hence, trying to alter risk-taking behavior might not be the path to choose. Risk-taking behavior profiles could, however, offer guidance for health care professionals when considering which actions to take when they encounter non-adherence. Or these profiles could be used in a more preventive way; to screen for potential non-adhering individuals and to offer them guidance and additional monitoring. In our opinion, it makes more sense to implement interventions that ensure medication is taken, in the treatment of more impulsive patients, and to make those patients more aware of the risks involved in non-adherence. For patients that are intentionally non-adherent, the healthcare professional could discuss reasons for non-adherence and try to find a medication regimen that the patient agrees to. For all non-adherent patients, and especially those who refuse to take their medication, shared decision making seems to be an important method for improving treatment outcomes.

Conclusions

Like any model or theory, the validity of the RT-18 can never be completely established, and evidence will accumulate that is either supportive or unsupportive of the hypothesized construct (John & Benet-Martinez, 2000). Combining all the pieces we found thus far, there is substantial evidence to support the RT-18 indeed measures the personality construct of risk-taking behavior and that risk-taking behavior comprises two factors; risk-taking and risk assessment. Hence, we feel that at this moment, the RT-18 is a sufficiently valid measure of risk-taking behavior in adolescents and young adults recruited in the vicinity of Utrecht. An advantage of the RT-18 is the short time that is needed for the administration, in general 2-5 minutes.

We do stress that the validity of the RT-18 and the underlying personality construct need to be clarified much more, for instance in other target-populations and across cultures. It should also be noted, that although the validity of the RT-18 is sufficient, certain psychometric properties still need to be improved or have room for improvement.

In short, we have taken the first promising steps towards the development and validation of the RT-18, an instrument to assess risk-taking behavior in adolescents and young adults. The RT-18 might prove to be useful in a number of situations; from gaining insight in the processes underlying medical decision making and thereby aiding the shared decision making process, to guiding healthcare professionals when dealing with risk-behaviors like non-adherence to prescribed medication.

References

af Klinteberg, B., Magnusson, D., & Schalling, D. (1986). Self-report assessment of personality traits: Data from the KSP inventory on a representative sample of normal male and female subjects within a developmental project Department of psychology, University of Stockholm.

Allen, D. N., Donohue, B., Sutton, G., Haderlie, M., & Lapota, H. (2009). Application of a standardized assessment methodology within the context of an evidence-based treatment for substance abuse and its associated problems. Behavior Modification, 33(5), 618-654. doi:10.1177/0145445509343284 [doi]

Aluja, A., Rossier, J., García, L. F., Angleitner, A., Kuhlman, M., & Zuckerman, M. (2006). A cross-cultural shortened form of the ZKPQ (ZKPQ-50-cc) adapted to english, french, german, and spanish languages. Personality and Individual Differences, 41(4), 619-628.

Appelt, K. C., Milch, K. F., Handgraaf, M. J., & Weber, E. U. (2011). The decision making individual differences inventory and guidelines for the study of individual differences in judgment and decision-making research. Judgment and Decision Making, 6(3), 252-262.

Arnett, J. (1994). Sensation seeking: A new conceptualization and a new scale. Personality and Individual Differences, 16(2), 289-296.

Barratt, E. S. (1985). Impulsiveness subtraits: Arousal and information processing. Motivation, Emotion and Personality, , 137-146.

Barry, D. T. (2001). Assessing culture via the internet: Methods and techniques for psychological research. CyberPsychology & Behavior, 4(1), 17-21.

Blais, A., & Weber, E. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. Judgment and Decision Making, 1(1), 33-47.

Bland, J. M., & Altman, D. G. (1997). Cronbach's alpha. BMJ (Clinical Research Ed.), 314(7080), 572.

Buchanan, T. (2002). Online assessment: Desirable or dangerous? Professional Psychology: Research and Practice, 33(2), 148.

Buss, A. H., & Plomin, R. (1975). A temperament theory of personality development. Wiley-Interscience.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychological Bulletin, 125(3), 367-383.

Chmielewski, M., & Watson, D. (2009). What is being assessed and why it matters: The impact of transient error on trait research. Journal of Personality and Social Psychology, 97(1), 186-202. doi:10.1037/a0015618.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Archives of General Psychiatry, 50(12), 975.

Comeau, N., Stewart, S. H., & Loba, P. (2001). The relations of trait anxiety, anxiety sensitivity, and sensation seeking to adolescents' motivations for alcohol, cigarette, and marijuana use. Addictive Behaviors, 26(6), 803-825.

Cortina, J. M. (1993). What is coefficient alpha? an examination of theory and applications. Journal of Applied Psychology, 78(1), 98.

Coughlin, S. S. (1990). Recall bias in epidemiologic studies. Journal of Clinical Epidemiology, 43(1), 87-91.

Cyders, M. A., & Coskunpinar, A. (2011). Measurement of constructs using self-report and behavioral lab tasks: Is there overlap in nomothetic span and construct representation for impulsivity? Clinical Psychology Review, 31(6), 965-982.

Dahlbäck, O. (1990). Personality and risk-taking. Personality and Individual Differences, 11(12), 1235-1242.

de Haan, L., de Haan, H., Olivier, B., & Verster, J. (2012). Alcohol mixed with energy drinks: Methodology and design of the utrecht student survey. International Journal of General Medicine, 5, 889-898.

de Maat, S., de Jonghe, F., Schoevers, R., & Dekker, J. (2009). The effectiveness of long-term psychoanalytic therapy: A systematic review of empirical studies. Harvard Review of Psychiatry, 17(1), 1-23.

De Vet, H. C., Terwee, C. B., Mokkink, L. B., & Knol, D. L. (2011). Measurement in medicine: A practical guide Cambridge University Press.

Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010). Review: Understanding the construct of impulsivity and its relationship to alcohol use disorders. Addiction Biology, 15(2), 217-226.

DiMatteo, M. R., Haskard-Zolnierek, K. B., & Martin, L. R. (2012). Improving patient adherence: A three-factor model to guide practice. Health Psychology Review, 6(1), 74-91.

Evenden, J. L. (1999). Varieties of impulsivity. Psychopharmacology, 146(4), 348-361.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. Personality and Individual Differences, 6(5), 613-619.

Eysenck, S. B., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. Psychological Reports, 43(3f), 1247-1255.

Ferguson, C. J. (2010). A meta-analysis of normal and disordered personality across the life span. Journal of Personality and Social Psychology, 98(4), 659.

Fineberg, N. A., Potenza, M. N., Chamberlain, S. R., Berlin, H. A., Menzies, L., Bechara, A., . . . Hollander, E. (2010). Probing compulsive and impulsive behaviors, from animal models to endophenotypes: A narrative review. Neuropsychopharmacology, 35(3), 591-604.

Gasper, K., & Clore, G. L. (1998). The persistent use of negative affect by anxious individuals to estimate risk. Journal of Personality and Social Psychology, 74(5), 1350.

John, O. P., & Benet-Martinez, V. (2000). Measurement: Reliability, construct validation, and scale construction. Handbook of Research Methods in Social and Personality Psychology,

Kruger, D. J., Wang, X., & Wilke, A. (2007). Towards the development of an evolutionarily valid domain-specific risk-taking scale. Evolutionary Psychology, 5(3), 555-568.

KyngÅs, H. A., Kroll, T., & Duffy, M. E. (2000). Compliance in adolescents with chronic diseases: A review. Journal of Adolescent Health, 26(6), 379-388.

Lejuez, C., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: The balloon analogue risk task (BART). Journal of Experimental Psychology: Applied, 8(2), 75.

Luengo, M., Carrillo-De-La-Pena, M., & Otero, J. (1991). The components of impulsiveness: A comparison of the I. 7 impulsiveness questionnaire and the barratt impulsiveness scale. Personality and Individual Differences, 12(7), 657-667.

MacLeod, C., & Cohen, I. L. (1993). Anxiety and the interpretation of ambiguity: A text comprehension study. Journal of Abnormal Psychology, 102(2), 238.

Mather, M., Gorlick, M. A., & Lighthall, N. R. (2009). To brake or accelerate when the light turns yellow? stress reduces older adults' risk taking in a driving game. Psychological Science, 20(2), 174-176. doi:10.1111/j.1467-9280.2009.02275.x; 10.1111/j.1467-9280.2009.02275.x

Owen, A. M., Downes, J. J., Sahakian, B. J., Polkey, C. E., & Robbins, T. W. (1990). Planning and spatial working memory following frontal lobe lesions in man. Neuropsychologia, 28(10), 1021-1034.

Plomin, R. (1976). Extraversion: Sociability and impulsivity? Journal of Personality Assessment, 40(1), 24-30.

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. Annual Review of Psychology, 63, 539-569.

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. Psychological Bulletin, 132(1), 1-25.

Rogers, R. D., Owen, A. M., Middleton, H. C., Williams, E. J., Pickard, J. D., Sahakian, B. J., & Robbins, T. W. (1999). Choosing between small, likely rewards and large, unlikely rewards activates inferior and orbital prefrontal cortex. The Journal of Neuroscience, 19(20), 9029-9038.

Rohrmann, B. (2002). Risk attitude scales: Concepts and questionnaires. Melbourne: University of Melbourne,

Rohrmann, B. (2005). Risk attitude scales: Concepts, questionnaires, utilizations. Project Report.Online Access Http://Www.Rohrmannresearch.Net/Pdfs/Rohrmann-Ras-Report.Pdf, 13, 2012.

Skeel, R. L., Pilarski, C., Pytlak, K., & Neudecker, J. (2008). Personality and performance-based measures in the prediction of alcohol use. Psychology of Addictive Behaviors, 22(3), 402.

Smith, G. T., & Combs, J. (2010). Issues of construct validity in psychological diagnoses. In R. Krueger, & N. Eaton (Eds.), Personality traits and the classification of mental disorders: Toward a more complete integration in DSM–5 and an empirical model of psychopathology. (pp. 97-222) Educational Publishing Foundation.

Stanford, M. S., Mathias, C. W., Dougherty, D. M., Lake, S. L., Anderson, N. E., & Patton, J. H. (2009). Fifty years of the barratt impulsiveness scale: An update and review. Personality and Individual Differences, 47(5), 385-395.

Tavakol, M., & Dennick, R. (2011). Making sense of cronbach's alpha. International Journal of Medical Education, 2, 53.

Terwee, C. B., Bot, S. D., de Boer, M. R., van der Windt, Daniëlle AWM, Knol, D. L., Dekker, J., de Vet, H. C. (2007). Quality criteria were proposed for measurement properties of health status questionnaires. Journal of Clinical Epidemiology, 60(1), 34-42.

Vermeire, E., Hearnshaw, H., Van Royen, P., & Denekens, J. (2001). Patient adherence to treatment: Three decades of research. A comprehensive review. Journal of Clinical Pharmacy and Therapeutics, 26(5), 331-342.

Weber, E. U., Blais, A., & Betz, N. E. (2002). A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. Journal of Behavioral Decision Making, 15(4), 263-290.

Zaleskiewicz, T. (2001). Beyond risk seeking and risk aversion: Personality and the dual nature of economic risk taking. European Journal of Personality, 15(S1), S105-S122.

Zuckerman, M. (2002). Zuckerman-kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model. Big Five Assessment, 377-396.

Appendices

Samenvatting

Hoofdstuk 1

Sommige individuen lijken geneigd te zijn om veel risico te nemen, terwijl anderen juist weer overkomen als risicomijdend. Een over het algemeen risico-nemende houding kan een grote impact hebben op de beslissingen van dat individu. Dit proefschrift is gericht op het in kaart brengen van individuele verschillen in risicogedrag, met name gezondheidsrisico's. Dit is gedaan door zowel de onderliggende psychologische component (persoonlijkheidskenmerk of karaktereigenschap), als het daadwerkelijke risicogedrag te meten. Het doel van dit proefschrift was het ontwikkelen en valideren van een nieuw meetinstrument, de *Risk-Taking Questionnaire 18 items* (RT-18), die risicogedrag als karaktereigenschap meet bij adolescenten en jong volwassenen.

Hoofdstuk 2

In Studie 1, hebben 522 studenten de RT-18 ingevuld en 100 hiervan vulden de RT-18 een tweede keer in en voerden daarnaast ook de Cambridge Gambling Task (CGT) uit. De test-hertest betrouwbaarheid van de totaal score bleek voldoende. Significante correlaties werden gevonden tussen de RT-18 totaal score en de CGT uitkomsten risico-nemen (*risk-taking*), gok proportie (*overall proportion bet*), en risico aanpassing (*risk adjustment*). In Studie 2, onder 7834 jong volwassen sociale drinkers en recreatieve drugsgebruikers, scoorden mannen significant hoger dan vrouwen en recreatieve drugsgebruikers scoorden significant hoger dan sociale drinkers op de totaal score van de RT-18. Verder liet factor analyse zien dat de RT-18 niet uit één totaal score maar uit 2 factoren of schalen bestaat; risico-nemen (*risk-taking*) en risico afwegen (*risk assessment*). In Studie 3 met 903 studenten, correleerden beide RT-18 schalen significant met scores op de twee schalen van de *Stimulating-Instrumental Risk Inventory*; stimulerend risico-nemen (ongecontroleerde impulsieve besluitvorming gericht op korte termijn), en instrumentaal risico-nemen (gecontroleerd risico-nemen gericht op de lange termijn).

Hoofdstuk 3

Dit hoofdstuk onderzocht de betrouwbaarheid van metingen met de beide RT-18 schalen risico-nemen en risico afwegen. De interne consistentie, meetfout (is van invloed op de precisie van het meetinstrument) en de test-hertest betrouwbaarheid zijn hiervoor onderzocht in twee afzonderlijke populaties jong volwassenen in de leeftijd van 18 tot 30 jaar (n=104 en n=92). Onze bevindingen lieten zien dat metingen met beide RT-18 schalen voldoende betrouwbaar zijn bij jong volwassenen, en bovendien ook voldoende betrouwbaar zijn bij jong volwassenen die alcohol en drugs gebruiken.

Hoofdstuk 4

Doel van dit hoofdstuk was om de construct validiteit van de RT-18 schalen bij 106 jong volwassenen (18-30 jaar) te onderzoeken. Hiervoor hebben we gekeken naar de convergentie met instrumenten die een soortgelijk construct meten en man-vrouw verschillen. Om de analyses te vereenvoudigen, hebben we de gebruikte instrumenten gegroepeerd op basis van overeenkomsten in meetmethode en/of gemeten psychologisch construct. Alle correlaties in de eerste groep waar we de meeste overlap verwachtten (*impulsive sensation seeking, venturesomeness, impulsivity, en novelty seeking*), waren hoger dan r=.51 behalve voor de RT-18 schaal risico afwegen welke een iets lagere correlatie liet zien met venturesomeness (r=.26). Als we de scores op de RT-18 schaal risico-nemen vergelijken met scores op instrumenten uit groep 2, waar we een kleine overlap verwachtten; de *domain specific risk-taking scale*, de *evolutionairy valid domain-specific risk-taking scale*, de *risk scenario questionnaire* en de *risk propensity questionnaire*, waren de correlaties tussen .50 en .71. Effecten voor de RT-18 schaal risico afwegen waren iets kleiner, tussen .23 en .46. Mannen scoorden significant hoger dan vrouwen op de RT-18 schaal risico-nemen zoals verwacht, maar niet op de RT-18 schaal risico afwegen. Verder zagen we ook dat er weinig tot geen overlap was tussen zelf-beoordeling en gedragstaken, wat in lijn is met eerdere onderzoeken. Van de drie *Driving Game* uitkomsten was alleen rijden (*driving*) significant gecorreleerd met de RT-18 schaal risico-nemen (r=.27). Geen van de *Balloon Analoque Risk Task* uitkomsten correleerden met de RT-18 scores. Van de zes CGT uitkomsten, correleerde alleen gok proportie (*overall proportion bet*), risico aanpassing (*risk adjustment*) en risico-nemen (*risk-taking*) met de RT-18 schalen. Tezamen tonen deze resultaten aan dat de RT-18 schalen voldoende construct validiteit bezitten, omdat de sterktes van de correlaties wijzen op overlap met de andere constructen, maar niet dusdanig sterk zijn dat de RT-18 geen op zichzelf staand construct meet.

Hoofdstuk 5

De relatie tussen risicogedrag en alcohol gebruik en de rol van geslacht hierin, rekening houdend met leeftijd, depressiviteit, angst en leefstijl, werd onderzocht in 6002 studenten. Gebaseerd op zelf-gerapporteerde alcohol consumptie werden de deelnemers geclassificeerd als abstinent, gematigde drinkers of binge drinkers (gedefinieerd als het drinken van meer dan 4 (vrouwen) of 5 (mannen) alcoholische consumpties per keer). De kans (*odds*) op binge drinken ten opzichte van gematigd drinken nam toe naarmate de scores op de RT-18 schalen risico-nemen en risico afwegen hoger werden, en dit gold voor zowel mannen als vrouwen. De kans op gematigd drinken versus abstinentie werd vergroot door een hogere score op de RT-18 schaal risico-nemen, maar dit effect was alleen zichtbaar voor vrouwen. Voor de kans op binge drinken ten opzichte van abstinentie zorgde de RT-18 schaal risico-nemen voor een significant groter effect bij zowel mannen als vrouwen, maar de RT-18 schaal risico afwegen had alleen een significant effect bij vrouwen. Deze resultaten zouden kunnen bijdragen aan het ontwikkelen van alcohol preventie

methodes, omdat risicogedrag gemeten met de RT-18, rekening houdend met leeftijd, leefstijl, depressie, angst en stress, op een significant en geslachts-specifiek effect op alcohol gebruik laat zien.

Hoofdstuk 6

In dit hoofdstuk hebben we de associatie tussen risicogedrag en middelen gebruik onderzocht door gebruik te maken van een longitudinale studieopzet; een 31 dagen durende online dagboekstudie (109 studenten). In de analyses was de RT-18 schaal risico-nemen significant geassocieerd aan alcohol gebruik. Echter, als we rekening hielden met de RT-18 schaal risico afwegen, geslacht, *body mass index* (BMI), en eventueel lidmaatschap van een studentenvereniging, bleek dit effect niet (meer) significant. De RT-18 schaal risico afwegen was niet significant geassocieerd met alcohol gebruik. Zowel de RT-18 schaal risico-nemen als de RT-18 schaal risico afwegen waren significant geassocieerd met drugsgebruik. De verhoogde kans op drugsgebruik bleef significant voor de RT-18 schaal risico-nemen wanneer er rekening gehouden werd met de RT-18 schaal risico afwegen, alcohol gebruik, en roken maar dit effect was niet langer significant voor de RT-18 schaal risico afwegen. De RT-18 schaal risico afwegen was significant geassocieerd met roken, maar na rekening te hebben gehouden met geslacht, stress, alcohol gebruik en drugsgebruik, bleken geen van beide RT-18 schalen significant geassocieerd met roken. Gecombineerd risicogedrag gebaseerd op zowel alcohol, tabak als drugsgebruik nam toe naarmate de scores op de RT-18 schaal risico-nemen hoger werden. Een vergelijkbaar effect zagen we voor de RT-18 schaal risico afwegen. Kortom, deze studie toont aan dat de RT-18 schalen zowel geassocieerd zijn met de afzonderlijke risicogedragingen alcohol gebruik, drugsgebruik en roken, als met gecombineerd risicogedrag van deze middelen.

Hoofdstuk 7

De associatie tussen risicogedrag en opvattingen over geneesmiddelen (*beliefs about medicines questionnaire*; BMQ) is onderzocht in 777 adolescenten (12-18 jaar). De BMQ bestaat uit twee subschalen; schade door geneesmiddelen (*harm*) en overmatig gebruik van geneesmiddelen (*overuse*). Er zijn geen significante associaties tussen de twee RT-18 en de twee BMQ schalen gevonden voor meiden. Na het introduceren van wel of geen medicatiegebruik in het model, veranderde de associatie tussen de RT-18 schaal risico afweging en de BMQ schaal schade door geneesmiddelen, zodat meiden die in de afgelopen 12 maanden medicijnen hadden gebruikt een zwakkere maar significante associatie lieten zien, terwijl er geen significant effect was voor meiden die geen medicatie hadden gebruikt. Drie van de vier (behalve de RT-18 schaal risico-nemen en de BMQ schaal schade door geneesmiddelen) associaties tussen de

RT18 schalen en BMQ schalen waren significant voor jongens. Maar rekening houdend met al dan geen medicatie gebruik, waren alleen de associaties tussen de RT-18 schaal risico afweging en beide BMQ schalen significant, en werden ook sterker. Hieruit concludeerden we dat risicogedrag een goede kandidaat is om verder te bestuderen in de zoektocht naar factoren die van invloed zijn op medicatie-trouw.

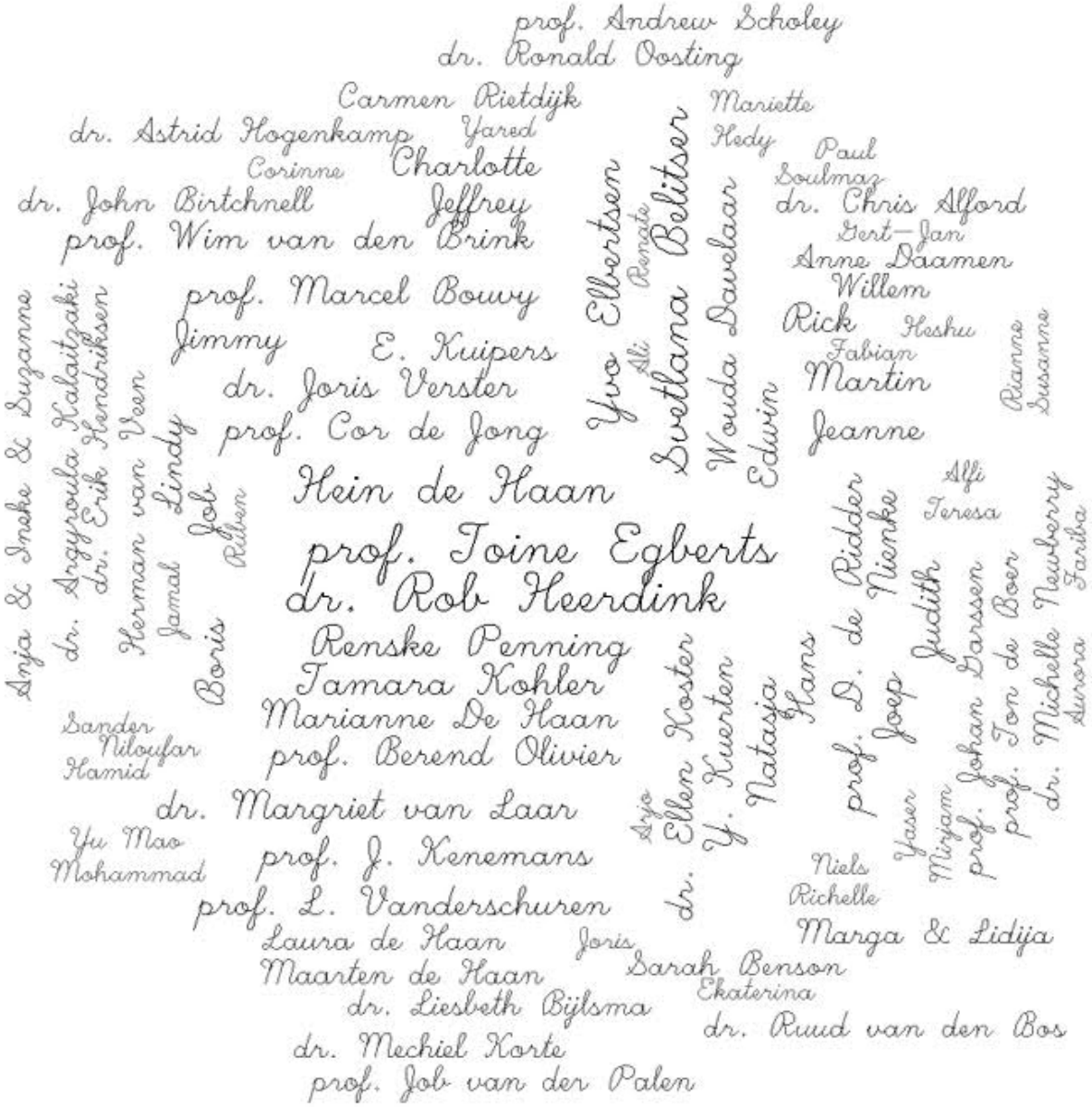
Hoofdstuk 8

Hoofdstuk 8 verkent de associatie tussen de zelfperceptie van interpersoonlijk gedrag en binge drinken (gedefinieerd als het drinken van meer dan 4 (vrouwen) of 5 (mannen) alcoholische consumpties per keer) in jong volwassenen, en de mogelijk mediërende rol van risicogedrag hierin. De onderzoekspopulatie bestond uit 2962 deelnemers van de Utrechtse Studenten Survey. De *persons relating to others questionnaire* (PROQ3) meet de zelfperceptie van interpersoonlijk gedrag op acht verschillende schalen; UN (pompeus, opschepperig, dominerend, beledigend versus toonaangevend, begeleidend, adviserend), UC (opdringerig, restrictief, bezitterig versus beschermend, helpend), NC (verlatingsangst versus vriendelijke betrokkenheid en interesse), LC (angst voor afwijzing en afkeuring versus zoekend naar zorg en bescherming), LN (hulpeloos, verantwoordelijkheid vermijdend, zichzelf kleinerend versus zoekend naar sturing, begeleiding en advies), LD (berustend, dienstbaar, teruggetrokken versus gehoorzaam, trouw, respectvol), ND (achterdochtig, niet-communicerend, zelfredzaam versus persoonlijke ruimte en privacy behoevend), en UD (sadistisch, intimiderend, tiranniserend versus controlerend en orde houdend). Voor mannen verlaagden LC, LD, en ND de kans op binge drinken, terwijl UC en UD deze verhoogden. Voor vrouwen verlaagden ND en UD deze kans. Deze effecten werden gemedieerd door risico-gedrag.

Hoofdstuk 9

In de algemene discussie van dit proefschrift zijn alle bevindingen met betrekking tot de ontwikkeling en validiteit van de RT-18 en de associaties met daadwerkelijke risico gedragingen samengevat en besproken. Verder zijn er suggesties gedaan voor verder onderzoek en implicaties voor de (farmaceutische) zorg. Tenslotte, hebben we de belangrijkste conclusies uit dit proefschrift weergegeven.

Acknowledgements



List of co-authors

Affiliations at the time at which the research was conducted.

Hein (H.A.)de Haan

Tactus Addiction Treatment, Deventer, the Netherlands.
Nijmegen Institute for Scientist Practitioners in Addiction, Nijmegen, the Netherlands.

Cor (C.A.J.)de Jong
Nijmegen Institute for Scientist-Practitioners in Addiction, Nijmegen, the Netherlands.

Toine (A.C.G) Egberts
Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, the Netherlands.
Department of Clinical Pharmacy, University Medical Center Utrecht, Utrecht, the Netherlands.

Rob (E.R.)Heerdink
Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, the Netherlands.
Department of Clinical Pharmacy, University Medical Center Utrecht, Utrecht, the Netherlands.

Yvanca Kuerten
Division of Pharmacology, Utrecht Institute for Pharmaceutical sciences, Utrecht University, Utrecht, the Netherlands.

Esther Kuipers
Division of Pharmacology, Utrecht Institute for Pharmaceutical sciences, Utrecht University, Utrecht, The Netherlands.

Ellen (E.S.) Koster
Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht Institute of Pharmaceutical Sciences, Utrecht University, Utrecht, the Netherlands.

Berend Olivier
Division of Pharmacology, Utrecht Institute for Pharmaceutical sciences, Utrecht University, Utrecht, The Netherlands.

Margriet van Laar
Trimbos Institute, Netherlands Institute of Mental Health and Addiction, Utrecht, the Netherlands.

Joris (J.C.)Verster
Division of Pharmacology, Utrecht Institute for Pharmaceutical sciences, Utrecht University, Utrecht, the Netherlands.

The CNS clinical pharmaco-epidemiology research group

Background

Central Nervous System Clinical Pharmacoepidemiology is one of the research themes of the division of Pharmacoepidemiology & Clinical Pharmacology of the Utrecht Institute for Pharmaceutical Sciences (UIPS). The division of Pharmacoepidemiology & Clinical Pharmacology consists of a multidisciplinary team of young and internationally oriented researchers. The research program is directed at the epidemiological, therapeutic and policy aspects of drug use and their effects. The mission of the research program is to contribute to the knowledge of and decision-making in the effectiveness, safety and economics of drug usage. In bridging the gap between the science of pharmacoepidemiology and the 'real world' of patients' drug usage and public health, the program covers a variety of methods and approaches from (molecular) epidemiology, pharmacovigilance, practice research and policy analysis. The myriad of research strategies provides an excellent environment for thoughtful learning and innovation in system therapeutics.

The Central Nervous System Clinical Pharmacoepidemiology research group focuses on the use and effects of psychotropic drugs in psychiatry and neurology, both in ambulatory care and in clinical settings. Principle investigators of this research group are Dr Eibert R Heerdink and Prof dr Toine CG Egberts. There is close collaboration with psychiatric hospitals including Altrecht and GGZ Centraal and with the University Medical Centre Utrecht.

Contact: www.uu.nl/science/pharmacoepidemiology

Theses from the CNS clinical pharmacoepidemiology research group:

Dr Arlette Scheifes (2015)
Psychotropic drug use in people with intellectual disability: patterns of use and critical evaluation. (Co)promotores: Prof dr ACG Egberts, Prof dr H Nijman, Dr ER Heerdink, Dr JJ Stolker.

Dr Heshu Abdullah-Koolmees (2015)
Continuity of Pharmaceutical Care for Psychiatric Patients. (Co)promotores: Prof dr ACG Egberts, Dr ER Heerdink, Dr H. Gardarsdottir.

Dr Adrienne Einarson (2015)
Antidepressant use in pregnancy: knowledge transfer and translation of research findings. (Co)promotores: Prof dr ACG Egberts, Dr ER Heerdink.

Dr Els van den Ban (2014)
ADHD medication use and long-term consequences. (Co)promotores: Prof dr ACG Egberts, Prof dr H Swaab, Dr ER Heerdink.

Dr Jochem Gregoor (2013)
Genetic Determinants of Antipsychotic Drug Response. (Co)promotores: Prof dr ACG Egberts, Dr J van de Weide, Dr ER Heerdink.

Dr Arne Risselada (2012)
Genetic determinants for metabolic abnormalities. (Co)promotores: Prof dr ACG Egberts, Dr H Mulder, Dr ER Heerdink.

Dr Bart Kleijer (2011)
Balancing the benefits and risks of antipsychotics. (Co)promotores: Prof dr ACG Egberts, Prof dr MW Ribbe, Dr ER Heerdink, Dr R van Marum.

Dr Wilma Knol (2011)
Antipsychotic induced parkinsonism in the elderly: assessment, causes and consequences. (Co)promotores: Prof dr AFAM Schobben, Prof dr ACG Egberts, Dr PAF Jansen, Dr R van Marum.

Dr Inge van Geijlswijk (2011)
Melatonin in sleepless children. Everything has a rhythm? (Co)promotores: Prof dr ACG Egberts, Prof dr H Vaarkamp, Dr M Smits.

Dr Maurits Arbouw (2010)
Assessment of pharmacotherapy in Parkinson's disease. (Co)promotores: Prof dr ACG Egberts, Prof dr HJ Guchelaar, Prof dr C Neef, Dr KLL Movig.

Dr Laurette Goedhard (2010)
Pharmacotherapy and aggressive behaviour in psychiatric patients. (Co)promotores: Prof dr ACG Egberts, Prof dr H Nijman, Dr ER Heerdink, Dr JJ Stolker.

Dr Jeroen Derijks (2009)
Effects of antidepressants on glucose homeostasis. Effects and mechanisms. (Co) promotores: Prof dr ACG Egberts, Dr ER Heerdink, Dr GHP de Koning, Dr R Janknegt.

Dr Helga Gardarsdottir (2009)
Drug treatment episodes in pharmacoepidemiology: antidepressant use as a model. (Co) promotores: Prof dr ACG Egberts, Dr ER Heerdink.

Dr Kim Gombert - Handoko (2009)
Treatment failure in epilepsy: exploring causes of ineffectiveness and adverse effects. (Co)promotores: Prof dr ACG Egberts, Prof dr YA Hekster, Dr J Zwart-van Rijkom, Dr W Hermens.

Dr Tessa Ververs (2009)
Antidepressants during pregnancy, risks for mother and child. (Co)promotores: Prof dr GH Visser, Prof dr AFAM Schobben, Dr E Mulder.

Dr Emmeke Wammes – van der Heijden (2009)
Migraine and ischemia. (Co)promotores: Prof dr ACG Egberts, Dr C Tijssen.

Dr Katja van Geffen (2008)
Initiation, execution and discontinuation of antidepressant therapy: considerations and decisions of patients. (Co)promotores: Prof dr ACG Egberts, Dr E Heerdink, Dr R van Hulten.

Dr Mirjam Knol (2008, summa cum laude)
Depression and diabetes. Methodological issues in etiologic research. (Co)promotores: Prof dr DE Grobbee, Prof dr ACG Egberts, Dr M Geerlings, Dr ER Heerdink.

Dr Ingeborg Wilting (2008)
Patterns and clinical outcomes of lithium treatment. (Co)promotores: Prof dr ACG Egberts, Prof dr WA Nolen, Dr ER Heerdink.

Dr Hans Mulder (2007)
CYP2D6 and 5HT2c polymorphisms in psychiatric pharmacotherapy. (Co)promotores: Prof dr ACG Egberts, Dr FFW Wilmink.

Dr Gerard Hugenholtz (2005)
Antipsychotics in daily clinical practice: patterns, choices and consequences. (Co) promotores: Prof dr ACG Egberts, Prof dr WA Nolen, Dr ER Heerdink.

Dr Hamid Rahimtoola (2003)
Transitions in migraine treatment. (Co)promotores: Prof dr ACG Egberts, Prof dr HGM Leufkens, Dr CC Tijssen.

Dr Igor Schillevoort (2002)
Drug-induced extrapyramidal syndromes. (Co)promotores: Prof dr HGM Leufkens, Prof dr RAC Roos, Dr RMC Herings.

Dr David van de Vijver (2002)
Quality of the pharmacological treatment of patients with Parkinson's disease. (Co) promotores: Prof dr AJ Porsius, Prof dr RAC Roos, Prof dr A de Boer.

Dr Joostjan Stolker (2002)
Struggles in prescribing: determinants of psychotropic drug use in multiple clinical settings. (Co)promotores: Prof dr WA Nolen, Prof dr HGM Leufkens, Dr ER Heerdink.

Dr Welmoed Meijer (2002)
The value of observational research on antidepressant use: a broadened perspective. (Co) promotores: Prof dr HGM Leufkens, Prof dr WA Nolen, Dr ER Heerdink.

Dr Kris Movig (2002)
Detection and elucidation of adverse neuropsychiatric adverse effects. (Co)promotores: Prof dr ACG Egberts, Prof dr HGM Leufkens.

Dr Rolf van Hulten (1998)
Blue boy – why not? (Co)promotores: Prof dr A Bakker, Prof dr HGM Leufkens, Dr KB Teeuw.

Dr Toine Egberts (1997)
Pharmacoepidemiologic approaches to the evaluation of antidepressant drugs. (Co) promotores: Prof dr A Bakker, Prof dr HGM Leufkens, Dr GHP de Koning.

About the author

Lydia de Haan was born on 27 July 1986 in Amsterdam, the Netherlands. After completion of secondary schooling with classical education (Gymnasium) at the Staring College in Lochem in 2004, she studied Biology at Utrecht University. During this study Lydia completed a minor in Cognitive Psychology. Her bachelor thesis explored the possibilities of Induced Pluripotent Stemcells. In 2008 she had personally arranged a reimbursed internship at the Psychiatric Neurodevelopmental Genetics Unit, Center For Human Genetic Research, Massachusetts General Hospital, Harvard Medical School, in Boston, USA. She studied the underlying genetic and neuroimaging signatures of depression and cocaine dependence. After obtaining her BSc in Biology in 2009, she completed her MSc in Neuroscience and Cognition in 2011, at Utrecht University. Her master thesis explored the neurobiological correlates of alexithymia. She performed her Major research project at the division of Psychopharmacology researching a potential rat-model for depression. Her Minor research project involved the development of the RT-18, which lead to the PhD position, which in turn, has resulted in this thesis. During her PhD Lydia designed, conducted, analyzed, interpreted and reported multiple studies using divers methodologies ((online) surveys, clinical trials, laboratory computer based research).

Lydia lives with her partner Yvo Elbertsen, three mini-horses and two Main Coon cats in Stroe, the Netherlands where they enjoy living in the countryside.

List of publications

Publications related to this thesis

1. **de Haan, L.**, de Haan, H.A., de Jong, C.A.J., (In press). Interpersonal relating, risk-taking behavior and alcohol use in young adults.
2. **de Haan, L.**, Egberts, A.C.G., Heerdink, E.R. (2015). The relation between risk-taking behavior and alcohol use in young adults is different for men and women. Drug and Alcohol Dependence, 155, 222-227.
3. **de Haan, L.**, Kuipers, E., Kuerten, Y., van Laar, M., Olivier, B., & Verster, J.C. (2011). The RT-18: a new screening tool to assess young adult risk-taking behavior. International Journal of General Medicine, 4, 575.

Publications unrelated to this thesis

1. Koster, E.S., **de Haan,** L., Bouvy, M.L., Heerdink, E.R., (2015). Nonmedical use of Attention-Deficit/Hyperactivity Disorder medication among secondary school students in the Netherlands. Journal of Child and Adolescent Psychopharmacology, 25(8), 649-652.

2. Verster, J.C., Van Der Maarel, M.A., McKinney, A., Olivier, B. & **De Haan, L.** (2014). Driving during alcohol hangover among Dutch professional truck drivers. Traffic injury prevention, 15 (5), 434-8.

3. de Haan, H.A., Joosten, E.A., **de Haan, L.**, Schellekens, A.F., Buitelaar, J.K., van der Palen, J., & De Jong, C.A. (2013). A family history of alcoholism relates to alexithymia in substance use disorder patients. Comprehensive psychiatry, 54(7), 911-917.

4. Verster, J.C., van Doornen, L.J.P., Kleinjan, M., Garssen, J., **de Haan, L.**, Penning, R., Olivier, B. & Slot, K.A. (2013). Biological, psychological, and behavioral correlates of the alcohol hangover. Alcohol and Alcoholism, 48, 15-16.

5. Van den Bos, R., Taris, R., Scheppink, B., **de Haan, L.** & Verster, J.C. (2013). Salivary cortisol and alpha-amylase levels during an assessment procedure correlate differently with risk-taking measures in male and female police recruits. Frontiers in Behavioral Neuroscience, 7, 219.

6. **de Haan, L.**, de Haan, H.A., van der Palen, J., Olivier, B., & Verster, J.C. (2012). Effects of consuming alcohol mixed with energy drinks versus consuming alcohol only on overall alcohol consumption and negative alcohol-related consequences. International Journal of General Medicine, 5, 953.

7. **de Haan, L.**, de Haan, H.A., Olivier, B., & Verster, J.C. (2012). Alcohol mixed with energy drinks: methodology and design of the Utrecht Student Survey. International Journal of General Medicine, 5, 889-898.

8. Penning, R., **de Haan, L.**, & Verster, J.C. (2011). Caffeinated drinks, alcohol consumption, and hangover severity. The Open Neuropsychopharmacol Journal, 4, 36-39.

9. Verster, J.C., & **de Haan, L.** (2011). The 2D:4D digit ratio: a biomarker of alcohol and drug abuse? Current Drug Abuse Reviews, 4(2), 65-66.

… I guess my feet know where they want me to go

Walking on a country road…

from James Taylor - Country Road