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ORIGINAL ARTICLE

Risk Competence in Dealing With Alcohol and Other Drugs in Adolescence

Ede Nagy[a], Rolf Verres[a], and Dennis Grevenstein[b]

[a]Center for Psychosocial Medicine, Institute of Medical Psychology, University Hospital Heidelberg, Heidelberg, Germany; [b]Psychological Institute, University of Heidelberg, Heidelberg, Germany

ABSTRACT

Background: Adolescence is a critical phase for the development substance use patterns. We propose that individual competence in dealing with psychoactive substances is crucial for the development of healthy substance use behavior and prevention of substance misuse or addiction. *Objectives:* We present a new concept of health related skills in dealing with alcohol and other drugs in adolescence, its operationalization and validation. Our conception of risk competence (RICO) consists of the four major factors *being Reflective, Informed, Self-Controlled* and *Life-Oriented*, and their sub-facets. *Methods:* Based on a sample of $N = 753$ adolescents we used classical test theory as well as item response theory to create a new measure of RICO. Validity was investigated in a new sample of $N = 229$ with regard to substance use, risk perception, and measures of personality (Big Five, sense of coherence, general self-efficacy). *Results:* RICO contains 7 scales with 28 items that measure independent aspects of risk competence. Cross-sectional criterion validity for most of the scales could be shown. *Conclusions/Importance:* The new RICO scales are a valid measure of different aspects of risk competence in dealing with psychoactive substances. The questionnaire can be used in general research settings, but may also be applied to assess the effects of interventions.

KEYWORDS

Risk competence; adolescence; substance use; measurement; scale development

Substance use is very common among young people. According to official statistics about 10.9% of all youths aged 12 to 17 consume alcohol at least once a week, and 9.6% use tobacco on a regular basis in Germany. The one-year-prevalence of cannabis is 5.6% (BZgA, 2016). There is also considerable potential for substance misuse. In the same age group the 30-day prevalence of binge drinking is 14.1%. Furthermore, in the year 2014 in Germany overall 22,391 children and young people at the age of 10 to 20 years were hospitalized with a diagnosis of alcohol poisoning (BZgA, 2016). A problematic consumption of alcohol and other psychoactive substances can cause extensive health damage, lead to the development of addictive substance use patterns and a multitude of adverse psychological effects (Kaminer, 2016). The age of first use has been identified as a risk factor. Early and high frequent use increases the risk of substance misuse and addiction later in life (Behrendt, Wittchen, Höfler, Lieb, & Beesdo, 2009; Lynskey et al., 2003; Windle & Windle, 2012).

Taken together, adolescence is a highly critical phase for the development of healthy or unhealthy substance use patterns (Young et al., 2002). The reasons are most likely rooted in diverse processes. For example, cannabis use is usually initiated in adolescence and creates a potential for a number of negative outcomes (Hall, 2006). Especially during early adolescence or puberty, cannabis use can be problematic due to the complex interaction of cannabis with neurobiological processes, most notably with the development of the endocannabinoid system (Schneider, 2008). Additionally, Alcohol is still the most widely used psychoactive substance and its use can have negative effects on a neuropsychological (Jacobus & Tapert, 2013) as well as on a psychological and behavioral level (Arata, Stafford, & Tims, 2003).

The core question remains: Given the multitude of adverse effects, wouldn't it be best if youths would simply abstain? This is arguably an ideological question, yet an empirical answer could be that youths simply don't abstain. In a recent study in Germany, almost half of the participants aged 10 to 13 years rated beer and wine to be available "very easily" or "pretty easily". Moreover, perceived availability was a predictor of increased alcohol use and misuse (Suchert, Hanewinkel, & Morgenstern, 2014). For the present research we assumed that managing risk behavior such as substance use and finding a healthy attitude towards drugs are important developmental tasks in adolescence (Schulenberg & Maggs, 2002; Silbereisen, 1995). A young person has to develop the individual competence to deal with the life challenges associated with

CONTACT Ede Nagy ede.nagy@med.uni-heidelberg.de Center for Psychosocial Medicine, Institute of Medical Psychology, University Hospital Heidelberg, Heidelberg, Germany.

psychoactive substances. We present a new conceptualization of *risk competence* that should help youths to deal with alcohol and other drugs.

Risk competence

According to Gigerenzer (2013) *risk literacy* is a general capability to handle risks in an informed, critical, and reflective manner. Risk literacy can be considered domain specific, e.g. with regard to health (Gigerenzer, 2014). There are only a few concepts of risk competence for dealing with psychoactive substances. Most of these frameworks have been developed by practitioners in the field of drug prevention. Many modern drug prevention programs seek to promote critical awareness and life competences already in youth (Botvin, Griffin, Paul, & Macaulay, 2003; Foxcroft & Tsertsvadze, 2011), yet there is little empirical evidence for the underlying ideas on risk competence.

The theoretical frameworks are diverging. Franzkowiak (1996) defined knowledge about psychoactive substances, attitudes towards drugs, and drug related behavior as three independent components of risk competence. Koller (2003) presented risk competence in his prevention program "RISFLECTING" as a process of preparation and reflection of risk taking experiences mediated by consumption-competence, communication skills, and self-awareness. Weibel and colleagues (2007) considered risk competence as a process of interacting with the environment when (1) considering the various risks with regard to their consequences, (2) recalling this knowledge in critical situations, (3) making good informed decisions even in a case of reduced attention or under social influence, (4) maintaining the decision, and finally (5) drawing the corresponding conclusions from one's own mistakes.

Based on these presuppositions and additional health-psychological theories (see below) we consider risk competence (RICO) as a part of general life skills. RICO includes self-reflection (*being reflective*), risk knowledge (*being informed*), the wish to control one's substance use (*being self-controlled*), and an expanded life orientation (*being life-oriented*). Diverging from previous conceptions, we do no base RICO on a procedural model with a focus on cognitive decision-making abilities in a given situation. We rather adopted a view on individual differences. Furthermore, we did not include fundamental structural characteristics with regard to cognitive and emotional abilities. We see these essential characteristics as preconditions for the development of risk competence. Contextual factors such as bonding and social support were also not included, because they are difficult to influence by an intervention. Another fundamental aspect, commonly located on a personality level, is impulsivity. Impulsivity plays a key role in the initiation and development of substance misuse problems (Dawe & Loxton, 2004). We intentionally did not include impulsivity, because there are already proven and valid measures, such as the popular Barratt Impulsiveness Scale (Leeman, Hoff, Krishnan-Sarin, Patock-Peckham, & Potenza, 2014).

If RICO is to be improved by any kind of intervention, there must be a proper operationalization, in order to assess the current status and any improvement. Thus, we consider RICO a trait-like self-concept. We will describe the individual components of RICO in more detail in the following.

Self-reflection

Self-reflection (*being reflective*) is understood as the ability to (R1) reflect on drug related information, (R2) learn from one's own consumption experiences, and (R3) learn from consumption experiences of others in sense of perspective taking. Similar to the Health Belief Model (Becker, 1974) R1 represents the ability to perceive threats to one's own health. R2 refers to the ability to perceive and evaluate risks and corresponds to theories on risk perception (Slovic, 1987; Weinstein, 1984). Within the boundaries of Social Learning Theory (Bandura, 1986) R3 is the ability to learn from and reflect on the behavior of others.

Risk knowledge

Knowledge about risks (*being informed*) results from the cross-situational ability to recall risk-related information, which is a major goal of many prevention programs (Kröger, Winter, & Shaw, 1998). It includes verifiable factual knowledge of (Inf1) alcohol, (Inf2) tobacco, (Inf3) cannabis, and (Inf4) of psychoactive substances in general (e.g., effects, side effects, legal regulations). Empirical results concerning knowledge have been inconclusive so far. On the one hand knowledge has been described a protective factor for substance misuse in the past (Rumpold et al., 2006; Smart & Stoduto, 1997). On the other hand more knowledge about psychoactive substances has been associated with increased substance use as well (Dermota et al., 2013). In other cases, knowledge was only predictive of healthier substance use patterns in subgroups of heavy users (Aguilar-Raab, Heene, Grevenstein, & Weinhold, 2015).

Controlling substance use

The ability to make consumption-related decisions, control frequency of use, dosage, setting, and the type of drug

all relate to the competence of *being self-controlled*. This includes the abilities to (C1) intentionally and consciously control one's own substance use, (C2) the perceived controllability of one's substance use behavior (Lilja, Larsson, Wilhelmsen, & Hamilton, 2003), and (C3) having prior experiences with controlling one's substance use. C1 and C2 correspond to the Theory of Planned Behavior (Ajzen, 1991) that emphasizes the intention to and the perceived controllability of a given behavior.

Orientation in life

Having orientation in life includes steering personal needs with regards to, (O1) a value oriented attitude to life as an aspect of moral development (Kohlberg, Althof, Noam, & Oser, 1995), (O2) a forward-looking reflective mindset, as well as (O3) the belief that one can achieve goals through one's own efforts following the concept of general self-efficacy (Schwarzer, 1992). The protective function of a forward-looking attitude has been pointed out in comprehensive psychological concepts such as Positive Psychology (Seligman, 2011). In the context of substance misuse general life skills have long been considered a major protective factor (Poole & Evans, 1987). Kogan and colleagues (2005) drew attention to the protective function of a conventional and value-oriented attitude as well as of a positive life orientation with regard to young people's substance use.

The present research aims at an operationalization of the postulated concept of risk competence in the form of a questionnaire that can be used in general research settings, but may also be applied to assess the effects of interventions. We will describe the construction of a new scale in study 1. Study 2 focuses on an initial validation of the scale.

Study 1: Development of a new risk competence scale

Methods

In a first step we generated a pool of 106 Items. The number of the items and the response format (dichotomous or four-point Likert-scale) differed for some subscales. The three subscales R2 (learning from own consumption experiences), C1 (controlling own substance use) and C3 (having prior experiences with controlling substance use) were only applicable to youths with prior substance use experiences. We included these scales to enable a more accurate assessment of their attitudes and behaviors. We designed the new RICO scale to include aspects relevant for primary as well as secondary prevention (Cuijpers, 2002; Franzkowiak & Schlömer, 2003).

Participants and procedure

A sample of 789 students from five schools in the Rhine/Neckar District in Germany took part in the study. The study was approved by the ethics committee of the university's medical faculty (S-438/2011). The survey was conducted in schools using an online survey program (Décieux, Heinz, & Jacob, 2011). After providing informed consent and permission from legal guardians, students were seated individually in front of computers. The data were screened for incomplete or fake responses (e.g., by examining self-reported age or logically impossible responses). After the initial cleanup, a sample of $N = 753$ students was available for test construction. Demographics are presented in Table 1. Most participants attended junior or academic high school. Only a minority attended lower types of schools. As the lowest category was underrepresented, these participants were

Table 1. Sample characteristics and demographics.

	Study 1	Study 2
N	$N = 753$	$N = 229$
age	$M = 15.34$, $SD = 0.92$, range 14 to 18	$M = 14.34$; $SD = 0.74$, range = 13 to 17
sex	47.3% males, 52.7% females	48.0% males, 52.0% female
School type:		
basic schooling ("Hauptschule")	$n = 26$; 3.5%	$n = 3$; 1.3%
junior high school ("Realschule")	$n = 375$; 49.8%	$n = 122$; 53.3%
academic high school ("Gymnasium")	$n = 352$; 46.7%	$n = 104$; 45.4%
parent with university level degree	31.5%	29.7%
living together with both biological parents	67.1%	69.4%
Leisure activities:		
with friends at home	81.9%	80.8%
playing sports and going outside	50.5%	48.0%
going to associations and youth groups	19.7%	24.0%
going to clubs, discos, bars, or cafés with friends	36.7%	7.0%
going out alone	4.5%	4.4%
Experience with psychoactive substances	overall:73.0%, girls: 75.9%, boys: 78.7%	overall: 65.9%, girls: 57.1%, boys: 75.5%
alcohol	overall: 68.5%, girls: 67.0%, boys: 70.2%	overall: 60.3%, girls: 51.1%, boys: 69.1%
tobacco	overall: 45.0%, girls: 46.1%, boys: 43.8%	overall: 27.9%, girls: 21.8%, boys: 34.5%
cannabis	overall: 22.2%, girls: 17.1%, boys: 27.8%	overall: 10.5%, girls: 5.9%, boys: 15.5%

integrated in the subsample of junior high school students. Most students reported spending their leisure time with friends at home, playing sports and going outside, going to clubs, discos, bars, or cafés with friends. Only a minority reported spending their leisure time alone. Based on social influence theory (Fearnow-Kenny, Wyrick, Hansen, & et al., 2001) we assumed that youths spending their leisure time with friends at home as well as going to discos, bars of cafés with friends would have more experience with psychoactive substances due to their social environment. The proportion of this subgroup was 28.8%. Most participants in our sample had prior experience with psychoactive substances, predominantly with alcohol.

Item selection

On the basis of the Classical Test Theory (CTT), Exploratory Factor Analysis (EFA) and Item Response Theory (IRT) the item pool was reduced to an economical and effective size. We started in the framework of CTT and conducted difficulty and discriminatory analyses. Items with extreme difficulty, that is, items with affirming responses over 80% and under 20% as well as items with item inter-correlations of less than $r = .20$ were eliminated. Due to content-related and test-theoretical considerations (e.g. different response format) the subscales R1+R2+R3, Inf1+Inf2+Inf3+Inf4, C1+C3, and O1+O2 were analyzed together in the subsequent EFA (principal axis factoring with Promax-rotation and Kaiser-normalization). The subscales C2 and O3 were analyzed separately. The Kaiser–Meyer–Olkin criterion as well as Bartlett's test of sphericity indicated that the data were appropriate for factor analysis (cf. Table 2). A single factor was defined by the Kaiser criterion (eigenvalue > 1), at least 3 items with a factory loading of $\geq .30$, and a higher position on the screeplot than the rest of the factors. To achieve approximate unidimensionality of the extracted factors, items with substantial cross-loadings $> .30$ on at least 2 factors, higher loading on a secondary factor not surpassing the Kaiser criterion than on the primary factor, or with consistently weak loadings on more factors were eliminated in an iterative process (Costello & Osborne, 2005).

To account for the known restrictions of the CTT (Choi, Gibbons, & Crane, 2011; I. Koller, Alexandrowicz, & Hatzinger, 2012; Magno, 2009), we examined the fit of the extracted scales to different IRT models using the packages *eRm* (Mair & Hatzinger, 2007) and *ltm* (Rizopulos, 2006) within the statistic framework *R* 3.1 (R Development Core Team, 2014). The main benefit of scales constructed on the basis of IRT (along with the assumptions of unidimensionality, local independence and the nature of the item characteristic curve) is the parameter invariance. This can be examined on the basis of differential item functioning (DIF) analyses (de Ayala, 2009) in theoretically substantiated subsamples. The DIF of the scales was tested in the following subgroups: (1) sex (male vs. female), (2) age-group (younger: 14–15 years vs. older: 16–18 years), (3) school type (junior high school vs. academic high school), (4) parental home (living with both biological parents vs. absence of at least one parent), (5) higher education of the parents (at least one parent has a university degree vs. for none of the parents), and (6) leisure time activities (spending time with friends vs. any other activities). Substantial variability in adolescence substance use behavior has been reported for these subgroups in the past and a different handling with drug-related risks was assumed (Loxley et al., 2004; O'Malley, Johnston, Bachman, Schulenberg, & Kumar, 2006). Item fit to the Rasch Model (RM; Rasch, 1960), Rating Scale Model (RSM; Andrich, 1978), and Partial Credit Model (PCM; Masters, 1982) was confirmed by graphical model tests, Andersons´s likelihood quotient tests and Wald tests by the R-package *eRm* (Mair & Hatzinger, 2007). Fit to the 2PL (Birnbaum, 1968) and Graded Response Model (GRM; Samejima, 1969) was carried out iteratively by the "margins"-function (χ^2 test statistic) of the R-package *ltm* (Rizopulos, 2006). The verification of the DIF in *ltm* was carried out by the R-package *lordif* (Choi et al., 2011). To counteract the problem of alpha error accumulation due to multiple tests, the local alpha levels were adjusted according to the suggestion by Koller et al. (2012, p. 212)[1].

Results

On the basis of CTT and EFA the original item pool of 106 items was reduced to 55 items in seven scales. Mean, skewness, kurtosis, and internal consistency of the scales after EFA are shown in Table 2. Most absolute values of skewness and kurtosis were under the critical value of 1 (Miles & Shevlin, 2001, p. 72; Ziegler, Kemper, & Kruyen, 2014). Only the kurtosis of scale C2 (expectation to control of one's own substance use) showed a value of -1.01 indicating a slight deviation from the normal distribution. The subscale *control experiences* showed poor internal consistency (Cronbach's $\alpha = .44$) after EFA. We did not want to compromise the reliability of the resulting measure, so we dropped this subscale completely. IRT analyses further

[1] Adjustments depended on the test criteria. For subgroup invariance analyses the Andersen-LRT is adjusted by α/q and the Wald-Test by $\alpha/(q*k)$; for testing multidimensional subscales the Martin-Löf-Test is adjusted by α/q; the test of Local Stochastic Independency/Multidimensionality, the Andersen-LRT has no correction, and the Wald-Tests is adjusted by α/q; in Graphical model tests the adjustment for scatterplot is $\alpha/(q*k)$ and for DIF-Plots $\alpha/(q*k)$, where α = significance level =.10, q = number of splitting criteria, and k = number of items in the test.

Table 2. Kaiser–Meyer–Olkin criterion and Bartlett's test of sphericity for testing the appropriateness for factor analysis, and psychometric properties of the scales after EFA.

		R1 + R2 + R3			Inf1 + Inf2 + Inf3 + Inf4			C1 + C3			C2			O1 + O2			O3		
before EFA	Nr. of Items	11 + 7 + 8			10 + 9 + 9 + 10			9 + 6			3			8 + 12			4		
	Kaiser–Meyer–Olkin criterion	.891			.850			.774			.707			.879			.687		
	Bartlett's test	χ^2	*df*	*p*	χ^2	*df*	*p*	χ^2	*df*	*p*	χ^2	*df*	*p*	χ^2	*df*	*p*	χ^2	*df*	*p*
		7293.2	861	.000	4297.5	780	.000	1773.2	378	.000	668.7	3	.000	4866.1	300	.000	388.6	6	.000
after EFA		R1		R2	I			C1		C3	C2			O1			O2		
	Nr. of Items	11		5	17			5		2	3			10			4		
	M (SD)	2.72 (.67)		2.37 (.71)	0.51 (.24)			2.80 (.84)		2.60 (.93)	2.49 (.91)			3.10 (.5)			3.13 (.63)		
	Skewness (SE)	−0.18 (.09)		−0.16 (.10)	−0.16 (.09)			−0.33 (.10)		−0.24 (.14)	−0.23 (.09)			−0.49 (.09)			−0.67 (.09)		
	Kurtosis (SE)	−0.77 (.18)		−0.65 (.20)	−0.77 (.18)			−0.77 (.20)		−0.96 (.27)	−1.01(.18)			0.38 (.18)			0.36 (.18)		
	Cronbach´s α	.87		.62	.82			.82		.44	.79			.78			.72		

Notes. Before EFA: R1 = Self-reflection; R2 = learn from one's own consumption experiences; R3 = learn from consumption experiences of others; Inf = factual knowledge of 1= alcohol, 2 = of tobacco; 3 = of cannabis, 4 = of psychoactive substances in general; C1 = intentionally control the one's own substance use; C2 = the perceived controllability of one's substance use behavior; C3 = having prior experiences with controlling one's substance use; O1 = value oriented attitude to life as an aspect of moral development; O2 = forward-looking reflective mindset; O3 = self-efficacy.

After EFA: M = mean; SD = standard deviation; se = standard error; R1 = risk-awareness; R2 = learning from own experiences; Inf = knowledge about psychoactive substances; C1 = control intention; C2 = expectation to control; C3 was dropped; O1 = orientation in life; O2 = self-efficacy.

reduced the number to 28 items in seven scales. The characteristic of the items regarding scale format, target group and internal consistency are shown in Table 3. The scales showed best fit to different IRT models. The item location parameter *b* refers to the item difficulty and represents the point on the latent trait continuum with maximum information. The thresholds parameters (*b*1-*b*3) define the transition points on the latent continuum between response categories. The discrimination parameter *d* represents the variation of responses among subjects with different levels of the latent ability. Higher values represent a better ability to accurately pinpoint the latent ability. The Test Information Curves (Figure 1) illustrate the amount and extent of information on the latent ability provided by all items of the given scale.

The very restrictive test construction strategy severely reduced the number of items. This resulted in weak, but still mostly sufficient internal consistencies (Cronbach's Alpha) from .59 to .73. This is a common problem often seen with short scales (Ziegler et al., 2014). We found differential item functioning with regard to participants' sex for the four items R1-2, K1-1, O2-1, and O2-2. We retained these items, because differences between boys and girls were most expected and the DIF were comparatively low. A future standardization should investigate item weighting for the subgroups of boys and girls.

Study 2: Testing validity of the RICO scales

We investigated factorial validity and construct validity by examining criterion correlations with a number of other indicators relevant for adolescents' substance use. We assumed that higher scores on the RICO scales would indicate less harmful substance use and higher risk awareness, that is, risk perception. Longitudinal studies suggest that higher risk perception predicts less substance use in the future (Grevenstein, Nagy, & Kroeninger-Jungaberle, 2015; Borrelli, Hayes, Dunsiger, & Fava, 2010). Additionally, we investigated associations with classic aspects of personality. The Big Five are one of the most popular taxonomies of personality (Costa & McCrae, 2009). Neuroticism has been associated with use of tobacco (Malouff, Thorsteinsson, Rooke, & Schutte, 2007; Terracciano & Costa, 2004) and alcohol (Malouff et al., 2007). Additionally, numerous studies have shown a negative relation between conscientiousness, agreeableness and substance use (Atherton, Robins, Rentfrow, & Lamb, 2014; Chassin, Flora, & King, 2004; Suragh, Berg, & Nehl, 2013). In contrast, substance use has often been positively related to extraversion and openness (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008).

RICO's *Orientation* subscale constitutes a general orientation to life that should represent adolescents' belief to cope successfully with life challenges and to have values and goals in life. Consequently, we examined criterion correlations with two other reminiscent constructs. General self-efficacy represents an individual's generalized feeling to be able to succeed in a given situation. The protective character of GSE against addiction and substance misuse has often been discussed (e.g. Petraitis, Flay, & Miller, 1995). Sense of coherence stems from Antonovsky's (1987) salutogenic theory and describes a person's tendency to see life and its challenges as comprehensible, manageable, and meaningful. In the past, sense of coherence has been linked to various aspects of adolescent health behavior (Mattila et al., 2011), including substance use of tobacco, alcohol, and cannabis (Grevenstein, Bluemke, & Kroeninger-Jungaberle, 2016).

Methods

Study sample

A sample of $N = 229$ students took part in this study. Demographics are again shown in Table 1. The validation sample was noticeably younger than the scale development sample ($t = 14.46$, $df = 561.4$, $d = 1.20$). Most participants (65.9%) in the validation sample had prior experiences with psychoactive substances; 7.1% less than in the development sample. Most students indicated spending their leisure time with friends at home, playing sports and going in the nature, and going to associations and youth groups. Only a minority of 7% reported going to clubs, discos, bars, or cafés with friends.

Measures

Alcohol, tobacco, and cannabis use. Substance use frequency in the last six months was measured on a 7-point scale marked 0 = *not at all*; 1 = 1 *to* 2 *times*; 2 = 3 *to* 5 *times*; 3 = 6 *to* 9 *times*; 4 = 10 *to* 19 *times*; 5 = 20 *to* 39 *times;* 6 = 40 *times or more*. Additionally, participants reported the number of consumption days in the last month, as well as frequency of drunkenness and binge drinking in the last month (all potentially ranging from 0 to 31 days). Binge drinking was defined as the consumption of at least five alcoholic drinks on a single occasion. Finally, we asked participants how much alcohol they consumed on drinking days. Participants responded on a 12-point scale ranging from 0 = *zero drinks* to 11 = *more than* 10 *drinks*. All items and scales were adapted from the national survey on drug use among youths in Germany (BZgA, 2012).

Problematic alcohol consumption. Risky substance use was measured using the CRAFFT-d questionnaire

Table 3. Characteristics of the RICO-Items: Scale formats, internal consistency, IRT construction models, discrimination- and threshold parameters.

scale		Items	Scale format	target group	α	IRT model	*d*	*b*	*b1*	*b2*	*b3*
R1	R1-1	I am someone, who is quite careful about alcohol.	4-point	all	.67	RSM		0.65	− 0.20	0.76	1.37
	R1-2	Sometimes I wonder how I can protect myself from the negative aspects of alcohol and other drugs.						1.36	0.52	1.48	2.09
	R1-3	I believe that many people only drink so they can be accepted by the group they are in.						0.67	− 0.18	0.78	1.39
	R1-4	Films and stories about alcohol and other drugs make me think and be careful.						1.05	0.20	1.17	1.77
	R1-5	I find that people who are so drunk, they don't know what they are doing, are embarrassing.						0.51	− 0.34	0.62	1.23
R2	R2-1	From earlier experiences I can tell just how much alcohol and other drugs I can take.	4-point	user	.69	PCM		− 0.53	− 0.74	− 0.78	− 0.04
	R2-2	I only experience a "good high" (from alcohol or other drugs) if I am in the right kind of mood and situation.						0.27	0.17	− 0.1	0.73
	R2-3	After being "high" I think about if that something I want to do again.						0.05	− 0.15	0.12	0.16
	R2-4	Sometimes, talking with my friends, I am critical about our drug experiences.						0.35	0.68	0.42	− 0.05
Inf	Inf-1	Whether alcohol makes you feel better or worse also depends on the dosage: More than a certain amount can also make you feel sad or irritated.	dichotomous	all	.66	2PL	1.02	− 0.72			
	Inf-2	When you smoke shisha, the carcinogenic substances in tobacco smoke are filtered out.					0.73	− 0.11			
	Inf-3	Since cannabis is usually smoked with tobacco, users are at a greater risk of becoming addicted to cigarettes.					1.01	0.79			
	Inf-4	The effects of cannabis last for a maximum of half an hour.					1.32	0.54			
	Inf-5	When eating or drinking cannabis (e.g., hash-brownies or hash-tee) you can manage the effects and risk of overdose less well.					1.52	0.38			
	Inf-6	Addiction can have a variety of causes. The most important ones for the development of an addiction are frequency of use and dosage of the drug, regardless of whether it is alcohol, tobacco, or cannabis.					1.05	− 1.04			
	Inf-7	Regarding the topic of drugs the phrase "more than a small amount" refers to a dangerous overdose.					0.95	1.51			
	Inf-8	The same amount of a drug (e.g. alcohol or cannabis) can have completely different effects depending on when it is used (e.g., yesterday or today).					1.50	0.14			
	Inf-9	After consuming certain drugs (e.g., cannabis or speed) a drug test given by the police to car or other vehicle drivers can also detect use after some days.					1.39	− 0.85			
C1	C1-1	Before going to a party I consider how much I´ll drink.	4-point	user	.59	GRM	1.11		− 0.71	0.21	1.51
	C1-2	After having a bad drug experience I intent to handle alcohol and other drugs better.					3.72		− 1.36	− 0.77	0.05
C2	C2-1	In your opinion, how difficult is to control one's use of alcohol?	4-point	all	.73	GRM	1.73		− 1.01	0.26	1.74
	C2-2	In your opinion, how difficult is to control one's use of tobacco/cigarettes?					4.01		− 0.75	− 0.25	0.73
O1	O1-1	I know what is important for my future.	4-point	all	.70	GRM	1.21		− 3.15	− 2.19	− 0.47
	O1-2	I am someone who makes plans for their life.					1.20		− 2.03	− 0.36	1.20
	O1-3	It is important to abide by the generally accepted societal rules.					1.50		− 2.53	− 1.49	0.22
	O1-4	I live by rules and principles.					2.22		− 1.88	− 0.54	0.78
O2	O2-1	I can usually handle whatever comes my way (e.g., in the school or in a relationship).	4-point	all	.69	GRM	2.61		− 2.01	− 0.92	0.27
	O2-2	On the whole I am able to reach the goals I set.					1.53		− 2.96	− 1.34	0.84

Notes. R1 = risk-awareness; R2 = learning from own experiences; Inf = knowledge about psychoactive substances; C1 = control intention; C2 = expectation to control; O1 = orientation in life; O2 = self-efficacy; RSM = Rating Scale Model; PCM = Partial Credit Model; 2PL = Birnbaum Model; GRM = Graded Response Model. Scale format: 4-point Likert-Scale: "not at all true", "right a bit true", "fairly true", "exactly true", within the scale C2: "not at all difficult", "right a bit difficult", "fairly difficult", "very difficult"; dichotomous response format: "true", "false", "I don´t know" ("false" and "I don´t know" responses are interpreted as unsolved); α = Cronbach´s Alpha; RSM = Rating Scale Model; PCM = Partial Credit Model; 2PL = Birnbaum Model; GRM = Graded Response Model; *d* = discrimination parameter; *b* = item location parameter (item difficulty); b1 – b3 = threshold parameter for step *j-k*.

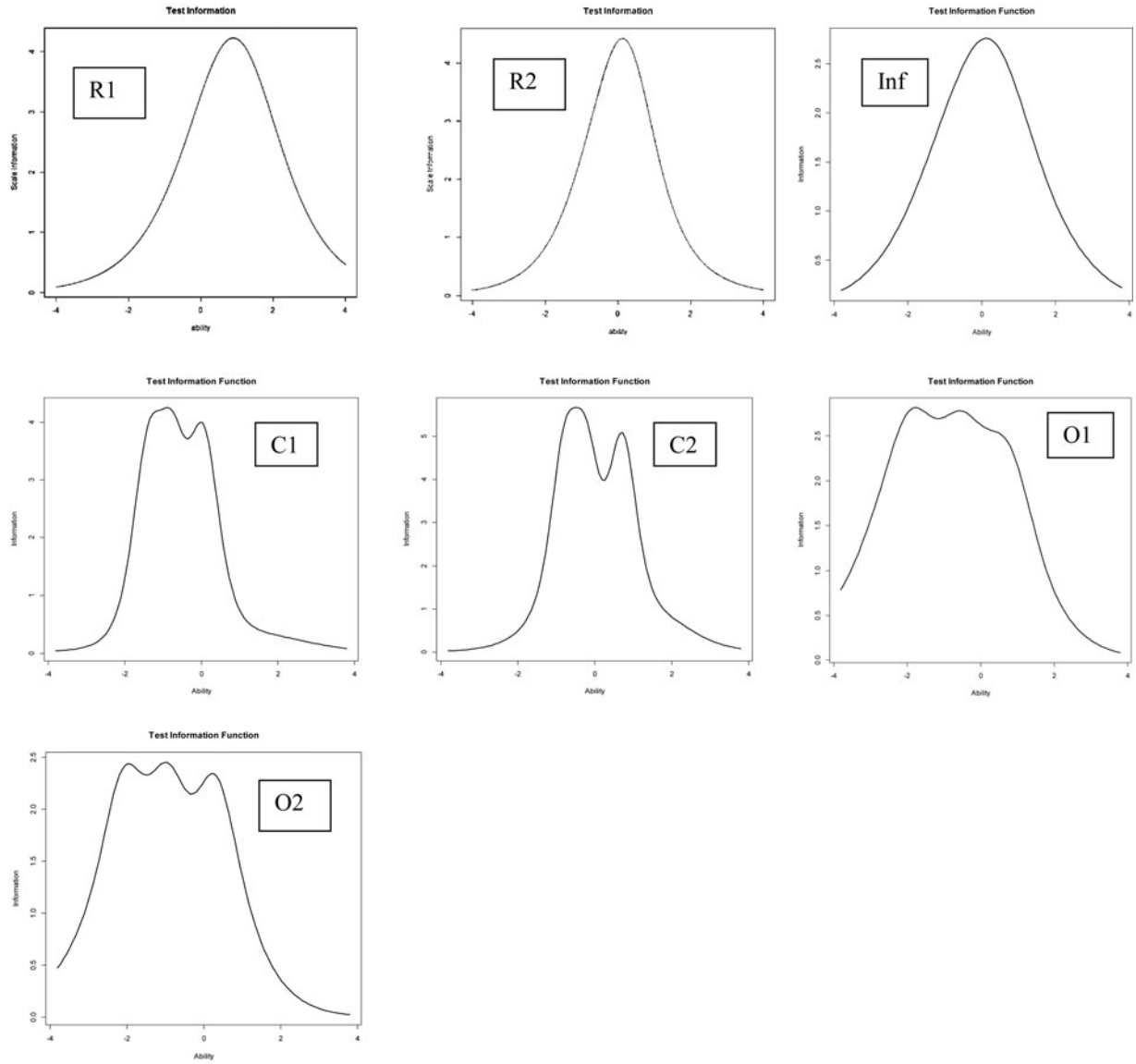

Figure 1. Test Information Functions of the RICO scales describing where the test is most discriminative on the trait continuum. *X*-axis: continuum on latent trait; *y*-axis: amount of information on the latent ability provided by the sum of the items of the given scale. R1 = risk-awareness; R2 = learning from own experiences; Inf = knowledge about psychoactive substances; C1 = control intention; C2 = expectation to control; O1 = orientation in life; O2 = self-efficacy.

(Tossmann, Kasten, Lang, & Strüber, 2009). It encompasses criteria for alcohol misuse and dependency in 6 items with a dichotomous format (e.g.: *Do you ever use alcohol or other drugs to RELAX, feel better about yourself, or fit in?*). Using regular scoring procedures, an individual giving more than two affirmative answers is considered to exhibit problematic alcohol use. The CRAFFT-d has shown good psychometric properties and construct validity in German samples (Wartberg, Kriston, Diestelkamp, Arnaud, & Thomasius, 2016). Cronbach's Alpha was .59 in our sample, mirroring the results presented by Wartberg and colleagues (2016).

Intention for future alcohol, tobacco and cannabis use in nonusers. The willingness for substance use in young age was found to be a valid predictor for later substance use (Ullrich-Kleinmanns, Jungaberle, Weinhold, & Verres, 2008). Therefore, intention not to consume could indicate a risk-avoiding attitude towards psychoactive substances. Intention for use was measured separately for alcohol, tobacco, and cannabis with the question "*would you use the substance if the opportunity presented itself?*" Participants responded on 3-point scales marked 2 = *Yes*; 1 = *I don´t know*; 0 = *No*.

Risk perception. Three different types of risk perception were assessed separately for alcohol, tobacco, and cannabis: general risk perception (*how risky is it for everybody*), personal risk perception (*how risky is it for me*), and the difference between both. General and personal

risk perception were measured on 7-point scales marked from 1 = *harmless* to 7 = *very dangerous*. Calculating the difference between general and personal risk perception gives a value representing an unrealistic optimistic attitude (Schwarzer & Renner, 1997; Weinstein, 1980) towards one's own vulnerability. The smaller this differential risk perception, the smaller the underestimation of subjective vulnerability. If this differential risk perception is close to zero, risks are evaluated accurately without a self-serving bias.

Big Five personality. Basic traits were measured using a German 25-item adaptation (BFI-25; Gerlitz & Schupp, 2005) of the original Big-Five-Inventory (John, Donahue, & Kentle, 1991). Answers were given on 7-point scales ranging from 1 = *strongly disagree* to 7 = *strongly agree*. Cronbach's Alpha was .81/.80/.71/.66/.52 for C/O/E/A/N respectively.

Generalized self-efficacy (GSE). GSE was assessed using Schwarzer & Jerusalem´s (1995) scale. It includes 10 items using 4-point scales ranging from 1 = *not at all true* to 4 = *exactly true*. Cronbach's Alpha was .88.

Sense of coherence (SOC). SOC was measured using a German adaption of Antonovsky's original 13-item Orientation to Life scale (Schumacher, Wilz, Gunzelmann, & Brahler, 2000). Answers were given on 7-point scales mostly ranging from 1 = *very rarely* to 7 = *very often*. Cronbach's Alpha was .75.

Statistical analysis

We used confirmatory factor analyses (CFA) using the *R*-package Lavaan (Rosseel, 2012). Model fit was evaluated using (1) χ^2-tests and a χ^2/df ratio ideally as low as 2 (Brown, 2015); (2) the comparative fit index (CFI) with acceptable/good model fit for values of .90/.95 and above (Bentler, 1990; Hu & Bentler, 1999); (3) the root mean square error of approximation (RMSEA) and (4) the standardized root mean square residual (SRMR) with values smaller .06 and .08 respectively indicating good fit (Hu & Bentler, 1999). A Full Information Maximum Likelihood estimator with robust standard errors was used for parameter estimation and handling of missing data (for the scales R2 and C1, which were constructed only for substance users).

Results

Factorial validity

We examined a model of seven independent, intercorrelated factors. Items loaded on their respective higher order factor. All latent variables were allowed to correlate. Most indices denoted acceptable model fit with the exception of CFI: $\chi^2 = 452.75$, $df = 329$, $\chi^2/df = 1.38$, $p < .01$, CFI = .869, RMSEA = .041 [CI_{90} = .031–.049], p-close = .97, SRMR = .078. The poor fit regarding CFI can be attributed to the high model complexity as CFI prefers more parsimonious models and pays a penalty for every model parameter added. As a very strict adherence to classic cut-offs is increasingly discouraged (Barrett, 2007), we conclude that the CFA has supported the factorial validity of the RICO scales. The measurement model with standardized estimates can be seen in Figure 2. Latent variable correlations can be seen in Table 5.

Construct validity

To ease interpretation, indicators of the criterion and construct validity, which showed significant correlations to the 7 RICO-scales, are presented in Table 4. Correlations between all study variables are shown in Tables 5, 6, and 7. We will focus on the criterion correlations of the RICO scales in the next paragraph.

Risk-awareness (R1). Risk awareness correlated with the 30-day prevalence rates of alcohol use (−.31), binge drinking (−.38), and drunkenness (−.51). It also predicted the amount of alcohol consumption on drinking days (−.47), the 6-month prevalence of alcohol use (−.41) and drunkenness (−.42), problematic alcohol use (−.22), as well with the intention for future tobacco- (−.19) and cannabis use (−.42) in nonusers. Positive correlations were found with general alcohol- (.14) and cannabis risk perception (.27), as well with the personal risk perception of alcohol (.33), tobacco (.17) and cannabis (.25). Risk awareness also correlated with the Big Five traits conscientiousness (.37) and agreeableness (.15), and extraversion (−.24).

Learning from own experiences (R2). The scale showed positive correlations with the 30-day prevalence of binge drinking (.34) and a problematic alcohol use (.28). A significant negative correlation was found between the scale and the differential risk perception (self-serving bias) regarding to cannabis use (−.22). Hence, participants, who scored high on R2 had less tendency to engaged in unrealistic optimism.

Knowledge about psychoactive substances (Inf). The scale correlated positively with the amount of alcohol consumed on drinking days (.20), 6-month prevalence of alcohol (.21) and tobacco (.38), self-serving bias regarding tobacco use (.17), and intention for cannabis use in nonusers (.20). Negative correlations emerged with general cannabis risk perception (−.16), as well with the personal alcohol- (−.14), tobacco (−.15) and cannabis (−.15) risk perception. Knowledge also correlated with extraversion (.17) and agreeableness (−.18).

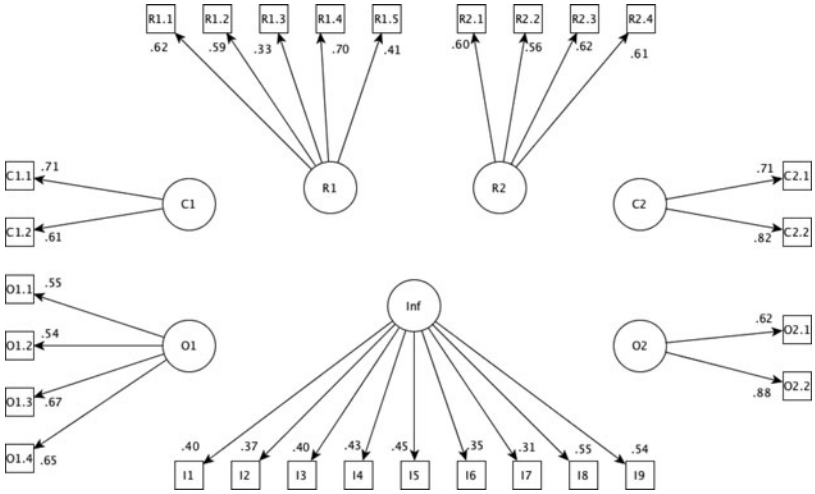

Figure 2. Measurement model of the Confirmatory Factor Analysis with standardized estimates. Correlations between latent variables are not shown, but listed in Table 5.

Intention to control (C1). Intention to control one's substance use correlated with the 30-day prevalence of alcohol (−.34), binge drinking (−.32), drunkenness (−.37), amount of alcohol consumption on drinking days (−.28), 6-month prevalence of alcohol use (−.33) and drunkenness (−.30), self-serving bias regarding to alcohol (−.30) and tobacco (−.21), as well with the intention to use cannabis in nonusers (−.33). Positive correlations were found with the general risk perception of tobacco (.24) and cannabis (.30), as well as personal risk perception of alcohol (31), tobacco (.33), and cannabis (.36). The scale correlated positively with neuroticism (.24).

Expectation to control (**C2**). Expectation to control one's substance use correlated with the intention to use cannabis in nonusers (−.14). The scale also correlated with general alcohol risk perception (.20), and the personal risk perception of alcohol (.23), tobacco (.14), and cannabis (.18).

Orientation in life (O1). The scale showed negative correlations with the 30-days prevalence of drunkenness (−.39), the amount of alcohol consumption on drinking days (−.26), the 6-month prevalence of alcohol (−.19), cannabis (−.35), and drunkenness (−.34). It also predicted problematic alcohol use (−.30) and the intention to use tobacco (−.23) and cannabis (−.33) in nonusers. The *orientation in life* scale also correlated with general risk perception of alcohol (.14), tobacco (.23), and cannabis (.32), as well with the personal risk perception of alcohol (.17), tobacco (.17), and cannabis (.26) risk-perception. The scale was also associated with the personality aspects conscientiousness (.48), openness (.13), agreeableness (.28), generalized self-efficacy (.34) and sense of coherence (.22).

Table 4. Criterion and construct validity of the RICO-scales ($N = 229$): significant correlations.

	criterion validity		construct validity	
	$r = (+)$	$r = (-)$	$r = (+)$	$r = (-)$
Risk-Awareness	GRP-A; GRP-C; PRP-A; PRP-T; PRP-C	30D-A; 30D-BD; 30D-D; 30D-QC; 6M-D; CRAFFT; CI-T; CI-C	C; A	E
Learning from own experiences	30D-BD; CRAFFT	GPD-C	—	—
Knowledge about psychoactive substances	30D-QC, 6M-A; 6M-T; GPD-T; CI-C	GRP-C; PRP-A; PRP-T; PRP-C	E	A
Control intention	GRP-T; GRP-C; PRP-A; PRP-T; PRP-C;	30D-A; 30D-BD; 30D-D; 30D-QC; 6M-A; 6M-D; GPD-A; GPD-T; CI-C	N	—
Expectation to control	GRP-A; PRP-A; PRP-T; PRP-C;	CI-C	—	—
Orientation in life	GRP-A; GRP-T; GRP-C; PRP-A; PRP-T; PRP-C	30D-D; 30D-QC; 6M-A; 6M-C; 6M-D; CFRAFFT; CI-T; CI-C	C; O; A; GSE; SOC;	—
Self-efficacy	GRP-T; GRP-C; PRP-C	CRAFFT; CI-C	E; C; O; A; GSE; SOC	N

Notes. r= significant correlation coefficient; A = alcohol; T = tobacco; C = cannabis; 30D = 30-day prevalence (number of days); 6M = 6-month prevalence (scale 1–6); CRAFFT = problematic alcohol use; BD= binge drinking; D = drunkenness; QC= quantity of alcohol consumption on an occasion (scale 0 to 10); GRP = general risk perception; PRP = personal risk perception; GPD = difference between general and personal risk perception (as indicator for self-serving bias); CI = control intention; N = neuroticism; E = extraversion; C = conscientiousness; O = openness; A = agreeableness; GSE = generalized self-efficacy; SOC = sense of coherence.

Table 5. Correlations between the RICO-scales and substance use ($N = 229$). Latent variable correlations from CFA are depicted below diagonal.

	M(*SD*)	R1	R2	Inf	C1	C2	O1	O2	30D-A	30D-T	30D-C	30D-BD	30D-D	30D-QC	6M-A	6M-T	6M-C	6M-B	CRAF
R1	2.81(.63)	—	.60	−.20**	.47**	.14*	.41**	.10	−.31*	−.09	−.05	−.38**	−.51**	−.47**	−.41**	−.17	−.38	−.42**	−.22**
R2	2.17(.77)	.17	—	.14	.18	.20*	.16	.10	.21	−.10	.04	.34*	.14	.18	.19	.09	.15	.21	.28**
Inf	1.46(.88)	−.34*	.16	—	.01	.01	−.04	.03	.00	.25	.30	.03	.18	.20*	.21*	.37**	.07	.07	.14
C1	2.45(.92)	.76**	.29	−.10	—	.29**	.38**	.16	−.34**	.05	.33	−.32*	−.37**	−.28**	−.33**	−.13	−.06	−.30*	−.07
C2	2.48(.91)	.16	.32*	.04	.54*	—	.06	−.06	.07	.11	.23	.18	.05	.01	.07	.18	.39	−.04	.09
O1	2.94(.64)	.62**	.24	−.07	.58**	.08	—	.50*	−.01	−.17	−.01	−.20	−.39**	−.26**	−.19*	−.17	−.45*	−.34*	−.30**
O2	3.05(.72)	.21*	.24	.07	.28	−.04	.70**	—	−.03	−.03	−.02	−.02	−.02	−.31	−.08	−.12	−.33	−.05	−.21**
30D-A	3.06(4.13)								—	.25	−.01	.81**	.75**	.45**	.66**	.31*	.39	.51**	.25**
30D-T	9.85(10.76)									—	.39	.13	.33	.30	.23	.83**	.23	.24	.24
30D-C	5.20(7.02)										—	.26	.28	.06	.00	.23	.78**	.23	.00
30D-BD	2.33(3.97)											—	.73**	.59**	.61*	.30	.48	.53**	.16
30D-D	1.47(1.38)												—	.66**	.70**	.56**	.54*	.74**	.25
30D-QC	1.69(2.44)													—	.64**	.48**	.25**	.49**	.43**
6M-A	1.67(1.30)														—	.41**	.36	.71**	.39**
6M-T	2.13(2.21)															—	.46*	.44*	.28*
6M-C	2.25(2.07)																—	.40	.19
6M-D	1.47(.95)																	—	.22
CRAF	0.29(.45)																		—

Notes: *M* = mean; *SD* = standard deviation; R1 = risk-awareness; R2 = learning from own experiences; Inf = knowledge about psychoactive substances; C1 = control intention; C2 = expectation to control; O1 = orientation in life; O2 = self-efficacy; A = alcohol; T = tobacco; C = cannabis; 30D = 30-day prevalence (number of days) ;); 6M = 6-month prevalence (scale 1–6); CRAF = problematic alcohol use; BD= binge drinking; D = drunkenness; QC= quantity of alcohol consumption on an occasion (scale 0 to 10); *= $p < .05$; **= $p < .01$; Pearson-coefficients; with the scale CRAFFT: Spearman´s Rho-coefficients.

Table 6. Correlations between the RICO-scales and risk perception and substance use intention (*N*=229).

	M(SD)	R1	R2	Inf	C1	C2	O1	O2	GRP-A	GRP-T	GRP-C	PRP-A	PRP-T	PRP-C	GPD-A	GPD-T	GPD-C	CI-A	CI-T	CI-C
R1	2.81(.63)		.06	−.20**	.47**	.14*	.40**	.09	.14*	.09	.27*	.33*	.17*	.25**	−.19**	−.12	−.04	−.15	−.18*	−.42**
R2	2.17(.77)			.14	.18	.20*	.16	.10	−.17	.03	.03	.00	.10	.15	−.14	−.11	−.22*	−.08	−.11	−.13
Inf	1.46(.88)				.01	.01	−.04	.03	−.06	−.01	−.16*	−.14*	−.15*	−.15*	.07	.17*	.03	.18	−.01	.20**
C1	2.45(.92)					.29**	.38**	.16	.03	.24*	.30**	.31**	.33**	.36**	−.30**	−.21*	−.15	−.20	−.23	−.33**
C2	2.48(.91)						.06	−.06	.20**	.10	.12	.23**	.14*	.18**	−.04	−.07	−.12	.04	.04	−.14*
O1	2.94(.64)							.50**	.14*	.23**	.32**	.17*	.17*	.26**	.04	.00	.00	−.19	−.23*	−.33**
O2	3.05(.72)								−.02	.13*	.17*	−.06	.15	.16*	.04	−.02	−.03	−.18	−.13	−.17*
GRP-A	2.68(2.39)									.30**	.19*	.40**	.36**	.35**	.51**	−.16*	−.28**	−.23*	−.14	−.11
GRP-T	1.33(2.30)										.33**	.31**	.57**	.30**	−.03	.19**	−.03	.11	−.25**	−.06
GRP-C	.38(1.28)											.27**	.34**	.74**	−.09	−.12	.13*	.04	−.13	−.44**
PRP-A	2.28(2.22)												.42**	.36**	−.59**	−.24**	−.20**	.01	−.16*	−.27**
PRP-T	1.22(2.20)													.66**	−.08	−.70**	−.56**	.01	−.21*	−.08
PRP-C	.38(1.30)														.03	−.54**	−.57**	−.07	−.11	−.35**
GPD-A	.16(1.70)															.08	−.06	−.23*	.03	.18**
GPD-T	.41(1.61)																.64**	.12	.10	.06
GPD-C	.21(1.41)																	.05	−.01	−.02
SUI-A	.44(.65)																		.13	.29**
SUI-T	.16(.43)																			.27**
SUI-C	.39(.67)																			

Notes. M = mean; SD = standard deviation; R1 = risk-awareness; R2 = learning from own experiences; Inf = knowledge about psychoactive substances; C1 = control intention; C2 = expectation to control; O1 = orientation in life; O2 = self-efficacy; A = alcohol; T = tobacco; C = cannabis; GRP = general risk perception; PRP = personal risk perception; GPD = difference between general and personal risk perception (as indicator for self-serving bias); SUI = substance use intention. *= $p < .05$; **= $p < .01$; Pearson-coefficients; with the scale C1: Spearman´s Rho-coefficients.

Table 7. Correlations between the RICO-scales and indicators of personality (*N*=229).

	M(SD)	R1	R2	Inf	C1	C2	O1	O2	N	E	C	O	A	GSE	SOC
R1	2.81(.63)		.06	−.20*	.47**	.14*	.41**	.09	.12	−.24**	.37**	.06	.15*	.06	.09
R2	2.17(.77)			.14	.18	.20*	.17	.10	−.12	−.01	.17	.14	.03	.15	.05
Inf	1.46(.88)				.01	.01	−.04	.03	−.05	.17**	−.04	.10	−.18**	.10	−.04
C1	2.45(.92)					.29**	.38**	.16	.24*	−.17	.15	.15	−.01	−.03	−.09
C2	2.48(.91)						.06	−.06	.07	−.06	−.04	−.08	−.12	−.08	−.06
O1	2.94(.64)							.50**	−.06	.01	.48**	.13*	.28**	.34**	.22**
O2	3.05(.72)								−.26**	.15*	.36**	.16*	.25**	.52**	.30**
N	21.68(4.70)									−.32**	−.10	−.19**	−.15	−.42**	−.41**
E	21.82(5.78)										.09	.16*	.04	.30**	.16*
C	23.07(6.05)											.22**	.33**	.47**	.32**
O	23.00(5.99)												.19**	.39**	.14*
A	26.34(4.78)													.40**	.40**
GSE	29.57(4.95)														.37**
SOC	56.77(10.67)														

Notes. M = mean; SD = standard deviation; R1 = risk-awareness; R2 = learning from own experiences; Inf = knowledge about psychoactive substances; C1 = control intention; C2 = expectation to control; O1 = orientation in life; O2 = self-efficacy; N = neuroticism; E = extraversion; C = conscientiousness; O = openness; A = agreeableness; GSE = generalized self-efficacy; SOC = sense of coherence; *= $p < .05$; **= $p < .01$; Pearson-coefficients.

Self-efficacy (O2). The scale correlated with problematic alcohol use (−.21), the intention to cannabis use in nonusers (−.17), general risk perception of tobacco (.13) and cannabis (.17), and personal risk perception of alcohol (.16). This scale showed numerous correlations with aspects of personality, i.e., extraversion (.15) conscientiousness (.36), openness (.16), agreeableness (.25), neuroticism (−.26), sense of coherence (.30), and most prominently general self-efficacy (.52).

Discussion

The presented studies investigated a new concept of risk competence in dealing with psychoactive substances (RICO) in adolescence, its operationalization and validation. In the first study, we operationalized the concept as a questionnaire based on classical test theory and items response theory. The final measure included 28 items in seven subscales. A model of seven intercorrelated factors best fitted the data, indicating that risk-competence is a bundle of heterogeneous and independent qualities rather than a general superordinate factor as has been assumed by many prevention practitioners (Franzkowiak, 1996; G. Koller, 2003; Weibel et al., 2007). Study 2 investigated criterion and construct validity using indicators of substance use, risk perception, and measures of personality. The RICO scales *risk-awareness, intention to control, orientation in life*, and *self-efficacy* exhibited strong evidence for criterion validity especially regarding problematic alcohol use. Adolescents with higher scores on these scales reported less risky substance use and had higher and less biased risk perceptions. Moreover, youths without previous experiences with tobacco and cannabis, and with high scores on the scales *risk-awareness, intention to control*, and *orientation in life* did not show interest in trying these substances in the future, indicating that RICO captures protective factors regarding the development of problematic substance use (Ullrich-Kleinmanns et al., 2008). The positive correlations of the scales *risk-awareness* and *orientation in life* with the big-five-factor *conscientiousness*, as well as the positive correlation of the scale *self-efficacy* with *sense of coherence* and *general self-efficacy* support the convergent validity of RICO and thus indicate a protective function.

Contrary to our expectations, the scales *learning from own experiences* and *being informed* positively correlated with the substance use behavior and negatively with most indicators of risk-perception, that is, those who had more knowledge and learned more from their own experiences did not show reduced substance use. Even though this is unfortunate from a drug prevention perspective, it is in line with prior research showing positive correlations between substance use and knowledge about substances (Aguilar-Raab et al., 2015).

It has been documented that risk perceptions are volatile and that longitudinal studies are necessary to get a clear picture on the protective processes (Brewer, Weinstein, Cuite, & Herrington, 2004). Our cross-sectional findings may therefore document a rather accurate assessment of risk taking behavior in young people. Moreover, the scale *learning from own experiences* indicated less self-serving bias regarding cannabis-risk-perception, at least partially suggesting more realistic risk-appraisal.

In our sample students attending vocational school were underrepresented. One might argue that there could systematic differences depending on social or cognitive conditions. For example students might systematically differ in terms of e.g., impulsivity or general intelligence. Future studies will need to validate the RICO construct in probability-based samples, including all types of schools.

RICO mostly measures self-control beliefs, rather than actual behavioral control. We did so, because a

self-description of one's own self-control can be measured more easily than actual behavior. Nonetheless, one has to keep in mind that self-reports can be biased, i.e., by unrealistic optimism (Weinstein, 1984), or even response styles, need for consistency, implicit theories, and social desirability (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). For example, unrealistic optimism has been shown to be a predictor of more negative alcohol experiences in the future (Dillard, Midboe, & Klein, 2009). However, our data showed that the control subscales of RICO had either zero or negative correlations with distortions in risk perception that a characteristic for unrealistic optimism. Thus, future studies should explore the relationship between RICO's control subscales and actual self-control capacity, such as controlled drinking.

The presented RICO concept focuses (with the exception of its subscale *orientation*) on risk competence in handling with psychoactive substances. We intentionally focused on this specific topic, yet consider risk competence to be a potentially valuable idea for other areas of risk taking behavior as well. Adolescence is a highly critical phase for risk taking behavior (Steinberg, 2008). Future studies could extend the concept of risk competence to other risk taking behaviors, such unprotected sex, risky driving, or extreme sports.

For the very first time, RICO offers an easy to use measure of key elements that are focused in modern drug prevention programs. Even though modern risk education has long relied on general life skills, outcomes are more often than not simply measured in terms of concrete substance use behavior (Cuijpers, 2003). The promotion of risk competence represents a major objective of the life-skills and risk pedagogy program REBOUND (Kröninger-Jungaberle, Nagy, von Heyden, DuBois & the REBOUND Participative Development Group, 2014) and the development of the RICO scales was inspired by developmental work in the wake of the REBOUND program. The RICO scales offer a new way to evaluate risk education. This could potentially shed light on why the effect sizes produced by drug prevention programs are generally very low (Foxcroft & Tsertsvadze, 2011). The present research has shown that risk competence is not a unitary construct, but comprises several independent components. Further research using the RICO scales may thus help to provide an answer to the unsettled question of what the key variables are that promote the development of healthy substance use patterns in youth.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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RICO Scale in English and German

R1-1	I am someone, who is quite careful about alcohol.
R1-2	Sometimes I wonder how I can protect myself from the negative aspects of alcohol and other drugs.
R1-3	I believe that many people only drink so they can be accepted by the group they are in.
R1-4	Films and stories about alcohol and other drugs make me think and be careful.
R1-5	I find that people who are so drunk, they don't know what they are doing, are embarrassing.
R2-1	From earlier experiences I can tell just how much alcohol and other drugs I can take.
R2-2	I only experience a "good high" (from alcohol or other drugs) if I am in the right kind of mood and situation.
R2-3	After being "high" I think about if that something I want to do again.
R2-4	Sometimes, talking with my friends, I am critical about our drug experiences.
Inf-1	Whether alcohol makes you feel better or worse also depends on the dosage: More than a certain amount can also make you feel sad or irritated.
Inf-2	When you smoke shisha, the carcinogenic substances in tobacco smoke are filtered out.
Inf-3	Since cannabis is usually smoked with tobacco, users are at a greater risk of becoming addicted to cigarettes.
Inf-4	The effects of cannabis last for a maximum of half an hour.
Inf-5	When eating or drinking cannabis (e.g., hash-brownies or hash-tee) you can manage the effects and risk of overdose less well.
Inf-6	Addiction can have a variety of causes. The most important ones for the development of an addiction are frequency of use and dosage of the drug, regardless of whether it is alcohol, tobacco, or cannabis.
Inf-7	Regarding the topic of drugs the phrase "more than a small amount" refers to a dangerous overdose.
Inf-8	The same amount of a drug (e.g. alcohol or cannabis) can have completely different effects depending on when it is used (e.g., yesterday or today).
Inf-9	After consuming certain drugs (e.g., cannabis or speed) a drug test given by the police to car or other vehicle drivers can also detect use after some days.
C1-1	Before going to a party I consider how much I´ll drink.
C1-2	After having a bad drug experience I intent to handle alcohol and other drugs better.
C2-1	In your opinion, how difficult is to control one's use of alcohol?
C2-2	In your opinion, how difficult is to control one's use of tobacco/cigarettes?
O1-1	I know what is important for my future.
O1-2	I am someone who makes plans for their life.
O1-3	It is important to abide by the generally accepted societal rules.
O1-4	I live by rules and principles.
O2-1	I can usually handle whatever comes my way (e.g., in the school or in a relationship).
O2-2	On the whole I am able to reach the goals I set.
R1-1	Ich bin jemand, der ziemlich vorsichtig mit Alkohol umgeht.
R1-2	Ich mache mir manchmal Gedanken darüber, wie ich mich vor den negativen Seiten von Alkohol oder anderen Drogen schützen kann.
R1-3	Ich glaube, dass viele Leute nur trinken, um in der Gruppe akzeptiert zu werden.
R1-4	Filme oder Geschichten über die Auswirkung von Alkohol und anderen Drogen machen mich nachdenklich und vorsichtig.
R1-5	Ich finde, dass betrunkene Leute, die nicht mehr wissen, was sie machen, peinlich sind.
R2-1	Aus früheren Erfahrungen kann ich gut einschätzen, wie viel ich von Alkohol oder anderen Drogen vertrage.
R2-2	Eine gute Rauscherfahrung erlebe ich nur dann, wenn ich in der richtigen Verfassung und Situation dafür bin.
R2-3	Nach einem Rausch mache ich mir Gedanken darüber, ob ich das noch einmal will.
R2-4	Mit meinen Freunden spreche ich manchmal auch kritisch über unsere Rauscherfahrungen.
Inf-1	Ob Alkohol die Stimmung verbessert oder verschlechtert hängt auch von der Dosierung ab: Wird eine bestimmte Menge überschritten, treten häufig auch Traurigkeit oder Gereiztheit auf.
Inf-2	Beim Shisharauchen (Wasserpfeife) werden die krebserregenden Stoffe des Tabakrauchs herausgefiltert.
Inf-3	Da Cannabis meistens zusammen mit Tabak geraucht wird, heben Kiffer eins höheres Risiko auch von Zigaretten abhängig zu werden.
Inf-4	Die Wirkung von Cannabis hält maximal eine halbe Stunde an.
Inf-5	Bei gegessenem (z.B. "Haschkekse") oder getrunkenem Cannabis ("Haschtee") kann man die Wirkungen und die Gefahr einer Überdosis schlechter kontrollieren.
Inf-6	Sucht kann verschiedene Ursachen haben. Am wichtigsten für die Suchtentwicklung ist aber die Häufigkeit und Menge der Droge (egal ob Alkohol, Tabak oder Cannabis).
Inf-7	Wenn in Zusammenhang mit dem Thema Drogen von einer "nicht geringen Menge" gesprochen wird, dann meint man eine gefährliche Überdosis.
Inf-8	Dieselbe Dosis einer Droge (z.B. Alkohol oder Cannabis) kann zu zwei verschiedenen Zeitpunkten (z.B. gestern – heute) ganz unterschiedlich wirken.
Inf-9	Nach dem Konsum mancher Drogen (z.B. Cannabis oder Speed) kann ein Drogentest, wie er von der Polizei bei Auto-oder Rollerfahrern durchgeführt wird, auch einige Tage später noch den Konsum nachweisen
K1-1	Vor einer Party überlege ich mir, wie viel ich trinke.
K1-2	Nach einer schlechten Rauscherfahrung nehme ich mir vor, besser mit Alkohol oder anderen Drogen umzugehen
K2-1	Wie schwer ist es deiner Meinung nach, den Konsum von Alkohol unter Kontrolle zu halten?
K2-2	Wie schwer ist es deiner Meinung nach, den Konsum von Zigaretten/Tabak unter Kontrolle zu halten?
O1-1	Ich weiß, was wichtig für meine Zukunft ist.
O1-2	Ich bin jemand, der sein Leben plant.
O1-3	Es ist wichtig, sich an die allgemein akzeptierten Regeln in der Gesellschaft zu halten.
O1-4	Ich lebe nach Regeln und Prinzipien
O2-1	Wenn ein Problem in meinem Leben auftaucht (z.B. Stress in der Schule, Beziehungsstress), kann ich es aus eigener Kraft meistern.
O2-2	Ich schaffe es in der Regel meine Ziele zu erreichen