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Targets for primary prevention: Cultural, social and intrapersonal factors associated with co-occurring health-related behaviours

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***Objective*:** Multiple studies have identified clusters of co-occurring health-related behaviours. Little is known, however, about factors associated with such clusters. This study aims to identify these factors and to assess whether their effects are in accordance with the Theory of Triadic Influence (TTI).
***Design*:** A cross-sectional study using a representative sample ($N = 3497$) of the Dutch population aged 19–40.
***Main Outcome Measures*:** Our data concerned 18 health-related behaviours combined in three clusters (Health, Alcohol and Delinquency) and 30 non-behaviour-specific (i.e. ultimate or distal) cultural, social and intrapersonal factors. The three clusters were used as outcomes in regression analyses.
***Results*:** Descriptive Norms of Friends and Gender were associated with all three behaviour clusters. Furthermore, Having Parents who Smoke or Consume Alcohol was associated with, respectively, the Health and Alcohol clusters. Self-Control and past Parental Monitoring were associated with the Health and Delinquency clusters. Effect sizes were moderate to large (r^2: 0.05 to 0.22).
***Conclusion*:** Factors with a moderate to large association with several behaviour clusters were identified. These factors were located within the social and intrapersonal stream of the TTI, not within the cultural stream.

Keywords: multiple risk behaviour; theory of triadic influence; self-control; delinquency; descriptive norm; parental monitoring; determinant; cluster

Introduction

During the past decade, health-related behaviours have frequently been shown to co-occur (e.g. Conry et al., 2011; Faeh, Viswanathan, Chiolero, Warren, & Bovet, 2006; Lippke, Nigg, & Maddock, 2012; Poortinga, 2007; Schuit, Van Loon, Tijhuis, & Ocke, 2002; Van Nieuwenhuijzen et al., 2009; Wiefferink, et al., 2006). These studies

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investigated co-occurrence of health behaviours in several ways. Some studies looked at *joint prevalences*, i.e. the prevalence of combinations of risk behaviours (e.g. Faeh et al., 2006; Poortinga, 2007; Schuit et al., 2002). Some studies identified *clusters of persons* who show the same behaviours (e.g. Conry et al., 2011). Other studies identified *clusters* (also called factors) *of behaviours* closely associated with each other. The latter type of clusters will be used in this study. The following clusters were found: a cluster of healthy eating and physical activity (Lippke et al., 2012), a cluster of smoking and alcohol abuse (Wiefferink et al., 2006), three separate clusters of, respectively, health-promoting behaviours, alcohol/sexual behaviour, and delinquent behaviours (Van Nieuwenhuijzen et al., 2009).

The existence of health behaviour clusters has triggered some researchers to search for factors associated with these clusters (e.g. Brooks, Magnussen, Spencer, & Morgan, 2012; Prochaska, 2008). If such factors exist, then there would be support for the development of more integrated approaches to promoting healthier lifestyles. In the words of Prochaska (2008) 'Multiple Health Behaviour Research represents the future of preventive medicine' (p. 281). Some studies identified characteristics of persons with multiple risk behaviours (e.g. Brooks et al., 2012). However, to our knowledge, evidence is most lacking on factors associated with several clusters of behaviours. Therefore, the aim of the present study is to identify such factors. Many studies focused on the influence of factors on *separate* health-related behaviours. Some researchers showed the similarity of such factors across behaviours. Durlak (1997) suggested in a literature review that the risk factors for various behaviours, including behaviour problems, drug use, HIV/AIDS, poor physical health and smoking are to a large extent the same. These were impoverished neighbourhoods, poor school quality, low family socio-economic status, parental problems (e.g. depression, drug abuse) and childrearing practices. Similarly, family-related factors (e.g. parental monitoring, parent–child relationship, family social support and personal autonomy in relation to family; see Brooks et al., 2012; Finkenauer, Engels, & Baumeister, 2005; Wiefferink et al., 2006) were all found to be associated with health-related behaviours or delinquency.

Approaches that look for influential factors require insight into the pathways of such factors on clusters of health behaviours. Various theories have emerged in health promotion practice and research to understand the nature and course of health-related behaviours (for an overview, see Diclemente, Crosby, & Kegler, 2009). Among these, Flay and Petraitis (1994) proposed an integrative theory of health behaviour: the Theory of Triadic Influence (TTI). The TTI includes higher order descriptions and explanations of health-related behaviours and suggests that changes in higher order factors, which are called 'determinants' to emphasise their causal influence on behaviour, will produce greater and more sustainable health promotion effects than more traditional approaches (Flay, Snyder, & Petraitis, 2009). In the current study, the TTI is used as a theoretical framework. Three 'streams of influence' of determinants are distinguished in the TTI: the cultural/attitudinal stream, the social/normative stream and the intrapersonal stream (see Figure 1). Within each of these streams, three levels of determinants with increasing influence on behaviour are distinguished: ultimate, distal and proximal.

Proximal determinants are most likely to be influential, but for a specific, single behaviour. For example, the best predictors for smoking are intention to smoke, attitude towards smoking, subjective norm towards smoking and non-smoking self-efficacy (Flay, 2002). Proximal determinants can be modelled using various theories of which

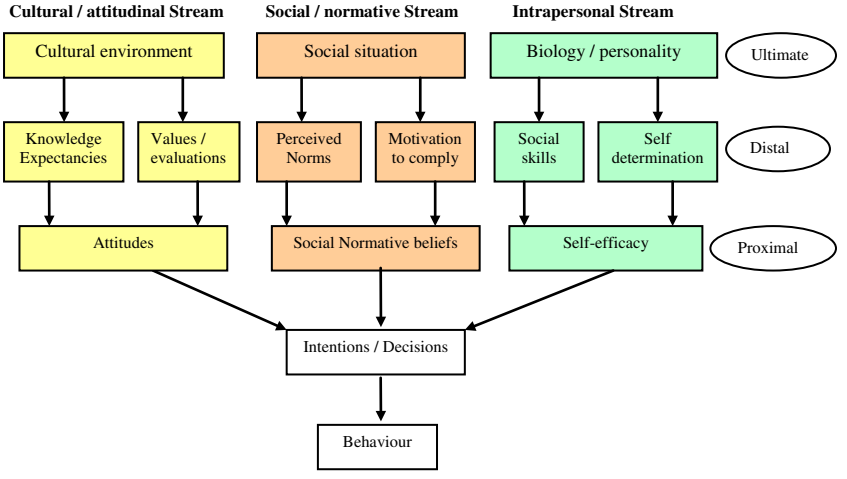

Figure 1. The Theory of Triadic Influence (adapted from Flay & Petraitis, 1994).

the TTI most builds on the Theory of Planned Behaviour (Ajzen, 1991). Ultimate determinants of behaviour are factors in one's background and environment that are believed to be the deep-seeded, root causes of behaviour (Flay & Petraitis, 1994). They include personality dispositions (e.g. Big Five personality measures) and one's sociocultural heritage. Distal determinants are more personally relevant than ultimate ones, but are still general in nature. They include social relationships, knowledge and values, and sense of self and social competence. Distal and ultimate determinants are assumed to have weaker direct effects on a single behaviour, but they are likely to have a more general impact; hence, they may have an impact on multiple behaviours. The TTI labels them as distal and ultimate, by assumed larger distance from the health behaviour concerned. This part of the TTI is most innovative as it explicitly models factors that have been studied in a more general way in, for instance, the fields of parenting and personality (Carver, 2005; Darling & Steinberg, 1993).

The present study assesses the associations of distal and ultimate factors with health-related behaviour clusters. According to the TTI, distal and ultimate factors can be expected to affect a wider range of health behaviours. We disregarded the group of proximal factors, because these factors can be expected to have more behaviour-specific influences, while we focus on non-behaviour-specific influences. Furthermore, it is known that effective prevention strategies also include some distal and ultimate factors, while most studies focus on proximal factors (see Donath et al., 2012).

The following three behaviour clusters found by Van Nieuwenhuijzen et al. (2009) are used as outcomes: Health (including having breakfast, fruit consumption, non-smoking, hours of sleep and physical activity), Alcohol (including alcohol consumption and unsafe sexual behaviour) and Delinquency (including physical and verbal aggression, delinquent behaviour, drug abuse, and jumping traffic lights). The study aims to identify factors associated with several of these clusters and to assess whether their associations follow the pathways as hypothesised by the Theory of Triadic Influence. The research questions are:

(1) Which factors have a strong association with several behaviour clusters?
(2) To which of the three streams of the Theory of Triadic Influence (i.e. cultural, social or intrapersonal; Figure 1) do these factors belong?
(3) Is the association of the group of distal factors stronger than the group of ultimate factors, as could be derived from the Theory of Triadic Influence? And how strong is the association of the combined groups with each behaviour cluster?

Methods

Sample and design

Our study included a subsample from a Dutch nationwide representative sample of people aged 12–40 who participated in the Risk Behaviour Survey in 2005–2006. Ethical approval was gained from the ethical committee of the Faculty of Social Sciences, Utrecht University, the Netherlands. Respondents came from a stratified random sample taken from a database of about 200,000 households in the Netherlands. A cross-sectional design was used. Online questionnaires were completed once by 3423 (71%) of a total sample of 4820 people. In addition, two groups were oversampled, i.e. participants from disadvantaged backgrounds, and those belonging to an ethnic minority group (for details see Van Nieuwenhuijzen et al., 2009). In total, 4468 (67%) people participated in the survey, stratified in three age groups (adults, late adolescents and young adolescents). Because different behaviour clusters were found for each of these age groups (see Van Nieuwenhuizen et al.), and differences between age groups were not the focus of the present study, we selected only the largest age group, that is 3497 (78%) adults, aged 19–40, for the present study. The sample characteristics are presented in Table 1.

Measures

Data were collected by face-to-face, computer-assisted interviews and internet questionnaires. The survey instruments included items about health behaviours, either

Table 1. Background characteristics of the adults' sample (aged 19–40, $N = 3497$) from the risk behaviour survey, the Netherlands, 2005–2006.

Background characteristic	Descriptive statistic
Age (mean ± SD)	30.64 ± 6.29
Sex (% female)	51.9
Educational level	
% low	36.7
% medium	33.6
% high	29.5
Ethnicity (% Dutch)	90.3
Household type	
% Couples with children	58.1
% Couples without children	23.2
% Singles with children	6.8
% Singles	11.9

positive or adverse, derived from standardised questionnaires that are used for routine health behaviour monitoring in the Netherlands. Supplementary material is provided that presents an overview of the factors used in this study, their psychometric properties, references, and for each factor an example of an item with answer categories and score range (Supplementary material, Table 1). In this overview, the factors are categorised by the three streams within the ultimate and distal dimensions of the model of Flay and Petraitis (Figure 1). The TTI assumes that the distance to the behaviour of a distal (or ultimate) factor in one stream is equal to that of a distal (or ultimate) factor in another stream. This is represented in Figure 1 by equal distances. We regarded the variables age and sex as ultimate factors within the intrapersonal stream, because they concern a person's background.

As mentioned above, as outcomes, we used the factor scores on the three behaviour factors (referred to as clusters) for adults estimated by Van Nieuwenhuijzen et al. (2009): Health, Alcohol and Delinquency. The factor scores were available for all respondents. The Health factor included: having breakfast (no. of days a week), fruit consumption (no. of days per week times portions per day), vegetable consumption (no. of days per week times portions per day), non-smoking (no. of cigarettes per day), hours of sleep and physical activity (total time in half-hours). The Alcohol factor included the number of glasses of alcohol consumed per day, number of days of alcohol consumption per week and unsafe sexual behaviour (condom use in new sexual contacts, ranging from always to never). The Delinquency factor included physical and verbal aggression (from the Aggression Questionnaire), delinquent behaviour last year and in the past, drug abuse (from no drugs, soft drugs in the last 12 months, to hard drugs in the last 4 weeks) and ignoring red lights as a pedestrian (number of times in last month) or while driving a car (number of times in last month). Van Nieuwenhuijzen et al. initially identified the three factors using exploratory categorical principal component analysis and then performed a confirmatory factor analysis (CFA). The CFA solution showed a satisfactory goodness-of-fit (CFI = 0.95, RMSEA = 0.05). A higher score on the Health factor indicates a healthier lifestyle. A higher score on the Alcohol factor indicates higher alcohol consumption and more unsafe sex. A higher score on the Delinquency factor indicates having more delinquent behaviour. The correlations between the factors were −0.51 for Health and Delinquency, 0.35 for Alcohol and Delinquency and −0.35 for Health and Alcohol (see Figure 1 and Table 2 in Van Nieuwenhuijzen et al., 2009).

Statistical analysis

Multiple imputation using MICE (Van Buuren & Groothuis-Oudshoorn, 2011) was performed to create five imputed data-sets, in line with Rubin (1987), who stated that 5–10 imputed data-sets are enough to achieve high efficiency. Overall, 20% of the respondents had a missing value on one or more ultimate factors, and 31% on one or more distal factors. To answer the first research question, three regression analyses were performed with the separate behaviour clusters as outcome variables and distal and ultimate factors as predictors. Variables with a skewed distribution were log-transformed. This was necessary for the factor: 'negative interaction with best friends'. Both simple and multiple regression analyses were performed to assess univariate associations and adjusted associations (i.e. adjusted for the effect of the other factors) of each factor with

a behaviour cluster, respectively. The significance of the regression coefficients was determined using a False Discovery Rate correction for multiple testing (Benjamini & Hochberg, 1995), and an overall two-sided α of 0.05. However, even after this correction for multiple testing, small standardised regression coefficients (e.g. $\beta = 0.04$) were significant. The reason for this was the large sample size of our study. Therefore, to assess the strength of the associations, we inspected effect sizes rather than significance values.

To assess the univariate associations, effect sizes r^2 (i.e. squared standardised regression coefficients) were computed. For categorical predictor variables, the squared multiple correlation coefficient (R^2) was used as effect size. To assess the adjusted associations, the effect size index f^2 was computed for each predictor (Cohen, 1988). Because the effect size f^2 takes into account the total variance-accounted-for (total VAF; i.e. R^2) by a multiple regression model, the use of the index f^2 is preferred to the use of a squared standardised regression coefficient when the influence of a predictor is compared *across* outcomes (Cohen, 1988). Effect sizes f^2 were computed as the relative increase in VAF between the multiple regression model including all factors except for a specific factor and the model including all factors (see Cohen, 1988, formula 9.2.3, p. 410). Thus, the effect size can be interpreted as the relative proportion of outcome VAF by the factor. To assess the direction of the association, we inspected the sign of the regression coefficient. The guidelines of Cohen (1988) for the interpretation of the strength of an effect are as follows: $r^2 = 0.01$ is considered as 'small', $r^2 = 0.09$ as 'medium' and $r^2 = 0.25$ as 'large'. On the basis of these values, we formulated the following *ranges*: effect sizes between 0.05 and 0.20 were considered to be 'medium', and those above 0.20 were considered to be 'large'.

To answer the third research question, we estimated the VAF of several regression models, using the two groups of factors (ultimate or distal). The VAF of the model including both groups was subtracted from the sum of VAFs of the models including one group. The VAF that remained indicated the *shared* VAF. If the groups are completely independent, the shared VAF is zero, and the total VAF is equal to the sum of the separate VAFs. If the influence of the ultimate factors is completely mediated by the distal factors, then the shared VAF is equal to the separate VAF of the ultimate group alone. Analyses were performed using *R* version 2.15.1 (R Core Team, 2012), and the mean of the five imputed data-sets was used as final point estimate for all groups.

Results

Factors associated with several behaviour clusters

Figure 2 shows the univariate associations between a factor and each of the three health-related behaviour clusters. Univariate effect sizes ranged from 0.00 to 0.22. Most of the effect sizes were small (i.e. below 0.05), with some exceptions (Figure 2). In general, the effect sizes for the Health and Delinquency clusters were somewhat higher than for the Alcohol cluster (Figure 2).

To assess which factors were strongly associated with several clusters, we first focused on factors that showed a medium to large association (r^2) with all three behaviour clusters. These were Sex, an ultimate factor, and Descriptive Norms of Friends, a distal factor (Figure 2). Men exhibited a less healthy lifestyle compared to

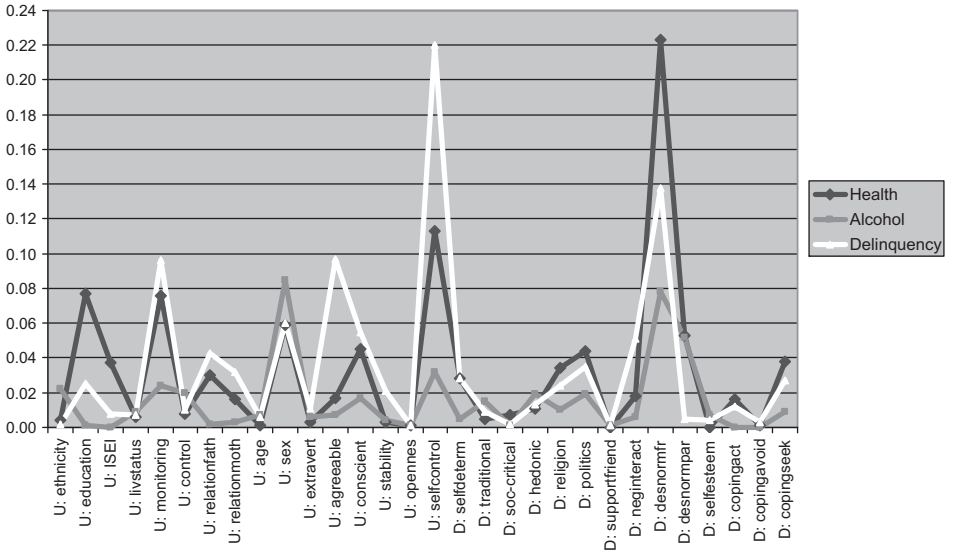

Figure 2. Effect sizes r^2 (y-axis) representing the univariate association of each ultimate (U) and distal (D) factors (x-axis) with the three behaviour clusters Health, Alcohol and Delinquency in 19–40 year-old men and women ($N = 3497$) in the Netherlands, 2005.

women, i.e. they had a lower average score on the Health cluster, a higher score on the Alcohol cluster and a higher score on the Delinquency cluster. Having more friends who smoke was strongly associated ($r^2 = 0.22$) with a lower score on the Health cluster, having more friends who consume alcohol was associated with a higher score on the Alcohol cluster and having more friends who use drugs (i.e. cannabis) was associated with a higher score on the Delinquency cluster.

Second, we focused on factors with a medium to large univariate association with two of the three behaviour clusters. These were the ultimate factors Parental Monitoring and Self-Control, and the distal factor Descriptive Norms Parents. Having parents who monitored their adolescent's behaviour more frequently was associated with a higher score on the Health cluster, and a lower score on the Delinquency cluster. A higher score on Self-Control was associated with a higher score on the Health cluster, and strongly associated with a lower score on the Delinquency cluster ($r^2 = 0.22$). Having parents who smoke was associated with a lower score on the Health cluster, and having parents who consume alcohol was associated with a higher score on the Alcohol cluster.

Figure 3 shows the associations of the factors in a multivariate context with each of the three health-related behaviour clusters. In this case, effect sizes represent the association of one factor, adjusted for the effect of all other factors (so-called adjusted associations). The adjusted associations were smaller than the univariate ones and ranged from 0.00 to 0.14. The adjusted associations did not show any new important factors compared to the univariate associations. The multivariate picture indicated that

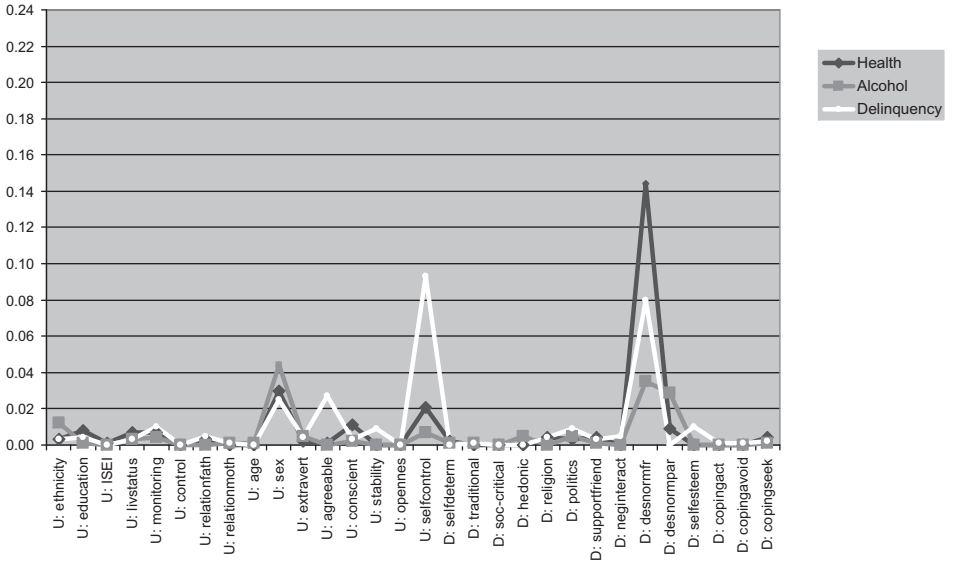

Figure 3. Adjusted effect sizes f^2 (y-axis) representing the association of each ultimate (U) and distal (D) factors (x-axis), adjusted for all other factors, with the three behaviour clusters Health, Alcohol and Delinquency in 19–40 year-old men and women ($N = 3497$) in the Netherlands, 2005–2006.

the distal factor Descriptive Norms of Friends was the most important factor ($f^2 = 0.14$ for Health), followed by the ultimate factor Self-Control ($f^2 = 0.09$ for Delinquency).

Position of the strongly associated factors in the theory of triadic influence

We looked into which of the three 'streams of influence' the strongly associated factors belonged (Figure 1 and Supplementary material Table 1). Self-Control and Sex were from the intrapersonal stream. Descriptive Norms of Friends, Descriptive Norms of Parents and Parental Monitoring were from the social stream. None of the influential predictors belonged to the cultural stream.

Associations of the group of ultimate and the group of distal factors

Figure 4 shows the results of the regression models with each of the behaviour clusters as outcome and either the group of ultimate factors or the group of distal factors as predictors, or both groups jointly. It was only for the Health cluster that the association of the group of distal factors was stronger than that of the group of ultimate factors (VAF 29% vs. 25%, respectively). For the Alcohol cluster, the associations of both groups were equal (VAF 16%). For the Delinquency cluster, the association of the group of ultimate factors was stronger than that of the group of distal factors (VAF 35% vs. 23%, respectively).

The model with both groups of ultimate and distal factors accounted for 39, 24 and 43% of the total variance in the Health, Alcohol and Delinquency clusters, respectively

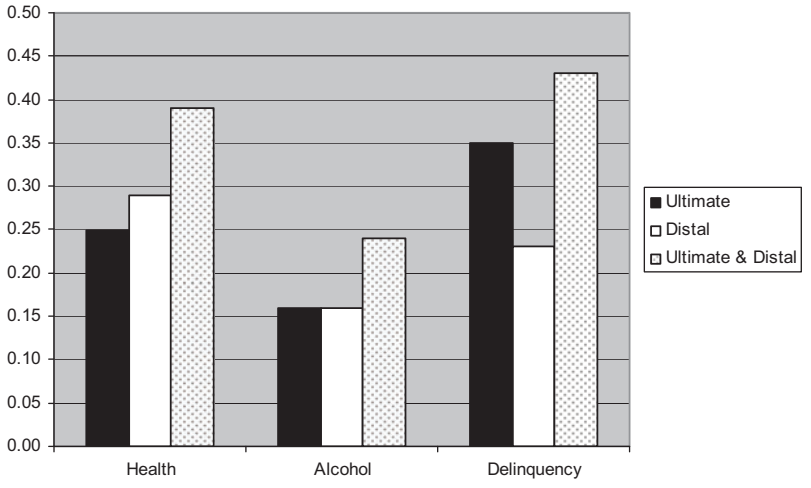

Figure 4. Overview of variance-accounted-for (R^2) by the regression models differing in group of factors (ultimate, distal, or both) as predictors and behaviour cluster as outcome for 19–40 year-old men and women ($N = 3497$) in the Netherlands, 2005–2006.

(Figure 4). For the Health cluster, the shared VAF by both groups was 15% (i.e. 29% + 25–39%), i.e. 38% of the total VAF. For the Alcohol cluster, the shared VAF was 8% (i.e. 33% of the total VAF). For the Delinquency cluster, the shared VAF was 15% (i.e. 35% of the total VAF).

Conclusion and discussion

With regard to the question of which factors are strongly associated with several clusters of health-related behaviours, our results suggested that Descriptive Norms of Friends and of Parents, Self-Control, Parental Monitoring and Sex were associated with more than one behaviour cluster. Descriptive Norms of Friends and Sex were associated with all three clusters: Health, Alcohol and Delinquency. Descriptive Norm of Parents was associated with Health and Alcohol. Parental Monitoring and Self-Control were associated with Health and Delinquency. The strongest associations were observed for Descriptive Norms of Friends and for Self-Control: the effect sizes of these factors were remarkably large. Descriptive Norms of Friends accounted for 22% of the variance in the Health behaviour cluster, and Self-Control Friends accounted for 22% of the variance in the Delinquency cluster. According to the Theory of Triadic Influence (TTI; Flay & Petraitis, 1994), three of these factors can be considered as ultimate factors and two of them as distal factors. They were located in the social and intrapersonal streams of influence. No factors were found that belonged to the third stream of influence, the cultural stream.

Our results were inconclusive regarding the question of whether the association of distal factors is stronger than the association of ultimate factors. The association of distal factors was stronger only with the Health cluster. The shared association by both

groups of factors was about one third of the total variances-accounted-for. This was the same for the three behaviour clusters.

The finding that Descriptive Norms of Friends is one of the strongest associated ~~common~~ factors with a wide range of health behaviours confirms previous findings (e.g. Griffin, Botvin, Scheier, Doyle, & Williams, 2003). A systematic review by Wiefferink et al. (2006) showed that in most studies, perceived healthy behaviour of significant others (e.g. peers, friends and parents) was positively associated with the health-related behaviours of adolescents. Our study adds that this association also holds for adults and that this also holds if the entire array of potentially influential factors is taken into account in one analysis. The mechanism behind the association of Descriptive Norms of Friends can be explained in several ways. One explanation emphasises the role of the environment on health behaviour. The perception of healthy or unhealthy behaviours in other persons who are closely related stimulates persons to show or adapt healthy or unhealthy behaviours. For example, the results from a longitudinal study by Maxwell (2002) suggested that there was peer influence to initiate and to stop alcohol and chewing tobacco use. Another explanation involves selection, i.e. people seek other people exhibiting their preferred behaviours (Engels, Knibbe, Drop, & De Haan, 1997; Van der Zwaluw et al., 2009).

The finding that Self-Control is the other strongly associated common factor corresponds with many studies showing that self-control, i.e. the ability to refrain from impulsive actions that are detrimental in the long term, is a major determinant of behaviour in general (Baumeister, Vohs, & Tice, 2007) and more specifically for deviant behaviour in childhood (Eisenberg et al., 2001), adolescence and adulthood (Gottfredson & Hirschi, 1990; Pratt & Cullen, 2000), and health behaviour (Finkenauer et al., 2005). Moffitt et al. (2011) showed that childhood self-control predicts physical health, substance dependence, personal finances and criminal offending outcomes in adults. It has been argued that self-control may be constitutional (Rothbart, Ahadi, & Evans, 2000), the result of adequate parenting (Gottfredson & Hirschi, 1990) or a combination of both (Shonkoff & Phillips, 2000). Our findings underscore the importance of self-control as a generic trait that underlies a broad set of behavioural outcomes and may help in explaining the findings that health-related behaviours and deviant behaviour co-occur.

Our study showed that in addition to Descriptive Norms of Friends and Self-Control, two other factors were strongly associated: Descriptive Norms of Parents and Parental Monitoring. The perception of healthy or unhealthy behaviours in parents may stimulate their children to initiate healthy or unhealthy behaviours. For example, Hung, Yen, and Wu (2009) showed that having parents who both used alcohol was a significant predictor of sixth graders' first alcohol use. Our study showed that Parental Monitoring was associated with both the Health and the Delinquency cluster. This finding is in line with several previous studies. Among these, Li, Stanton, and Feigelman (2000) provided evidence for an inverse relationship between perceived parental monitoring and various risk behaviours cross-sectionally and longitudinally. Griffin et al. (2003) showed that parental monitoring was one of the predictors that turned out to be protective for all four outcomes measured (i.e. smoking, alcohol, aggression and delinquency) among early adolescents. Brooks et al. (2012) showed that those adolescents with a low personal autonomy in relation to family showed a lower associated risk.

In our study, we distinguished between Parental Monitoring and Parental Control. Parental Monitoring was measured as the respondents' rating about their parents' knowledge of their school and free time activities (during adolescence, i.e. the last years living with your parents). Parental Control was measured as the respondents' rating about parental permission and requirements (during adolescence). Parental Control can be seen as a source of parental knowledge (Kerr & Stattin, 2000). The correlation between the two parental measures was moderate in our study ($r = 0.26$). Our results suggest that the perception that your parents know what you do (Parental Monitoring) has a stronger association with health and delinquency behaviours than having to ask for permission and having to bear in mind parental requirements (Parental Control).

Our findings partly confirm the TTI of Flay and Petraitis. Important factors were found from both the social and the intrapersonal stream, but not from the cultural stream. Also, both ultimate and distal factors played a role. The TTI also hypothesises a hierarchy in these influences. Our results for the Delinquency cluster do not confirm this. For this cluster, the association of the ultimate factors appeared to be stronger than that of the distal ones. Furthermore, for all three behaviour clusters, the distal factors only partly mediated the role of the ultimate factors, by showing approximately one-third of shared variance-accounted-for. Several previous studies also used the TTI (Donath et al., 2012; Johnston, Westphal, Earnshaw, & Thomas, 2012; Lippke et al., 2012). Many of our operationalisations of the ultimate and distal factors (see Supplementary material, Table 1) correspond roughly to those of Donath et al. (2012). For example, they also included scales to measure relationship with parents, parental control, hedonistic value orientation and self-esteem. However, contrary to our results for the Alcohol cluster, Donath et al. found that most factors for binge drinking in German adolescents were from the cultural stream. A reason for this difference in findings could be that Donath et al. did not include descriptive norm of parents and peers (i.e. their alcohol consumption). Another reason could be the underrepresentation of ultimate factors from the cultural stream in our study (also see below, the paragraph on limitations). Similar to our results, a large influence of factors from the social stream (family and peer networks) was found to be important in smoking initiation and progression among Australian young people (Johnston et al., 2012). Lippke et al. focused mainly on the clustering of health-related behaviours, and therefore was less comparable. As was shown in our study, the TTI can be a useful tool to integrate findings in multiple health-related behaviours and their factors.

The present study has several strengths. First, a broad range of factors was measured from the cultural, social and intrapersonal streams of the Theory of Triadic Influence. Second, relatively large percentages of the variance in the health-related behaviour clusters were accounted for: 43, 39 and 24% in the Delinquency, Health and Alcohol clusters, respectively. Third, instead of focusing on significance levels, effect sizes were emphasised. Because of the large sample size ($N = 3974$), small effect sizes (r^2: 0.01 to 0.05) were also significant ($p < 0.05$), even when using an FDR correction to control the overall significance level. We therefore preferred to focus on effect sizes rather than significance levels in order to highlight practical relevant associations of common factors with behaviour clusters.

Some limitations of this study should also be mentioned. The relationships were determined from cross-sectional data, and therefore no *causal* pathways could be established. Furthermore, the reliabilities of some of our measurements were low (i.e.

four of the Big Five personality scales). This might explain why the Big Five personality measures showed only small to medium effect sizes. Finally, all factors in our study were operationalised at an individual level. This may have caused an underrepresentation of ultimate factors of the cultural stream, such as media influence, legislation, policy and neighbourhood safety. Some of these factors have been included in previous studies (e.g. Donath et al., 2012; Johnston et al., 2012).

The existence of factors associated with multiple health-related behaviour clusters supports Prochaska's ideas about multiple health behaviour research (Prochaska, 2008). The factors identified in this study may offer clues for the development of integrative interventions (including, cohesive policy interventions; Hale & Viner, 2012) in the field of primary prevention. First, our findings suggest that addressing Self-control and Descriptive Norms of Friends might reduce a broad range of negative outcomes. Second, Parental Monitoring and Descriptive Norms Parents may remain important ultimate targets for intervention development since these provide good opportunities for achieving positive health outcomes sustainable for life. Experimental studies should be conducted to determine if interventions addressing these social and intrapersonal factors indeed succeed in changing a variety of health-related behaviours at once.

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Supplementary material

All Supplemental Material is available alongside this article on http://dx.doi.org/10.1080/08870446.2013.879137.

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