Regular articles

Assessing the Efficacy of MOTI-4 for Reducing the Use of Cannabis Among Youth in the Netherlands: A Randomized Controlled Trial ☆

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ABSTRACT

The Moti-4 intervention, in which motivational interviewing, self–monitoring, and strengthening behavioral control are used, was developed in the Netherlands in response to several rapid assessments of problematic use of cannabis among vulnerable adolescents. The main goal of the study reported in this article was to determine whether the Moti-4 intervention was able to reduce two outcome measures pertaining to the level of cannabis use; the amount of Euros spent a week on cannabis and the mean number of cannabis joints (cigarettes) smoked in a week.

In a randomized controlled trial (RCT) with a 6-month follow-up, 27 trained Dutch prevention workers recruited 71 Moti-4 participants and 60 controls assigned to usual care. Participants were Dutch youth aged 14–24 years who had used cannabis during the preceding month. At baseline (T0), post-test (T1) and 6-month follow-up (T2), participants completed a questionnaire with 51 items. The 27 prevention workers also completed a checklist to assess the fidelity of delivering each item to each participant in the Moti-4 protocol. Multilevel and binary logistic regression was used to assess the impact of the prevention worker and 14 participant variables on the likelihood of drop-out. Mean scores for cannabis use outcome measures by Moti-4 participants and controls at baseline, T1 and T2 were compared using paired sample t-tests. Top-down multiple regression was used to assess relationships between Moti-4 and 13 other variables on the one hand and changes in weekly cannabis use at T1 and T2 on the other. The Moti-4 experimental condition had a significant and positive influence in reducing the level of expenditure on cannabis ($p < 0.05$). There was no significant difference in outcome, neither for the 4 participating institutes nor for the professionals implementing the intervention. Baseline cannabis use was the strongest predictor ($p < 0.001$) of weekly cannabis expenditure at posttest and 6-month follow-up. This effect was still present at T2. Being female, having two Dutch parents and perceived behavioral control also made significant positive contributions ($p < 0.05$). Attitude at baseline was only related to cannabis expenditure after 6 months ($p = 0.005$). At T2 Moti-4 participants were found to have a significant reduction in the number of joints smoked weekly compared to T0 (on the average 4 joints). The study demonstrated that Moti-4 is an effective intervention to reduce cannabis use in youth.

1. Introduction

For decades cannabis has been the most commonly used illicit drug worldwide (Anthony & Helzer, 1995; Degenhardt & Hall, 2012). Most people begin cannabis use during adolescence and its use usually peaks during late adolescence and early adulthood (Hart, 2005).

While most consumers use cannabis infrequently, without apparent negative consequences, some users experience problems related to frequent use (Van Laar et al., 2014). The possible adverse outcomes of excessive cannabis use have become well documented in the last 20 years (Hall & Solowij, 1998). In parallel, the way professionals look at cannabis consumption has changed radically since the 1970s (Krabben, Pieters, & Snelders, 2008; Sussman & Ames, 2008). It is estimated that approximately 10% of those who have ever tried cannabis will eventually become dependent; the risk of dependence increasing significantly with frequency of use (Anthony & Helzer, 1995; Copeland & Swift, 2009; Van der Pol et al., 2013).

In addition to dependence, cannabis use is associated with a variety of health problems including cognitive and respiratory impairment and psychotic episodes (Copeland & Swift, 2009; Fischer, Rehm, & Hall, 2009; Horwood et al., 2010; Kuepper et al., 2011; Solowij, 2010). There is a clear link between early onset of cannabis use and subsequent poor academic achievement (Pope et al., 2003). Moreover, the physical, psychological and developmental consequences of excessive cannabis use during adolescence may extend into adulthood (Ferguson & Boden, 2008; Horwood et al., 2010). A study in the Netherlands in 2012 found that 7.7% of 12–18 year olds had used cannabis in the previous month (Van Laar et al., 2014). A relatively high percentage of past month users was found to belong to the vulnerable populations of school drop-outs (55%), marginalized and homeless youth (87%), adolescents in custody (59%), in truancy projects (45%) or attending special education (45%) (Snoek, Wits, & van der Stel, 2010; Van Laar et al., 2014).

Many studies in drug prevention have shown that a shift toward targeted approaches is needed to increase the effectiveness of public health efforts (Conrad, Castellanos-Ryan, & Strang, 2010; Cousijn, Goudriaan, & Wiers, 2011; Dupont, Kaplan, Braam, Verbraeck, & de Vries, 2014; Spits, Dupont, & Oudejans, 2014). The awareness to timely identify, find and deliver services to target groups that are vulnerable for addiction has become of major importance in Dutch drug prevention policy (Snoek et al., 2010). A randomized controlled trial of the Australian Adolescent Cannabis Check Up (ACCU), involving a two-session brief motivational enhancement (Martin & Copeland, 2008) has been replicated in the Netherlands. Some changes in cannabis consumption were found, but none reached significance (De Gee, Verdurmen, Bransen, De Jonge, & Schippers, 2014). Recently 67% of the studies of brief motivational enhancement were found to have beneficial effects (Barnett, Sussman, Smith, Rohrbach, & Spruijt-Metz, 2012). In this same review study all 7 studies on cannabis showed significant reductions. These results indicate that motivational enhancement is especially appropriate for interventions for reducing levels of cannabis use.

In order to create an intervention that was suitable for the Dutch situation, we developed Moti-4 (Dupont, Lemmens, Adriana, van de Mheen, & de Vries, 2015), a brief motivational enhancement intervention designed for young vulnerable non-treatment-seeking cannabis users. The existing practice as usual of the last 20 years in Dutch cannabis prevention was the important starting point for Moti-4. In designing the Moti-4, we integrated elements of two other dominant theories in prevention science: the theory of planned behavior and self-determination theory described below (Fishbein & Ajzen, 2010; Ryan & Deci, 2000). The final protocol involves a mandatory set of 14 theory-based items (Table 1).

In this article we describe the development of Moti-4 and the randomized clinical trial (RCT) to assess its efficacy. The main research question of the RCT was whether the intervention was able to reduce cannabis use among youth for whom it was indicated that their use was problematic. We hypothesized that Moti-4 participants would significantly reduce their use more than that of the controls. We also wanted to assess the influence of the individual professionals and the institution administering the intervention, on the levels of cannabis consumed. Furthermore, we expected from our theoretical approach the use of other drugs, as well as the social norm, attitude and perceived behavioral control, to predict the level of cannabis use. These variables were included in our analysis.

2. Material and Methods

2.1. Moti-4

Since 1995, various kinds of targeted prevention initiatives have been applied in the Netherlands including *Hasj en weedweek*, *CIA*, *Wietcheck* and *ABC-gesprek* (Spits et al., 2014). In the Moti-4 intervention, the most effective elements of these best practices, such as motivational interviewing, self–monitoring, and strengthening behavioral control, were used, mixed and compressed into a protocol (Dupont et al., 2015). The goals of Moti-4 are to reduce the use of cannabis in the target group and to increase their motivation to change their behavior. The protocol for the intervention was developed using intervention mapping (Bartholomew, Parcel, Kok, Gottlieb, & Fernandez, 2011), a systematic approach for developing theory- and evidence-based interventions that provides a method for the process of health promotion program development. The development of the Moti-4 program followed the six consecutive steps of intervention mapping (Dupont et al., 2015): 1) needs assessment; 2) behavioral and learning outcomes; 3) selecting methods of behavior change and translating methods into intervention strategies and materials; 4) producing the program components; 5) program adoption and implementation; and 6) planning of program evaluation.

The Moti 4 intervention integrates elements of the theory of planned behavior, motivational interviewing and self-determination theory (Fishbein & Ajzen, 2010; Miller & Rollnick, 2012; Ryan & Deci, 2000). The theory of planned behavior and its later adaptations (De Vries, Backbier, Kok, & Dijkstra, 1995) postulate that intention, the most important determinant of behavior, is in turn conditioned by three independent constructs: attitude, subjective norms, and perceived behavioral control. In the theory of planned behavior, motivation to change ones intention is the result of social norm, attitude and perceived behavioral control. Motivational interviewing (MI) is a client-centered counseling style that aims to explore and resolve ambivalence about changing personal behaviors (De Jonge, 2005; Miller & Rollnick, 2012). MI has been a guiding principle in Moti-4 ever since we hypothesized that changing intentions about cannabis use was largely a matter of counseling work focusing on attitudes, social norms, and perceived behavioral control to increase the motivation to change cannabis use behavior. Self-determination theory (SDT, Ryan & Deci, 2000), in which conditions supporting the individual experience of autonomy, competence, and relatedness are argued to foster the most volitional and most effective forms of motivation, also informed our design of the Moti-4 intervention. With this integrated theory of change as a basis, we also had an intermediate objective of encouraging and motivating the Moti-4 study participants to change their intentions toward

Table 1
The 14 items discussed during each of the 4 sessions in the Moti-4 intervention, their purpose and the number of the session in which the item is most important.

Obligatory items	Main purpose	Session #
Assessment of use and life areas (e.g. euroADAD, MATE-Y)	Triage, screening, motivational interviewing	1
Stage of use	Triage, indication, motivational interviewing	1
Recording use/diary	Self-monitoring motivational interviewing	1/2
Users chart	Monitoring, social norm, motivational interviewing	1/2
Knowledge transfer	Increasing knowledge	2
Reasons for use	Motivational interviewing	2/3
Pros and cons balance	Motivational interviewing	2/3
Confidence measuring rod	Readiness for change	3
Social network	Social norm; relatedness (can foster effective motivation)	3
Peer pressure and craving	Increasing relatedness and resilience	3
Plan for change	Action planning, coping planning, self-monitoring	2/3
Feedback given to referring person	Relatedness, support	4
Meeting with parents or educators (optional)	Relatedness, support	4
Planning follow-up	Sustainability	4

use (Barnett et al., 2012; Martin & Copeland, 2008; Miller & Rollnick, 2012; Solowij, 2010). Knowledge about cannabis effects and dependence form one component of the attitudinal condition for changing the intention to engage in problematic use of cannabis (Fishbein & Ajzen, 2010). It raises problem awareness, also affecting the attitude and encouraging behavioral resilience and engagement in behavioral alternatives to increase behavioral control. Influencing the social norms of the environment of the participants was also expected to reinforce the intention to decrease the use of cannabis (Bartholomew et al., 2011; Fishbein & Ajzen, 2010). Self-monitoring was used to raise the participants' awareness of changes in subjective norms during the process. The prevention workers discussed the outcomes of self-monitoring compared to the actual cannabis use in this age group.

2.2. Feasibility study, training, and pilot study

The method of responsive evaluation (Abma & Widdershoven, 2006) was used to explore the opinions of the target group and stakeholders from the participating institutions. Information sessions were organized involving the stakeholders such as addiction prevention workers, health care workers, social workers, community workers as well as members of the direct target group (N = 31). In the sessions a social climate was created in which the stakeholders and target group members would feel free to express their commitment to, but also concerns about the proposed intervention. These information sessions resulted in the design of a four-session intervention that included a manual and a training course for prevention workers (Dupont et al., 2015). The manual and training course clearly expressed that the Moti-4 intervention was designed with the aim to stimulate targeted youth to critically examine and adjust their own cannabis use. This was achieved by first screening for substance use and problems in related areas such as in school or family and/or psychiatric or physical health issues. The initial screening was then, followed by knowledge transfer, creating awareness, motivational interviewing, and strengthening the youngster's resilience. The intervention involved a mandatory set of 14 theory-based items (Table 1). Strict adherence to the protocol of the 14 items was considered essential to ensure the fidelity of the intervention. For instance, the item of *knowledge transfer* can be addressed using various quizzes and/or videos, depending on the level of the adolescent and the personal preference of the prevention worker.

For all 14 items, several tools were made available in the Moti-4 manual. The protocol dictated that each item must be dealt with in a consecutive order during the four meetings.

Thirty experienced addiction prevention workers were recruited in three Dutch regions and trained to implement the Moti-4 intervention. Previous training in motivational interviewing and a higher vocational education degree were preconditions for selection as a trainer. The training course consisted of "going through the motions" of the four sessions, the use of the tools, recruitment of the target group members, the theoretical background of Moti-4, an explanation of the necessity of evaluation research on the intervention and the eligibility criteria for inclusion of participants. The feasibility of the intervention was assessed in 9 interviews, which led to some minor adaptations to the program. These trained professionals then recruited participants (N = 31), which were referred by their parents, by agencies for youth care and drop-out, field workers and by student counselors. A pilot study was undertaken with pre- and post-test assessments (Dupont et al., 2015). The results of our pilot study showed that after the intervention, the average weekly amount of money spent on cannabis had decreased by 47%. Likewise, a significant decrease was found in last week's frequency of use. As for the motivation to change, a statistically significant increase was found for action planning and a large increase in the intention to stop using cannabis. The change in the motivation to smoke less cannabis was small.

2.3. Participants and design of the trial

The intervention targeted current cannabis users in adolescence or early adulthood (14–24 years old) who had used cannabis in the last month. Additionally, the youth in the trial had to meet one or more of the following criteria:

- A clear relationship between cannabis use and problems at school, work or in relationships (Henry, 2010; Pope et al., 2003) as reported by parents, teachers, or other referrers.
- Experiencing physical or mental health problems as a possible result of cannabis use (Kuepper et al., 2011; Van Os, Kenis, & Rutten, 2010), as reported by parents, teachers, or other referrers. Exploring whether these problems were caused or exacerbated by cannabis use forms an integral part of Moti-4.
- High risk of developing problematic use because of personal circumstances such as homelessness or marginalization, truancy, having addicted parents, or attending special education (Snoek et al., 2010; Van Laar et al., 2014).
- Age-inappropriate experimentation (Madras et al., 2009); weekly cannabis use under the age of 16 was considered to be problematic.

The participants were referred to the prevention service by their parents, by agencies for youth care and drop-out, by prevention field workers and by student counselors in the school system. Twenty-seven prevention workers, trained in Moti-4 (by the lead investigator), recruited 168 non-treatment-seeking participants in the Dutch provinces of Brabant, Limburg and Overijssel from these referrals (see Fig. 1). Thirty-seven were not enrolled because although they were recruited they did present themselves for the first session. A blocked
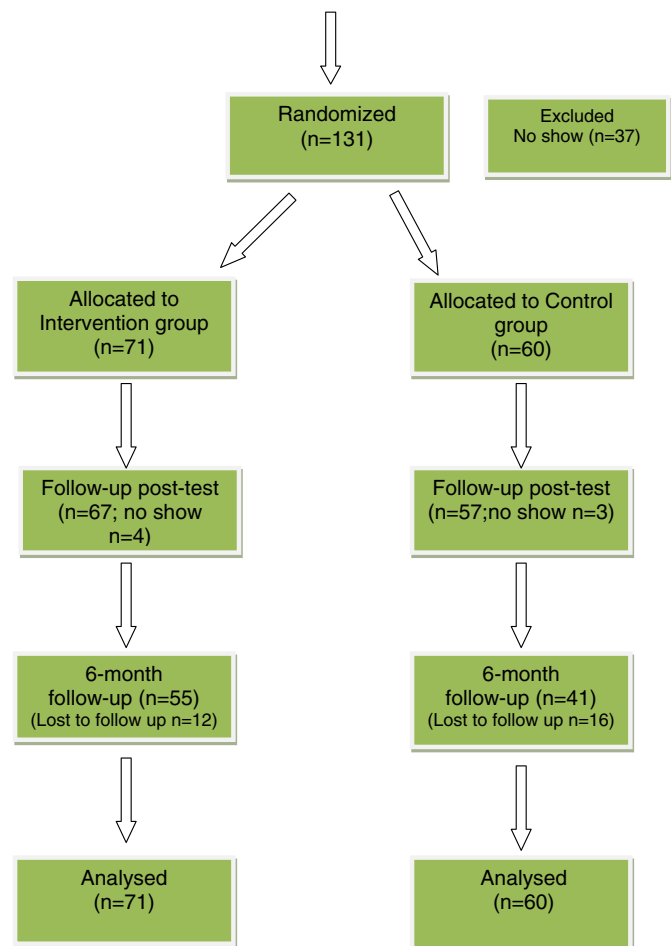

Fig. 1. Moti-4 RCT – Flow diagram of the trial participants.

randomization list was generated in Microsoft Excel. After they signed an informed consent form, participants (131) were centrally randomized to the intervention (71) and control (60) conditions. Only after the baseline assessment had been completed, were the results of the randomization communicated to the prevention workers. These 27 prevention workers led all Moti-4 sessions and the control sessions. In order to control the fidelity of the implementation, mandatory feedback sessions were organized. The prevention workers had to complete a checklist with the 14 obligatory items (see Table 1). For every participant included in our analyses (see Fig. 1) this checklist had to be complete. Participants were blinded to the condition to which they had been assigned. A small number dropped out after one session (n = 7). Moti-4 participants completed the four sessions in 1 month, with at least a week's interval between each session. The control condition consisted of 1 hour session in which the effects of cannabis on the body were discussed. If Internet access was available, a computerized animation was used to illustrate the information. After the session, the participants' knowledge about cannabis and its effects was challenged in a quiz. Correct answers were discussed and an information leaflet was given to the youth to take home. Prevention workers were instructed to avoid MI techniques such as open ended questioning and directed reflectioning. Personal advice was only given when it was explicitly requested. Our study used the same control condition as the 'Weed-check' study to allow comparison (De Gee et al., 2014). A medical ethics committee (METC Atrium: 12-N-110) approved the study. All participants signed an informed consent form before participation. A repeated measures design was implemented consisting of pre- and post-test (T0 and T1) and a follow-up interview 6 months after the post–test (T2), with both the intervention and control group participants (see Fig. 1).

2.4. Measurement Instruments

The self-report questionnaire we used included seven items on socio-demographic information, including gender, living situation, level of education, nationality, and country of birth of mother and father; seven questions on substance use (cannabis, alcohol and other drugs) and 24 items on the psychosocial determinants of cannabis use based on the I-Change model (De Vries et al., 1995). All determinants were assessed with multiple items consisting of five-point Likert scales (in general: totally agree-agree-neutral-disagree-totally disagree) which were later summed to make a composite score for each determinant. Attitude was measured with eight items, four of which were about the pros (social, relaxed, happy, creative) and four about the cons (bad for your lungs, expensive, negative influence on school performance and development of mental disorder) of cannabis use. Perceived behavioral control was assessed by two items (How difficult is it for you not to smoke cannabis?; How difficult is it for you to refuse a joint when a friend offers you one?). Social influence was assessed by three questions to assess the participants group of friends and their cannabis use (How many of your friends are cannabis users? How often do you hang out with users? How often do you hang out with non users), four distinct questions on social norm (both approval and disapproval of friends and parents respectively) and one question on perceived peer pressure (How often do you experience pressure from your friends to smoke a joint?). Three kinds of intentions were measured: the intention to use cannabis, the intention to quit and the intention to reduce cannabis consumption. Action plans were measured by three questions (I made specific plans to: stop, reduce and resist respectively).

Two outcome measures were used to measure the level of cannabis. The first outcome measure assessed the amount of Euros per week spent on cannabis. If respondents were growing cannabis only for personal use or were given cannabis for free, they were asked to give a reliable estimate. The second outcome measure was the estimation of the number of cannabis "joints" (cigarettes) smoked each week. Since the potency of cannabis varies with the

price, and since the number of cannabis cigarettes might not be reliable because the amount of cannabis rolled in a cannabis cigarette varies, the amount of money spent each week on cannabis was conceived as a necessary complementary measure to validly assess the level of actual cannabis use each week.

2.5. Statistical analyses

The control and intervention groups were compared at baseline (T0) using independent t-tests and chi-square tests. Binary logistic regression was used to assess the impact of 14 variables (Table 2) on the likelihood of not completing the post-test (T1) and/or the 6-month follow-up (T2). Mean scores for weekly expenditure and cannabis joints smoked by both Moti-4 participants and controls were compared between baseline, T1 and T2, using paired sample t-tests.

The effect of Moti-4 on weekly expenditure and cannabis joints smoked at post-test and 6-month follow-up in our respondent group was assessed using top-down multiple regression. The influence of the professional administering the intervention was investigated by including the prevention worker as a random intercept in a linear multilevel model. However, as no significant changes in the -2 log likelihood were found compared to the model without this random intercept ($\chi^2(df = 1) = 2.09$, $p = 0.08$ at T1, $\chi^2(df = 1) = 0.00$, $p = 1.00$ at T2 for Euros spent per week; $\chi^2(df = 1) = 0.39$, $p = 0.27$ at T1, $\chi^2(df = 1) = 0.07$, $p = 0.40$ at T2 for number of cannabis joints smoked per week), we concluded that the influence of the professional was negligible.

These analyses did not require the use of a multilevel linear model. Instead, multiple regression was performed to assess relationship of attending Moti-4 and 13 other baseline variables (institution, gender, age, living situation, educational level, nationality of parents, cannabis use, tobacco use, alcohol consumption, use of other drugs, attitude, norm and perceived behavioral control) with changes in weekly expenditure and number of cannabis joints smoked at post-test and 6-month follow-up on the other. This regression analysis used a top-down strategy to remove some of these 13 potential predictor variables (Kleinbaum, Kupper, & Muller, 1988). Each time, we examined the least significant predictor variable. If it was not significant at $\alpha = 10\%$, then the variable was removed and the analysis was rerun without this variable. If it was significant at $\alpha = 10\%$, the analysis stopped and the final regression model was obtained.

3. Results

At baseline the control group reported a statistically significant greater alcohol intake than the intervention group. No statistically significant differences were found regarding sex, age, the institution where the participant was recruited, their education, living situation, cannabis use, use of alcohol and other drugs, or attitude, social norm and perceived behavioral control (Table 2).

3.1. Drop-out analysis (T1 and T2)

Of the randomized respondents, 5% (n = 7) did not present for the post–test (T1). Eighty-two percent of participants in the intervention condition, and 72% in the control condition completed the 6-month follow-up (T2) (see Fig. 1). None of the 14 independent variables we used had a statistically significant relation with dropout rate at either T1 or T2. Perceived behavioral control was, however, marginally significant (p = 0.055, Wald statistic = 3.68). The odds ratio indicated a slight effect of perceived behavioral control (0.63), indicating that lower esteem of self–mastery at baseline was associated with a higher dropout rate.

Table 2
Sample characteristics at baseline (*$p < 0.05$).

|	Total sample	Moti-4 condition	Control condition	Statistical test value
n	131	71	60	
Age, mean (SD)	18.0 (2.6)	17.9 (2.8)	18.2 (2.5)	$t(128) = .64$
Female (%)	16.0	12.7	20.0	$\chi^2(1) = .81$
Institution Tactus (%)	25.2	19.7	31.7	$\chi^2(3) = 3.33$
Vincent van Gogh (%)	12.2	15.5	8.3	
Mondriaan (%)	29.8	31.0	28.3	
Novadic-Kentron (%)	32.8	31.7	33.8	
Living with (at least one) parents (%)	68.7	74.6	61.7	$\chi^2(1) = 1.98$
Higher education (% high school or higher)	50.4	47.9	53.3	$\chi^2(1) = .19$
Having at least one non-Dutch parent (%)	19.1	16.9	21.7	$\chi^2(1) = .22$
Cannabis use (€) mean (SD)	18.7 (21.2)	18.2 (21.6)	19.4 (20.9)	$t(124) = .30$
Cannabis use sessions per week, mean (SD)	3.93 (2.48)	3.87 (2.5)	4.02 (2.48)	$t(129) = .33$
Average number of cigarettes per day (SD)	9.4 (7.6)	9.6 (7.3)	9.2 (7.9)	$t(127) = -.26$
Alcohol #glasses/week (SD)	11.5 (14.6)	8.9 (12.2)	14.6 (16.6)	$t(129) = 2.27$*
Reported use of other drugs (%)	62.6	67.2	57.1	$\chi^2(1) = .92$
Attitude, mean (SD)	3.03 (.50)	3.09 (.51)	2.97 (.48)	$t(129) = -1.2$
Norm at baseline, mean (SD)	2.40 (.62)	2.38 (.58)	2.44 (.67)	$t(128) = .54$
Perceived behavioral control, mean (SD)	2.98 (1.14)	2.94 (1.19)	3.02 (1.08)	$t(129) = -.40$

3.2. Prediction of use at T1 and T2

Mean scores for weekly expenditure and cannabis joints smoked by Moti-4 participants and controls at baseline, post-test (T1), and follow up (T2) (see Fig. 2), were compared using paired sample t-tests. A significant difference in the mean expenditure scores of the Moti-4 group was found between T0 ($M = €17.85$) and T1 ($M = €12.26$, $t(65) = 3.16$, $p = 0.002$) as well as between T0 and T2 ($M = €9.89$, $t(55) = 2.79$, $p = 0.007$). The difference in mean weekly joints smoked between T0 and T2 (4 joints, $p = 0.004$) is also significant, unlike the difference between T0 and T1. The differences across time in mean values of controls were not significant.

Control variables that were not found to make a statistically significant contribution ($p > 0.10$) in the analysis of weekly expenditure and number of cannabis joints smoked at T1 were removed stepwise, starting with the least significant variable. For Euros spent weekly at T1, the control variables of cannabis use at baseline, sex, nationality and perceived behavioral control at baseline remained in the model. For the number of joints smoked weekly at T1 the control variables of

cannabis use at baseline, sex, educational level and norm at baseline remained in the model.

The same procedure was followed for weekly expenditure and weekly number of cannabis joints smoked at T2. The control variables that remained in the model for both outcome measures are displayed in Table 3.

At T1, the final models for Euros spent and for the number of joints smoked explained 54% and 61% of the variance of weekly expenditure and number smoked weekly respectively. At T2, the final models explained 45% and 34% of the variance of weekly expenditure and number smoked weekly respectively. Moti-4 turned out to be a significant predictor of reducing one's weekly expenditure on cannabis (average reduction €5.27 at T1; €8.57 at T2). At T1 there was not a significant reduction compared to T0. However, at T2 Moti-4 participants were found to have a significant reduction in the number of joints smoked weekly compared to T0 (on the average 4 joints). Including Moti-4 into the analysis model explained an additional 2% of the variance at
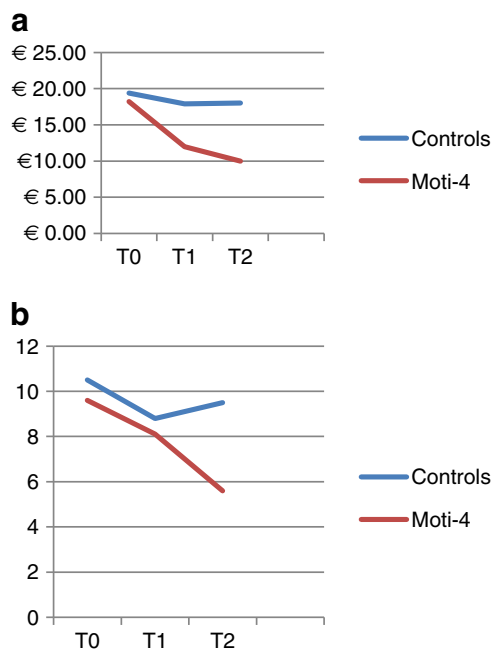
Fig. 2. a. Mean weekly expenditure (€) on cannabis at T0, T1 and T2. b. Mean number of joints smoked weekly at T0, T1 and T2.

Table 3
Results of top-down multiple regression analyses for variables predicting weekly cannabis use (expressed in € and number of joints) at post-test and 6-month follow-up.

	B	SE B	t	p
Post-test (T1) € weekly				
Gender	−8.098	3.244	−2.496	.014*
Nationality	5.712	3.063	1.865	.065
Cannabis use at baseline	.552	.060	9.259	.000**
Perceived behavioral control	−2.514	1.134	−2.216	.029*
Moti-4	−5.270	2.376	−2.218	.029*
6-month follow-up (T2) € weekly				
Gender	−12.386	4.253	−2.912	.005*
Nationality	10.798	4.042	2.672	.009*
Cannabis use at baseline	.491	.080	6.153	.000**
Attitude at baseline	9.376	3.285	2.854	.005*
Perceived behavioral control	−3.104	1.506	−2.060	.042*
Moti-4	−8.572	3.126	−2.742	.007*
Post-test (T1) number of joints weekly				
Gender	−2.927	1.196	−1.773	.018*
Education	−2.383	1.156	−1.966	.047*
Norm at baseline	2.918	1.470	3.034	.054
Cann. use at baseline	.858	.089	13.100	.000**
Moti-4	.104	1.169	.085	.932
6-month follow-up (T2) number of joints weekly				
Gender	−7.370	2.415	−3.052	.003*
Cannabis use at baseline	.574	.097	5.921	.000**
Moti-4	−4.052	1.950	−2.078	.040*

Final model for € at T1: Adjusted $R^2 = 0.54$ ($R^2 = 0.61$ for number of joints model); Final model at T2: Adjusted $R^2 = 0.45$ ($R^2 = 0.34$ for number of joints model).
  * $p < 0.05$.
  ** $p < 0.001$.

T1 and 4.4% at T2 for the outcome weekly amount of Euros spent. For the number of joints smoked "weekly, Moti-4 explained no additional variance at T1 and 2.9% of the variance at T2. Since the outcome variables were not exactly normally distributed, the analyses for the final models were redone employing bias-corrected accelerated bootstrapping (with 5000 bootstraps). These analyses basically led to the same results.

4. Discussion

The Moti-4 experimental condition had a significant and positive influence in terms of reducing the level of weekly expenditure on cannabis, an effect which was even larger at the 6-month follow-up. Moti-4 participants were found to have a significant reduction in number of joints smoked weekly (on the average 4 joints) after 6 months compared to baseline, whereas directly after the intervention compared to baseline no significant reduction in the number of joints was found. Attitude at baseline was only related to weekly expenditure on cannabis after 6 months. Being female, having two Dutch parents and greater perceived behavioral control were associated with more positive changes in terms of expenditures on cannabis use. Female participants also smoked less joints per week. These findings provide evidence that the Moti-4 might be an effective preventive intervention to address cannabis use in youth.

Many studies have found that women show more improvement in drug interventions (Barbor, 1994; Hernandez-Avila, Rounsavile, & Kranzler, 2004; Khan, Jacobson, Gardner, Prescott, & Kendler, 2005). One explanation might be that women are more likely to seek social support (Sussman & Ames, 2008), or they may suffer more from stigmatization and so benefit more from changing their behavior (Sussman & Ames, 2008). Having two Dutch parents was found to be a favorable condition for a youth in making plans to reduce cannabis consumption. Dutch parents might be more likely to support their children once they have made a decision to quit or reduce their cannabis consumption. The tolerant Dutch attitude towards cannabis use might enable children to communicate with their parents about their decision to change their behavior. In contrast youth with first-generation immigrant parents may be less likely to have an open communication about reduction of their cannabis consumption because their parents do not share the Dutch tolerant attitude. Furthermore these first generation immigrant children are often alienated from traditional cultural groups that discourage drug use. This acculturation gap between parents and children might make their abuse of cannabis more likely (Sussman & Ames, 2008).

Our study of Moti-4 used the same control condition, one similar outcome measure (number of joints) and very similar participants as the Weed-check study (De Gee et al., 2014). This enables us to compare the results with this modified Dutch version of the Australian ACCU. Contrary to the hypothesis, the ACCU results (Martin & Copeland, 2008) were not replicated in the Netherlands Weed-check study (De Gee et al., 2014). The number of joints per week, which significantly changed in the Moti-4 follow up, did not do so in the Weed-check condition. A finding from our feasibility study in which we interviewed professionals trained in ACCU and Moti-4, was that, in comparison to ACCU, the Moti-4 protocol offered professionals implementing the intervention some freedom and adaptability. The interventionist prevention workers were able to choose a tool that adapted to the level of the adolescent, their own personal preference and the local organizational framework. Thus, this mode of implementing the Moti-4 suggests that it may be more suitable to the Dutch situation than the strict translation of an Australian-designed intervention.

Moreover, no association was found between the professional administering the Moti-4 intervention and the use of cannabis at T1 and T2. Since, in addition, no significant difference in outcome was found between the institutions where the participants had been recruited, we conclude that there were no important differences in the delivery of MOTI-4 among the four institutions.

Given the limitations of our small study caution needs to be taken in interpreting the results. Obviously a larger study including more participants, more sites and more resources to collect and analyze more extensive quantitative data on fidelity is needed. The study was the first of its kind in the Netherlands and as an efficacy trial had to be designed and implemented on a relatively small budget.

We totally relied on self-reports and did not use urinalyses and other biomarkers to cross-validate our data. This means that we cannot rule out the possibility that some of the participants gave socially desirable answers. The fact that the Moti-4 participants had four sessions, whereas the control group had only one, may have resulted in a more intensive contact with the prevention worker than for the controls. Having four control sessions would control for the influence of this so called therapeutic alliance (Asay & Lambert, 1999). This may have resulted in more socially desirable responses for the Moti-4 group compared to the one session control condition because of more exposure to the prevention workers delivering the intervention. However since prevention workers followed up with the Moti-4 participants as well as the controls, a bias in the follow up is not to be expected.

Working with the 14 item checklist might have given the prevention workers freedom in choosing tools which may have led to more effective outcomes, but it might have limited the generalizability and reproducibility in other settings. Though all prevention workers were previously trained in MI, we have not checked for fidelity to MI. For example, audiotaping sessions and measuring the prevention workers proficiency in conducting MI in the different sections of Moti-4 might have been implemented, but this could not be done because of lack of resources.

Finally, another limitation of our study is that although Moti-4 had a significant influence, it only explained a small proportion of the variance. This raises the question of its cost-effectiveness. In this regard, a well-organized screening of large numbers of participants has shown small but promising results in 17 European countries in "Fred goes net" project (Wirth & Rometsch, 2010), in which first time offenders were screened.

Future research will have to investigate the particular mechanism of change accounting for the efficacy of the Moti-4. We used the Transtheoretical Model as a basis for its development, but a study of the relation between the effects of Moti-4 and the Stages of Change model would be useful (West, 2005). Our study showed that Moti-4 is a promising preventive intervention with enduring efficacy for youth with problematic cannabis use indications. Moreover, we found this significant favorable effect of Moti-4 in a sample of Dutch youth. This makes Moti-4 the first evidence-based intervention for non-treatment-seeking problematic cannabis using youth in the Netherlands. Further research will be needed to confirm the program's effectiveness for reducing problematic cannabis use for youth. In addition, future studies are recommended to test the effectiveness of the Moti-4 intervention for youth who present problematic use of alcohol and other substances, as well as a high risk for Internet and gaming addiction. Addiction Prevention Netherlands (VPN), an alliance of the official professional alcohol and drug prevention agencies in the Netherlands, aims to establish a national set of evidence-based interventions (Spits et al., 2014). Moti-4 has been developed and tested to become one of these nationally available VPN interventions. For further implementation, «nunc est bibendum» (Horatius, 30 B.C).

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