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# Associations between cigarette smoking and cannabis dependence: A longitudinal study of young cannabis users in the United Kingdom

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ABSTRACT

*Aims:* To determine the degree to which cigarette smoking predicts levels of cannabis dependence above and beyond cannabis use itself, concurrently and in an exploratory four-year follow-up, and to investigate whether cigarette smoking mediates the relationship between cannabis use and cannabis dependence.
*Methods:* The study was cross sectional with an exploratory follow-up in the participants' own homes or via telephone interviews in the United Kingdom. Participants were 298 cannabis and tobacco users aged between 16 and 23; follow-up consisted of 65 cannabis and tobacco users. The primary outcome variable was cannabis dependence as measured by the Severity of Dependence Scale (SDS). Cannabis and tobacco smoking were assessed through a self-reported drug history.
*Results:* Regression analyses at baseline showed cigarette smoking (frequency of cigarette smoking: $B = 0.029$, 95% CI = 0.01, 0.05; years of cigarette smoking: $B = 0.159$, 95% CI = 0.05, 0.27) accounted for 29% of the variance in cannabis dependence when controlling for frequency of cannabis use. At follow-up, only baseline cannabis dependence predicted follow-up cannabis dependence ($B = 0.274$, 95% CI = 0.05, 0.53). At baseline, cigarette smoking mediated the relationship between frequency of cannabis use and dependence ($B = 0.0168$, 95% CI = 0.008, 0.288) even when controlling for possible confounding variables ($B = 0.0153$, 95% CI = 0.007, 0.027).
*Conclusions:* Cigarette smoking is related to concurrent cannabis dependence independently of cannabis use frequency. Cigarette smoking also mediates the relationship between cannabis use and cannabis dependence suggesting tobacco is a partial driver of cannabis dependence in young people who use cannabis and tobacco.


## 1. Introduction

Together, cannabis and tobacco are two of the world's most used drugs, and despite their unique smoking relationship, relatively little is known about their combined effects. The high prevalence of cannabis use amongst young people in the UK is a growing concern. However, many daily cannabis users do not develop dependence. Prospective studies of the likelihood of developing a Cannabis Use Disorder (CUD) have investigated predictors of dependence amongst cannabis users (Swift et al., 2000; van der Pol et al., 2013) with baseline severity of dependence acting as a main predictor of dependence at one-year follow-up (Swift et al., 2000). However, there are a host of other factors which have been considered predictors of developing a CUD, for example; age of onset (Chen et al., 2005), gender (Coffey et al., 2000; von Sydow et al., 2002), impulsivity (Swift et al., 2008), mental health problems (Wittchen et al., 2007) and early onset of continued tobacco smoking (Coffey et al., 2000; Prince van Leeuwen et al., 2014; von Sydow et al., 2002). More recently, van der Pol et al. (2013) investigated a population of high risk young adult cannabis users and found that recent negative life events and social support factors such as living alone were more predictive of CUD then cannabis exposure variables suggesting the existing literature on the aetiology of cannabis use disorder is limited.

Relatively, tobacco is more harmful than cannabis (Nutt et al., 2010) and the majority of tobacco smokers are indeed nicotine dependent. The gateway hypothesis posits that tobacco acts as a gateway drug to the use of cannabis (Kandel et al., 1992). However, there is strong evidence for the 'reverse gateway' whereby cannabis smoking predicts tobacco onset (Patton et al., 2005). Several lines of

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investigation give weight to the hypothesised association between cannabis use and tobacco smoking. Firstly, there is evidence to suggest both nicotine and cannabis affect similar mesolimbic dopaminergic pathways suggesting overlapping mechanism in addiction (David et al., 2005; Filbey et al., 2009). Secondly, there are shared genetic (Agrawal et al., 2008, 2010), temperamental (Brook et al., 2010; Creemers et al., 2009) and psychological factors (Brook et al., 2010) that have been associated with the use of both drugs. Finally, both substances are smoked and often concurrently, such that cross-sensitisation to each substance might occur, with tobacco directly enhancing the subjective effect of cannabis (Agrawal and Lynskey, 2009; Baggio et al., 2013; Ream et al., 2008). As nicotine is more addictive than cannabis, tobacco smoking may be a primary driver of continued use and relapse in co-dependent users.

About 90% of cannabis users also identify as cigarette smokers (Agrawal et al., 2012), however, this exists as a complicated relationship given that increased cigarette smoking may substitute for reduced cannabis consumption (Allsop et al., 2014) and vice versa. Users of both drugs report more severe symptoms of CUD (Peters et al., 2012). Half of adults seeking treatment for CUD also smoke cigarettes and treatment outcomes for those using both cannabis and tobacco, in comparison to cannabis alone, are poor (Agrawal et al., 2009). Moreover, relative to those with a CUD, those with co-occurring nicotine dependence show poorer psychiatric and psychosocial outcomes (Peters et al., 2014; Ramo et al., 2013). In a recent controlled laboratory study, Haney et al. (2012) found that the strongest predictor of relapse in cannabis dependent individuals was their cigarette smoking status. Further, cigarette smoking ad libitum or after a short period of abstinence were both associated with relapse to cannabis use thus ruling out acute nicotine exposure or conditioned motivation (i.e., transfer) effects. This study suggests that cigarette smoking alongside cannabis use may confer a greater dependence syndrome and therefore a greater likelihood to relapse.

To understand the factors involved in the maintenance of substance use, such that prevention strategies are better informed, longitudinal designs of the use of both drugs are essential, especially during the critical period of adolescence. The present study aimed to investigate the degree to which cigarette smoking predicts the level of cannabis dependence above and beyond cannabis use itself, both at baseline, and in an exploratory four-year follow-up in a sample of young cannabis and tobacco users. Cigarette smoking at baseline, independently of smoking cannabis, is hypothesised to contribute to CUD concurrently and at follow up. Moreover, following previous research (Haney et al., 2012) we aimed to investigate if the effects of cannabis use on cannabis dependence are mediated by tobacco smoking using a multiple mediator model.

## 2. Methods

### 2.1. Design and participants

*2.1.1. Baseline.* A sample of 298 cannabis users who also used tobacco (≥1 day/month) were selected from a sample comprising of over 400 recreational (1–24 days/month) and daily (≥25 days/month) users aged 16–23 years old, as described elsewhere (Freeman et al., 2014; Morgan et al., 2012). Inclusion criteria were (a) to speak English fluently, (b) not to have learning impairments, (c) to have no history of psychotic illnesses and (d) normal or corrected-to-normal vision. All participants provided written, informed consent. Participants could also consent to be contacted for further studies and provided contact details as such. The study was approved by the UCL Ethics Committee and its aims were supported by the UK Home Office.

*2.1.2. Procedure.* Baseline measures were collected in participants' homes as part of a larger study investigating acute cannabis effects. Participants were required to abstain from all recreational drugs including alcohol for 24 h before each test day. Demographic information, a drug history and assessment of CUD, via the Severity of Dependence Scale (SDS; Gossop et al., 1995), were completed while participants were abstinent. Participants' past use of cannabis and tobacco were assessed using a semi-structured, questionnaire-based interview which included the following questions: (a) when did you last use tobacco? (b) For how many years have you smoked tobacco? (YEARS-TOB) (c) In a typical month, how many days do you use tobacco? (DAYS-TOB) (d) How many cigarettes do you smoke per day? (e) When did you last use cannabis? (f) For how many years have you used cannabis? (g) In a typical month, how many days do you use cannabis? (DAYS-CANNABIS) (h) How long does it take you to smoke an eighth (3.5 g)?

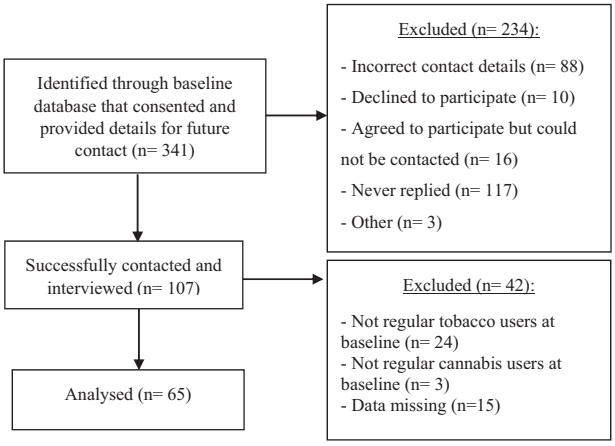


**Fig. 1.** Participant flow diagram for opportunistic follow up, 4 years after baseline.

Participants were assessed for cannabis dependence using the SDS which is five-item questionnaire focusing on 'loss of control' or 'psychological dependence' in relation to cannabis use. It has good and well-established psychometric properties and was found to be of equal utility in diagnosing cannabis dependence in comparison to more formal diagnostic assessments (Swift et al., 1998). A score of three on the SDS indicates cannabis dependence (Swift et al., 1998). The following measures were also administered; (a) the Wechsler Test of Adult Reading (WTAR; Wechsler, 2001) which is a measure of premorbid verbal intelligence (IQ) and consists of 50 irregularly spelt words. Scores range from 0 to 50; (b) the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) which is a 74-item questionnaire where higher scores indicate a greater schizotypal personality disorder severity; (c) the State-Trait Anxiety Inventory (STAI; Spielberger, 1983), only the 20 items from the trait scale were administered with higher scores reflecting greater trait anxiety; (d) the Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995) which is a 30 item questionnaire describing common impulsive behaviours, high scores reflect greater impulsivity; (e) the Beck Depression Inventory (BDI; Beck et al., 1961) which is a 21 item questionnaire indexing depression over the past week (a score of 10 indicates mild depression) and (f) the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 2003) which is a 28 item questionnaire assessing history of abuse.

### 2.2. Follow up

At follow-up, four years later, we attempted to re-contact the 341 participants who gave consent and invited them to participate in a semi-structured telephone interview (see Fig. 1 for participant flow diagram). The final sample consisted of 65 cannabis and tobacco smokers.

Participants were recruited through a preliminary email requesting their participation. All participants gave informed consent by telephone and were entered into a prize draw to win a tablet computer for participating. Telephone interviews were conducted between October and December 2013. Demographics, a drug history and the SDS, to reassess participants for CUD, identical to the baseline assessments, were collected.

### 2.3. Statistical analysis

All analyses were conducted in IBM Statistical Package for Social Sciences (SPSS), V.21. Assumptions of no perfect multicollinearity (no $rs \geq 0.8$), linearity, normally distributed errors and homoscedasticity were not violated. Correlations were conducted between cannabis dependence, predictors and possible confounders. At baseline, linear regression was used to assess the predictive relationship of cannabis variables on cannabis dependence. Tobacco smoking variables were added to the regression model to establish whether they could explain significant additional variance in CUD. Questionnaire measures that correlated strongly with cannabis dependence were then added to the model and finally variables that were not found to be significant as regression coefficients were removed generating the most parsimonious model (accounting for the greatest amount of variance with the least number of variables). Those predictors were then used to predict cannabis dependence in the follow up data. Unstandardised *B* coefficients are presented with 2 decimal places.

We used PROCESS for Statistical Package for Social Sciences (SPSS) version 21 (Hayes, 2013; Preacher and Hayes, 2008). Multiple mediation analyses were conducted on a priori hypotheses. We tested the possible indirect effects of