Environmental Cues and Attempts to Change in Daily Cannabis Users: An Intensive Longitudinal Study

John R. Hughes[a,*], **Shelly Naud**[b], **Alan J. Budney**[c], **James R. Fingar**[a], and **Peter W. Callas**[b]

John R. Hughes: john.hughes@uvm.edu

[a]Center for Behavior and Health, Departments of Psychiatry and Psychological Science, University of Vermont, Burlington, VT 05401

[b]Department of Mathematics and Statistics, University of Vermont, Burlington, VT 05401

[c]Department of Psychiatry, Geisel School of Medicine, Hanover, NH 03755

Abstract

Introduction—We tested whether environmental cues prompt or inhibit quit or reduction attempts among heavy cannabis users.

Methods—We recruited 196 daily cannabis users who intended to stop or reduce at some point in the next 3 months. Users called an Interactive Voice Response system daily over 3 months to report on cues that might prompt an attempt to quit or reduce (e.g., a request to stop), cues that might inhibit a quit/reduction attempt (e.g., someone offering cannabis), cannabis use, and attempts to stop or reduce cannabis. No treatment was provided.

Results—Our major findings were a) cost and health/psychological problems were the most common prompting cues, and seeing others use and being offered cannabis were the most common inhibiting cues, b) the number of different types of prompting cues prospectively predicted an increase in attempts to change in a dose-related manner, c) more proximal cues appeared to be more strongly related to change, d) requests to stop or reduce, and physical or psychological problems from cannabis, best predicted change attempts, and e) inhibiting cues did not consistently predict the probability of an attempt to change.

Conclusion—These preliminary results suggest several environmental cues prompt attempts to change cannabis use. Thus, interventions to increase the frequency of these cues, and specifically requests to stop or reduce cannabis use, and reinforcing concerns about health and mental adverse events from cannabis use may increase cannabis reduction or cessation.

*Corresponding author at: University of Vermont, Department of Psychiatry, UHC Campus, Mailstop #482, 1 South Prospect Street, Burlington, VT 05401. Tel: (802) 656-9610; Fax: (802) 847-1446.

Conflict of Interest

None

1. INTRODUCTION

Why cannabis users try to stop or reduce cannabis use has typically been examined in two types of studies. Epidemiological studies have examined self-quitting among young infrequent users. In these studies events such as obtaining a job, marriage, or having a child were associated with cessation (Aitken et al., 2000; Swift et al., 2000; VonSydow et al., 2001). Studies of heavy cannabis users in treatment (McBride et al., 1994; Stephens et al., 1993) or in convenience samples of non-treatment seekers (Copersino et al., 2006; Cunningham et al., 1999) asked reasons for wanting to quit. The most common reasons were adverse psychological symptoms, cost, establishing self-control, health concerns, improvement of self- or social image, legal concerns, and relationship problems (Chauchard et al., 2013; Copersino et al., 2006). Existing studies used retrospective reports, which are often inaccurate due both to poor memory and systematic bias (Hammersley, 1994; Shiffman et al., 1997). For example, in a recent prospective study, embarrassment about tobacco smoking was the strongest predictor of a tobacco quit attempt (Hughes et al., 2015), yet was not even listed as a possible reason in national polls of reasons for cessation. (http://www.gallup.com/poll/1717/tobacco-smoking.aspx)

A more valid method to examine why cannabis users try to reduce or quit is to measure environmental cues that logically might be related to a decision to change (e.g., someone asking the user to stop), and determine whether they prospectively predict attempts to change. We previously undertook this experimental method among tobacco smokers and found the greater the number of cues over 7 days, the more likely a quit attempt would occur on the 8th day. We also found five specific cues that predicted making a quit attempt (Hughes et al., 2015). The current study uses that same design to test whether environmental cues can predict an attempt to stop or reduce cannabis use. Determining such cues would help specify targets to include in media or clinical interventions; e.g., if embarrassment predicted but health symptoms did not predict attempts to change, then these interventions should focus on the former rather than the latter.

2. METHODS

2.1. Development of a List of Possible Cues

To develop a list of possible cues, we first searched the scientific literature and found a plethora of reasons for reducing or quitting. For example, some website sources listed up to 70 reasons (http://www.choosehelp.com/topics/addictions/39-reasons-why-life-is-better-without-a-heavy-marijuana-habit). In addition, we conducted a pilot study to better identify important possible cues. We placed ads in newspapers that stated "Marijuana users who have recently tried to stop or reduce wanted for 20–30 min phone survey. This is not a treatment study." Inclusion criteria were a) tried to stop or reduce marijuana in the last 30 days, b) previously used marijuana on 5 days/wk, and c) 18 yrs old. These participants' mean age was 34, 63% were men, and 57% were minorities. They averaged using 6.8 days/

week. Half (49%) had tried to quit and half (51%) to reduce in the last month. At the time of the interview, 37% were abstinent and 34% had reduced. Drs. Budney and Hughes (both of whom have clinical expertise in the treatment of marijuana dependence) used a semi-structured interview to ask users about a) events that prompted the recent and prior quit/ reduction attempts, and b) strategies used to prepare for quitting/reducing. They also had participants describe the days prior to and after stopping/reducing to elicit cues. The interview used standard qualitative methods (Holliday, 2002; Schram, 2003; Streiner and Norman, 1995), including starting with open-ended questions such as "What event caused you to decide to quit/reduce?" "Did you do anything to get ready to quit/reduce?" Participants were be reimbursed with a $25 shopping card for each interview. Summaries of results of these interviews were discussed among the authors and 12 non-overlapping cues that were face-valid were identified. Next, to verify the clarity of our cues, the first 40 participants in the main study were given a response option of "don't know/unclear". The incidence of this option was not more than 5% of any of the cues.

2.2. Study Design

We recruited daily cannabis users who planned to quit or reduce to join a 3-month prospective, non-treatment study. Study participation was via phone, mail and the internet. Participants called an Interactive Voice Response (IVR) system each morning to report the prior day's occurrence of cues, cannabis use, as well as intentional and non-intentional abstinence from or reduction of cannabis. Participants provided verbal consent. The University of Vermont Committees on Human Research approved the study and we registered the study at www.clinicaltrials.com (NCT01039415). A prior paper from this study described amount and types of cannabis on days participants were not trying to quit (Hughes et al., 2014a).

2.3. Recruitment

Major inclusion criteria were a) 18 years old, b) using cannabis 5 of 7 days/week, c) scored < 3 on the Severity of Dependence Scale (SDS) (Steiner et al., 2008) as applied to alcohol or non-cannabis illicit drugs, d) stated probably or definitely intend to reduce or stop cannabis use at some point in the next 3 months, and e) had no pending legal actions. We excluded one participant who entered residential treatment for cannabis during the study. Participants were recruited from throughout the US between 1/1/2010 and 3/1/2012 by several methods; the most common methods were on-line bulletin boards (e.g., www.craigslist.com) (30% of those enrolled), internet ads (23%), and participant referrals (16%). A typical message was "Marijuana users: Are you planning to quit or reduce? Join a research study to learn about attempts to change marijuana use. Only requires answering phone calls and filling out forms from home. No treatment will be offered". We screened 1,131 potential participants and excluded 883. The most common reason for exclusion was not reporting definitely or probably intending to stop or reduce use in the next 3 months (78%). Among the 248 eligible, 237 (96%) consented. We excluded another 41 participants because they showed significant noncompliance with IVR calls in the first week, leaving a sample of 196 cannabis users. Participant characteristics were intermediary between a population-based sample of daily users and a large sample of treatment-seeking daily cannabis users (Table 1).

2.4. Procedures

Participants completed a baseline on-line or paper survey and then called the IVR system by phone each morning to report cannabis use for the prior day. The IVR is a system in which participants respond to phone questions by entering data using the phone keypad (Corkrey and Parkinson, 2002). IVR has many of the assets of computer-assisted telephone interviewing; e.g., automatic skips, branching options, prohibition of illogical responses and outliers, standardized questioning, and direct data entry. Drug use outcomes are more validly reported in IVR compared to phone interviews, computer assessments, written questionnaires or in-person interviews.(Macalino et al., 2002). The IVR first asked whether participants were abstinent or had reduced on the prior day and, if so, whether this was intentional or not. Intentional abstinence was a day of no use of cannabis that the participant stated was because they "were trying to stop or reduce marijuana use". Intentional reduction was a day of "using less than usual" because they were trying to reduce. Non-intentional abstinence or reduction was change due to "no money to buy marijuana", "no marijuana was available", and similar reasons. The IVR then asked number of times cannabis was used the prior day. Finally, the IVR asked whether each of the 12 types of cues had occurred at least once during the day (yes/no). The IVR did not ask the number of times each of the 12 types of cue occurred because our pilot work suggested few cues occurred more than once/day. Participants were reimbursed $2 for daily IVR completion plus a $10 bonus if they completed all IVR calls in a week.

2.5. Data Analysis

In descriptive analyses, to insure that each participant contributed the same amount of data, we first calculated statistics within participants and then across participants. Most of the variables did not have normal distributions; thus, we usually report medians and 25th and 75th percentiles rather than means and standard deviations.

Our primary analysis was whether the number of different types of cues over 7-day periods prospectively predicted whether or not an attempt to change (which included an intentional abstinence or an intentional reduction) occurred on the eighth day. In this analysis, each participant contributed multiple tests. We only used predictor periods that were 7 consecutive days of "usual use;" i.e., we did not include 7-day epochs that included an intentional quit or reduction attempt. The participants contributed a median of 29 (7, 54) seven-day epochs for testing.

For testing, we chose 7-day epochs because we thought they would provide a sufficient sample of cue occurrences, and we thought more distal cues were unlikely to be as influential. A secondary analysis repeated our analysis examining cues over the last 3 days of the 7-day epoch, and on the last (i.e., 7th) day of the epoch to see if more proximal cues were more predictive. In addition, we examined the influence of cues on the eighth day; however, if an attempt to change occurred on the eighth day, we do not know if the cue on the eighth day occurred before or after the attempt. To examine the influence of each of the 12 specific types of cues, we used the number of days that each specific type of cue occurred during the epoch as the independent variable.

We ran multilevel logistic regression to test whether the number of cues over the 7-days epochs predicted the probability of abstinence or reduction on the eighth day. The regression used a number of different types of cues over the time period of interest as the predictor and whether an attempt to change occurred (yes/no) on the eighth day as the outcome. The multilevel regression models had a random-intercept and an unstructured covariance structure (Hox, 2002) which is appropriate for correlated random coefficient models using PROC GLIMMIX of the statistical software SAS v 9.4 (SAS Institute Inc, Cary, NC with the Laplace method of estimation. The models had random intercepts and a logit link (binary distribution). This statistical approach is appropriate when there are a large number of repeated measures and when there are varying numbers of records per participant.

3. RESULTS

3.1 Initial analyses

Few participants (13%) dropped out during the study. Missing data were uncommon (16% of calls). Almost all (89%) participants made at least one attempt to reduce or stop cannabis. Participants were attempting to change on 25% of days. Half (46%) of these days were attempts to stop cannabis use.

To examine the psychometrics of our cues, we conducted a factor analysis of the 12 cues to determine if we obtained our hypothesized two different sets of cues; i.e., those that should prompt a quit/reduction quit attempt, and those that should inhibit a quit/reduction attempt. The dependent variable was the percent of days that each cue occurred for each participant in the main study. A promax rotation resulted in four factors. Two factors represented prompts to change. Occurrence of physical and psychological symptoms loaded on one factor (factor loadings = .86 and .91), and someone asked participant to change and someone complained about use loaded on second factor (.95 and .96). One factor represented inhibition of change and included seeing someone used, being offered cannabis and being at a party (.61 – .91). A final factor represented unintentional change and included cannabis not being available, restrictions on cannabis use and using non-cannabis illicit drugs (.58 – .78). Thus, the factor analysis appeared to verify our categorization of cues. Because this factor analysis has not been verified, we based analyses on the 12 individual cues rather than the above factors.

3.2. Incidence of Cues

Few cues occurred at least weekly (Table 2). The median number of different prompting cues each week was 2 (0, 7) and the median frequency of different inhibiting cues was 4.5 (1, 7). The most common prompting cues were events that increased concern about the cost of using cannabis, and concern about health or psychological problems from use. The two most common inhibiting cues were seeing someone else use cannabis and someone offering cannabis. The remaining 8 cues were uncommon.

In terms of modulators of the occurrence of cues, among the baseline variables, younger users reported more inhibiting cues (F = 12.0; e.g., 1.0/week for 25 year olds vs 0.6/week for 50 yr olds). Whites had more prompting cues (F = 5.5; 0.9 vs 0.7), as did users with cannabis abuse/dependence (F = 14.6; 1.0 vs 0.5; Table 1). In addition, those who, at

baseline, stated they were "definitely", rather than "probably", likely to stop or reduce in the next 3 months had more inhibiting cues (1.0 vs 0.5/day, F = 13.8, p = .001). When we re-ran the analyses below with these variables as covariates the results below did not change.

3.3 Cues as predictors of attempts to change

Within participants, a greater number of different types of prompting cues prospectively predicted a greater probability of an attempt to change across the 7, 3, and 1 day epochs in a dose-related manner (Table 2, Figure 1). Thus, within a given participant, weeks with more different types of cues were more likely to result in an attempt to stop or reduce than weeks in which fewer types of cues occurred. For example, when no cues occurred the probability of an attempt to stop or reduce on a given day was about 2%, but increased 2–3 fold when several different cues occurred (Figure). The effect size (Beta coefficient) appeared to be greater for cues on the same day (0.25) and day prior (0.35), than for cues on 2–7 days prior (median = 0.20), suggesting more proximal cues were more predictive. The only individual cues that consistently predicted an attempt to change across time periods were a) someone asking or advising change, b) the occurrence of a physical symptom related to cannabis use and, c) occurrence of a psychological symptom related to cannabis use. Number of inhibiting cues and being at a party predicted a decrease in the probability of a change attempt, but only on the same day analyses, which as mentioned above is difficult to interpret. None of the baseline variables consistently moderated the effect of cues on change attempts.

4. DISCUSSION

4.1 Summary of Results

In this prospective 3-month study of non-treatment-seeking daily, cannabis users, the major findings were a) cost and health/psychological problems were the most common prompting cues, and seeing others use and being offered cannabis were the most common inhibiting cues; b) the number of different prompting cues prospectively predicted increased attempts to change in a dose-related manner; c) proximal cues appeared to be more robust predictors; d) requests to stop or reduce, and the occurrence of physical or psychological problems from cannabis best predicted change attempts; and e) inhibiting cues did not consistently predict the probability of an attempt to change.

4.2 Interpretation of Results

The few studies that examined predictors of attempts to stop or reduce cannabis have reported retrospective reasons for quitting that mostly tap cognitive states (e.g., desire to prove self-control; Ellingstad et al., 2006; Copersino et al., 2006; Chauchard et al., 2013). Several empirical studies have shown recall of such subjective states is often inaccurate due to memory and rationalization biases, etc. (Borland et al., 2012). In contrast, the current study focused on environmental events, mostly for three reasons. First, recall of events is usually more reliable than recall of internal states (Nisbett and Wilson, 1977). Second, humans are often reluctant to attribute change to an environmental event rather than a subjective state because this robs them of credit for the change (Skinner, 2002). Third, studies with tobacco smokers have found that half or more of quit attempts were

spontaneous; i.e., were not anticipated prior to the day of the attempt (Hughes et al., 2014b). This suggests that some environmental event occurred on the day of the attempt to change which lead to a sudden attempt to change. A similar process may be occurring with cannabis attempts to change cannabis use.

We believe our study is the first to examine whether environmental events prospectively predict attempts to change cannabis use. Our results can be seen as a conceptual replication of our prior study of the effect of cues on tobacco users contemplating quitting (Hughes et al., 2015). The present results replicate the tobacco study's finding that the number of prompting cues predicted an attempt to change in a dose-related manner and that several specific cues predicted future change. However, unlike the prior tobacco study, in this study of cannabis users, more proximal cues were more powerful than more distant cues. It is difficult to determine if our results are consistent with retrospectively reported reasons for quitting because these studies asked mostly about internal states, not environmental cues. However, social influences and health problems (both of which were found predictive in the current study) were often cited as reasons for quitting in prior retrospective studies (Ellingstad et al., 2006; Copersino et al., 2006; Chauchard et al., 2013); thus, our study can be seen as a more experimentally rigorous validation that these are important reasons for quitting or reducing.

4.3 Limitations and Assets

Our results should be considered preliminary for several reasons. Although prospective prediction is a better proxy for causality than retrospective recall, it still could be a non-causal proxy for other factors (Gordis, 2004). For example, perhaps some internal state (e.g. motivation to quit) increases the recall of the number of cues, and it is motivation, not number of cues, that is predicting attempts to change. Although the magnitude of the effect of the number of cues appears large (Figure 1), most of this increase occurs when relatively large numbers of cues occurred; e.g., more than two prompting cues/day; however, overall, participants averaged less than two prompting cues/week. This relatively small incidence of cues may have decreased our ability to detect effects and caused false negative results. We did not test the universe of possible environmental cues that might prompt or inhibit change attempts. More intensive qualitative research might find important cues we missed. We also did not ask about the salience of the cue; e.g., lung cancer vs. red eyes as physical problem predictors. The self-report of reduction attempts did not require a minimum amount of reduction. Self-reports may have been biased due to an attempt to link events and cessation/reduction. In order to observe more attempts to change, we studied only cannabis users who were planning to quit or reduce in the next 3 months and, thus, our sample is not representative and may be biased: e.g., perhaps those planning to change are more sensitive to cue effects. We cannot find any data on what proportion of daily cannabis users our sample represents. We did not biochemically verify attempts to reduce or abstain. Prior studies suggest that in non-treatment studies with little face-to-face contact, falsification of drug use is uncommon (Hjorthoj et al., 2012). Finally, we conducted several tests (e.g., Table 2 includes 64 tests) and, thus, may have obtained some false positives. We have not used p adjustments for the number of studies because many statisticians do not believe they are appropriate in an exploratory study such as ours (Feise, 2002)

The major assets of our study are a) the large sample size, b) use of non-treatment seeking cannabis users, c) daily collection of data, d) tests of prospective prediction of attempts to change, e) high compliance, and f) examination of within-participant rather than between-participant prediction.

4.4 Conclusions and Clinical Implications

Our results suggest several environmental cues *appear* to prompt attempts to change cannabis use and that the effect of these cues may cumulate over time. These results suggest that programs that increase the frequency of such cues; e.g., training health care professionals (Aveyard et al., 2011) or significant others (Patten et al., 2004) to recommend reduction/cessation or that discuss how cannabis use may influence the user's psychological and physical health, may result in abstinence or reduction. Our methods have several limitations and, thus, should be considered preliminary. The results suggest further research, such as tests of a) a more comprehensive list of cues that might prompt or inhibit attempts to change; b) whether the salience of the cue or the number of different types of cues, rather than the sheer number of cues, best predicts change; and c) whether experimental manipulation of the frequency of cues can increase abstinence.

Acknowledgments

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Highlights

- This study examined attempts to change (i.e., stop or reduce) cannabis among adult daily cannabis users

- A greater number of cues that should prompt quit attempts (e.g. being asked to stop) prospectively increases the probability of an attempt to change cannabis use two to four-fold. r

- More proximal cues appeared to be more potent

- Requests to stop or reduce, and physical or psychological problems from cannabis are the cues that best predict change attempts

- These results suggest that programs to increase requests to change cannabis use or that increase awareness of psychological and physical problems from cannabis use should increase cannabis cessation or reduction.

- Further research is needed to identify other possible cues that increase the probability of attempts to stop or reduce cannabis among heavy users.
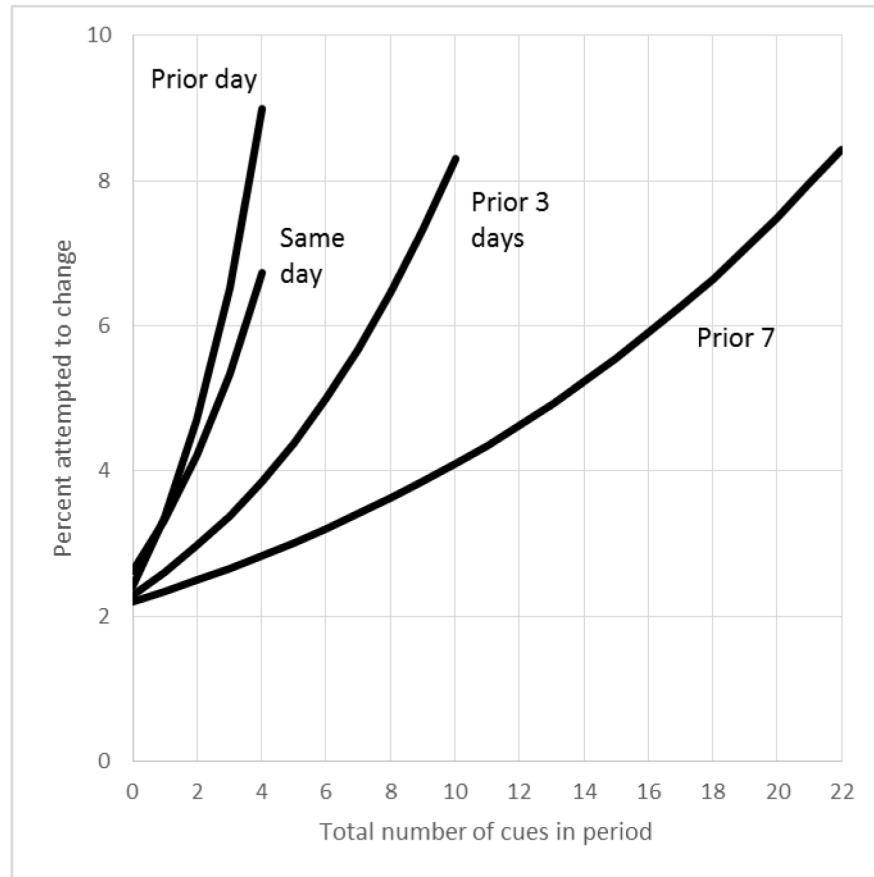
Figure 1.
Probability of an attempt to stop or reduce cannabis on a given day as a function of number of different types of cues and across 1, 3 and 7 days prior. The regression lines are plotted for the range of values represented by 95% of the observed data.

Table 1

Participant Characteristics

	Current Sample	Treatment Seekers TEDS, 2010	Daily Users, NSDUH 2010
n = 196	196	1323	10,698
% 18–29 yrs old	50%	49%	65%
Males	47%	70%	61%
Married	15%	24%	12%
HS or less	29%	51%	85%
Minority	41%	32%	62%
Employed full/part time	49%	68%	17%
Median age onset Cannabis use	15 (14, 17)	15	15
Cannabis abuse or dependence	76%	22%	91%

NSDUH = National Survey on Drug Use and Health

TEDS = Treatment Episode Data Set

Table 2

Incidence of Cues and Whether They Predicted Intentional Change.

Cues That Might Prompt Quit Attempt[a]	Percent of subjects with weekly occurrence	F values for Predicting change			
		During 7 prior days	During 3 prior days	On prior day	Same day
Total number of different prompting cues		7.6**	9.1**	7.6**	6.2*
A day in which at least one of the cues occurred	53%	6.4*	11.6***	6.4*	2.59
You had a physical symptom that you thought was caused or made worse by your cannabis use	14%	14.6***	16.1****	14.6***	1.7
You had a psychological symptom that you thought was caused or made worse by your cannabis use	15%	9.8**	11.8***	9.8**	0.8
Someone asked or advised you to stop or reduce your cannabis use	3%	4.3*	5.2*	4.3*	0.1
Something happened that made you more concerned about the cost of cannabis	16%	0.03	0.0	0.03	5.6*
You were in a place you could not use cannabis most of the day	13%	1.7	0.6	1.7	0.01
You ran out of Cannabis or your usual source for cannabis was not available	9%	0.6	0.5	0.6	4.7*
Someone complained about your use of cannabis	3%	1.8	5.1*	1.8	.02
Something happened that made you more concerned about being caught using cannabis	2%	1.6	0.3	1.6	2.41
Cues that Might Inhibit a Quit Attempt[b]					
Total number of different inhibiting cues		0.8	0.0	1.6	4.0*
A day in which at least one of the cues occurred	66%	0.1	0.7	2.0	2.8
You saw someone else using cannabis	58%	0.5	0.03	0.7	2.3
Someone offered you cannabis	37%	1.4	0.01	1.9	1.7
You were at a party or celebrating something	5%	0.1	0.2	0	4.7*
You used illegal drug other than cannabis	1%	0.2	0.4	0.8	0.9

[a] F values represent an increase in probability of a change attempt

[b] F values represent a decrease in probability of a change attempt

*
$p < 0.05$

**
$p < 0.01$

***
$p < 0.001$