

The 'next-day' effects of cannabis use: A systematic review.

Supplementary File 1

This file contains:

Page 2	Literature Search
Pages 3–4	Table S1. Neuropsychological tests and categories
Page 4	Table S2. Terms used to describe participants' cannabis use behaviour
Page 5	Figure S1. PRISMA flow diagram
Page 6	Study selection process
Pages 7–11	Table S3. The acute effects of THC use in included studies

Literature Search

Studies were identified by searching the online databases Scopus and Web of Science (Thomas Reuters) from inception until October 25th, 2021, using the following Boolean expressions:

Scopus:

(TITLE-ABS-KEY (cogniti* OR driving OR drive OR "processing speed" OR "reaction time" OR vigilance OR "executive function" OR memory OR psychomotor OR tracking OR perception OR "information processing" OR attention OR "crystallised intelligence" OR pilot* OR flight*)) AND (TITLE-ABS-KEY (cannabinoid* OR cannabis OR marijuana OR tetrahydrocannabinol OR THC OR nabiximols OR Sativex OR dronabinol OR marinol OR namisol)) AND (TITLE-ABS-KEY (duration OR "next day" OR "carry over" OR residual))

Web of Science:

TS = (cogniti* OR driving OR drive OR "processing speed" OR "reaction time" OR vigilance OR "executive function" OR memory OR psychomotor OR tracking OR perception OR "information processing" OR attention OR "crystallised intelligence" OR pilot* OR flight*) AND TS = (cannabinoid* OR cannabis OR marijuana OR tetrahydrocannabinol OR THC OR nabiximols OR Sativex OR dronabinol OR marinol OR namisol) AND TS = (duration OR "next day" OR "carry over" OR residual)

The star symbol (*) was used to capture derivatives of search terms (by suffixation) and enclosed quotation marks were used to capture exact phrases. No other restrictions (filters) were imposed. The search was updated on March 28th, 2022; however, no new (eligible) publications were identified.

Table S1. Neuropsychological tests and categories

Divided Attention
Divided Attention Task
Multi-attribute Task
Executive Function
Baddeley Reasoning Task
Logical Reasoning Task
Information Processing
Digit Symbol Substitution Test
Digit Cancellation Task
Bourdon's Cancellation Test
Two Letter Search Task
Visual Search Task
Card Sorting Task
Road Sign Test
Tracking Performance
Critical Tracking Task
Reaction Time
Simple Reaction Time
Choice Reaction Time Task
Circular Lights Task
Motor Function
Grooved Pegboard Task
Gibson Spiral Maze
Standing Steadiness Task
Sustained Attention
Continuous Performance Test
Psychomotor Vigilance Task
Sustained Attention Task
Rapid Visual Information Processing Task
Working Memory
Serial Sevens Subtraction Task
Verbal Fluency Task
Serial Addition & Subtraction Task
Backward Digit Span Task
Finger Labyrinths Task
Perception
Time Production Task

Table S1 Cont.

Learning and(or) Memory

Hopkins Verbal Learning Test Revised
Immediate and Delayed Recall Tasks
Buschkel Selective Reminding Task
Prose Recall Task
Perceptual Priming Task
Forward Digit Span Task

Spatial Reasoning

Mannequin Task

The Digit Span and Addition Tasks used in Rafaelsen *et al.* [1] and the Tapping, Spiral Rotor, Compensation Apparatus and Tracking Apparatus Tasks used in Kielholz *et al.* [2] were not adequately described or referenced to be categorised.

Table S2. Terms used to describe participants' cannabis use behaviour

Population	Definition
Cannabis Naïve	No lifetime exposure
Current Non-Users	No use ≥ 1 month and ≥ 1 lifetime exposure
Infrequent Users	< 1 use per month and ≥ 1 lifetime exposure
Monthly Users	1 to < 4 uses per month
Weekly Users	1 to < 4 uses per week
Daily Users	≥ 4 uses per week
Unclear	Insufficient information provided

See Sect. 2.5 'Data Extraction' of McCartney *et al.* [3] for full details.

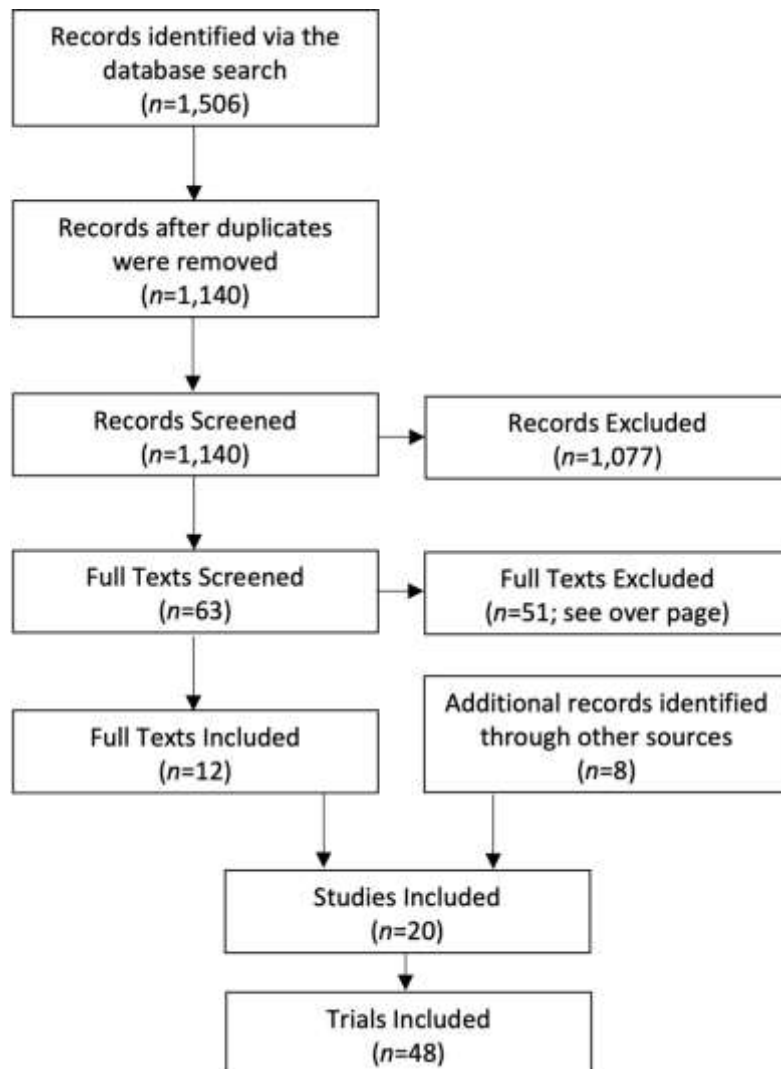


Figure S1. Study selection. Excluded full texts are listed over page. If a study contained multiple “intervention-arms”, more than one of which was eligible for inclusion, the separate “arms” were treated as discrete ‘studies’, termed *trials*. This search was performed on October 25th, 2021; an updated search was performed on March 28th, 2022; however, no new (eligible) publications were identified.

Study Selection Process

Fifty-one of the 63 full texts screened during the literature search were ineligible for inclusion in the current review. These publications were excluded for the following reasons:

- 1) Unable to locate a full text (n=2) [4, 5]
- 2) Not a full-length paper (n=2) [6, 7]
- 3) Not original research (n=8) [8-15]
- 4) Not an interventional study (n=4) [16-19]
- 5) Performance on a 'safety-sensitive' task or discrete neuropsychological test was not assessed (n=12) [20-31]
- 6) Performance as not assessed >8-hours post-(last) THC administration (n=22) [32-53]
- 7) The length of time between THC administration and the performance test(s) was unknown (n=1) [54]

Table S3. Characteristics and results of included trials (≤ 8 -hours treatment, only)

Citation	Study Design	Participants	Usual Cannabis Use Behaviour	Treatment	THC Dose (mg)	Performance Test	Time Since Last THC Use	Effect of THC (compared to placebo unless otherwise stated)
Matheson <i>et al.</i> [55]_a (2020)	Randomised; DB; PC (BSD)	C: 30 (21 M); 22±2 y I: 31 (18 M); 22±2 y	Weekly–Daily	Smoked Cannabis Cigarettes (562±170 mg; 12.5% THC) (<0.5% CBD)	70.3±21.3 ^a	Grooved Pegboard Task	1 h	No significant effects
						DSST	1 h	No significant effects
						CPT	1 h	No significant effects
						HVLT-R	1 h	No significant effects
Matheson <i>et al.</i> [55]_b (2020)	Randomised; DB; PC (BSD)	C: 30 (21 M); 22±2 y I: 30 (26 M); 22±2 y	Weekly–Daily	Smoked Cannabis Cigarettes (752±131 mg; 12.5% THC) (<0.5% CBD)	94.0±16.4 ^a	Grooved Pegboard Task	1 h	No significant effects
						DSST	1 h	No significant effects
						CPT	1 h	No significant effects
						HVLT-R	1 h	THC ↓ Percent Retained at 1 h.
Brands <i>et al.</i> [56]_a (2019)	Randomised; DB; PC (BSD)	C: 30 (21 M); 22±2 y I: 31 (18 M); 22±2 y	Weekly–Daily	Smoked Cannabis Cigarettes (562±170 mg; 12.5% THC) (<0.5% CBD)	70.3±21.3 ^a	Simulated Driving	0.5 h	No significant effects
						Simulated Driving (Dual Task)	0.5 h	THC ↓ Speed at 0.5 h.
Brands <i>et al.</i> [56]_b (2019)	Randomised; DB; PC (BSD)	C: 30 (21 M); 22±2 y I: 30 (26 M); 22±2 y	Weekly–Daily	Smoked Cannabis Cigarettes (752±131 mg; 12.5% THC) (<0.5% CBD)	94.0±16.4 ^a	Simulated Driving	0.5 h	THC ↓ Speed at 0.5 h.
						Simulated Driving (Dual Task)	0.5 h	THC ↓ Speed at 0.5 h.
Hartley <i>et al.</i> [57]_a (2019)	Randomised; DB; PC (WSD)	15 M; 22±3 y	Weekly	Smoked Cannabis Cigarettes (9.8% THC; 1 g tobacco) (<0.1% CBD and CBN)	10	Simulated Driving	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
						PVT	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
Hartley <i>et al.</i> [57]_b (2019)	Randomised; DB; PC (WSD)	15 M; 22±3 y	Weekly	Smoked Cannabis Cigarettes (9.8% THC; 1 g tobacco) (<0.1% CBD and CBN)	30	Simulated Driving	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
						PVT	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
Hartley <i>et al.</i> [57]_c (2019)	Randomised; DB; PC (WSD)	15 M; 22±3 y	Daily	Smoked Cannabis Cigarettes (9.8% THC; 1 g tobacco) (<0.1% CBD and CBN)	10	Simulated Driving	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
						PVT	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
Hartley <i>et al.</i> [57]_d (2019)	Randomised; DB; PC (WSD)	15 M; 22±3 y	Daily	Smoked Cannabis Cigarettes (9.8% THC; 1 g tobacco) (<0.1% CBD and CBN)	30	Simulated Driving	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
						PVT	BL, 1, 2, 4, 6 & 8 h	No relevant analyses ^b
Schoedel <i>et al.</i> [58]_a (2018)	Randomised; DB; PC (WSD) ^c	43 (31 M) ^d ; 38±9 y	Infrequent–Daily	THC Capsules	10	Divided Attention Task	BL, 1, 2, 3, 6 & 8 h	No significant effect
						HVLT-R	BL, 1, 2, 3, 6 & 8 h	No relevant analyses ^e
						DSST	BL, 1, 2, 3, 6 & 8 h	No relevant analyses ^e
Schoedel <i>et al.</i> [58]_b (2018)	Randomised; DB; PC (WSD) ^c	43 (31 M) ^d ; 38±9 y	Infrequent–Daily	THC Capsules	30	Divided Attention Task	BL, 1, 2, 3, 6 & 8 h	THC ↓ Tracking Accuracy at 3 and 6 h^f.
						HVLT-R	BL, 1, 2, 3, 6 & 8 h	No relevant analyses ^e
						DSST	BL, 1, 2, 3, 6 & 8 h	No relevant analyses ^e
Ronen <i>et al.</i> [59] (2008)	DB; PC (WSD)	14 (10 M); 22±2 y	Monthly–Weekly	Smoked THC Cigarettes	17	Simulated Driving	20 min	THC ↑ Dual Task Reaction Time, RMS Lane Position and RMS Steering Deviations at 20 min.
Ménétreay <i>et al.</i> [60]_a (2005)	Randomised; DB; PC (WSD)	8 M ^g ; Range: 22–30 y	Unclear	Hemp Milk Decoction	16.5	Road Sign Test	BL, 1, 2.5, 4, 5.5 & 7 h	Ambiguous ^h
						Divided Attention Task	BL, 1, 2.5, 4, 5.5 & 7 h	Ambiguous ^h
Ménétreay <i>et al.</i> [60]_b (2005)	Randomised; DB; PC (WSD)	8 M ^g ; Range: 22–30 y	Unclear	Hemp Milk Decoction	45.7	Road Sign Test	BL, 1, 2.5, 4, 5.5 & 7 h	Ambiguous ^h
						Divided Attention Task	BL, 1, 2.5, 4, 5.5 & 7 h	Ambiguous ^h
Ménétreay <i>et al.</i> [60]_c (2005)	Randomised; DB; PC (WSD)	8 M ^g ; Range: 22–30 y	Unclear	THC Capsules	20	Road Sign Test	BL, 1, 2.5, 4, 5.5 & 7 h	Ambiguous ^h
						Divided Attention Task	BL, 1, 2.5, 4, 5.5 & 7 h	Ambiguous ^h
Nicholson <i>et al.</i> [61]_a (2004)	DB; PC (WSD)	8 (4 M); Range 21–34 y	Current Non-Users	Oromucosal Spray	15	Word Memory Recall	Not Assessed	-
						Digit Memory Recall	Not Assessed	-
						6-Letter Memory Recall	Not Assessed	-

						DSST	Not Assessed	-
						Multi-attribute Task	Not Assessed	-
						Choice Reaction Time Task	Not Assessed	-
						Sustained Attention Task	Not Assessed	-
						Word Memory Recall	Not Assessed	-
						Digit Memory Recall	Not Assessed	-
						6-Letter Memory Recall	Not Assessed	-
						DSST	Not Assessed	-
						Multi-attribute Task	Not Assessed	-
						Choice Reaction Time Task	Not Assessed	-
						Sustained Attention Task	Not Assessed	-
						Word Memory Recall	Not Assessed	-
						Digit Memory Recall	Not Assessed	-
						6-Letter Memory Recall	Not Assessed	-
						DSST	Not Assessed	-
						Multi-attribute Task	Not Assessed	-
						Choice Reaction Time Task	Not Assessed	-
						Sustained Attention Task	Not Assessed	-
						Buschkel Selective Reminding Task	BL, 1, 2, 4, 6 & 8	Ambiguous
						RVIPT	BL, 1, 2, 4, 6 & 8	No significant effects
						Baddeley Reasoning Task	BL, 1, 2, 4, 6 & 8	THC ↑ Reaction Time at 1 h.
						Subtract Serial Sevens Task	BL, 1, 2, 4, 6 & 8	No significant effects
						Choice Reaction Time Task	BL, 1, 2, 4, 6 & 8	THC ↑ Number of Errors at 2 and 8 h.
						Digit Cancellation Task	BL, 1, 2, 4, 6 & 8	THC ↑ Number of Errors (Single Target) at 2 h and Number of Errors (Double Target) at 1 h. THC ↓ Time to Complete (Double Target) at 4 h.
						Simple Reaction Time Task	BL, 1, 2, 4, 6 & 8	No significant effects
						Buschkel Selective Reminding Task	BL, 1, 2, 4, 6 & 8	Ambiguous
						RVIPT	BL, 1, 2, 4, 6 & 8	No significant effects
						Baddeley Reasoning Task	BL, 1, 2, 4, 6 & 8	THC ↑ Reaction Time at 1 h.
						Subtract Serial Sevens Task	BL, 1, 2, 4, 6 & 8	No significant effects
						Choice Reaction Time Task	BL, 1, 2, 4, 6 & 8	THC ↑ Number of Errors at 1 h.
						Digit Cancellation Task	BL, 1, 2, 4, 6 & 8	THC ↑ Number of Errors (Single Target) at 2 and 4 h and Number of Errors (Double Target) at 1 h. THC ↓ Time to Complete (Double Target) at 1 and 2 h.
						Simple Reaction Time Task	BL, 1, 2, 4, 6 & 8	THC ↑ Reaction Time at 2 h.
						Smooth-Pursuit Eye Movements	BL, 0.25, 1.75, 3.5 & 5.5	Ambiguous ⁱ
						Circular Lights Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effect
						Serial Addition and Subtraction Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Digit Recall Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Logical Reasoning Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Mannequin Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Smooth-Pursuit Eye Movements	BL, 0.25, 1.75, 3.5 & 5.5	Ambiguous ⁱ
						Circular Lights Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effect
						Serial Addition and Subtraction Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Digit Recall Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Logical Reasoning Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Mannequin Task	BL, 0.25, 1.75, 3.5 & 5.5	No significant effects
						Time Production Task	1 h	THC ↓ Time Interval (60 & 120 s) at 1 h ⁱ
						Standing Steadiness Task	1 h	No significant effect
						DSST	1 h	THC ↓ Percent Correct at 1 h ⁱ

						Backward Digit Span Task	1 h	No significant effect
						Logical Reasoning Task	1 h	No significant effect
						Visual Divided Attention Task	1 h	THC ↑ False Alarms at 1 h^l
						Free Recall Task	1 h	No significant effect
Leirer <i>et al.</i> [65] (1991)	“Blinded” ^l ; PC (WSD)	9 (Sex NS); 31 y, Range: 24–40 y	Unclear	Smoked Cannabis Cigarettes	20	Simulated Flying	BL, 0.25, 4, & 8 h	THC ↓ performance at 0.25, 4 & 8 h
Chait [66] (1990)	DB; PC (WSD)	12 (9 M); 21 y, Range: 18–26 y	Weekly–Daily	Smoked Cannabis Cigarettes (800–900 mg; 2.1% THC)	“Eight Puffs” ^k (Dose Unknown)	Time Production Task	Not Assessed	-
						Simple Reaction Time Task	Not Assessed	-
						Forward Digit Span Task	Not Assessed	-
						Visual Divided Attention Task	Not Assessed	-
						Choice Reaction Time Task	Not Assessed	-
						Backward Digit Span Task	Not Assessed	-
						DSST	Not Assessed	-
						Buschkel Selective Reminding Task	Not Assessed	-
Heishman <i>et al.</i> [67] _a (1990)	Randomised; DB; PC (WSD)	3 M; Range 27–29 y	Unclear	Smoked Cannabis Cigarettes (2.57% THC)	“1 x Cigarette” (Dose Unknown)	Two Letter Search Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Logical Reasoning Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Digit Recall Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Serial Addition and Subtraction Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Circular Lights Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
Heishman <i>et al.</i> [67] _b (1990)	Randomised; DB; PC (WSD)	3 M; Range 27–29 y	Unclear	Smoked Cannabis Cigarettes (2.57% THC)	“2 x Cigarette” (Dose Unknown) ^m	Two Letter Search Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Logical Reasoning Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Digit Recall Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Serial Addition and Subtraction Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Circular Lights Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
Heishman <i>et al.</i> [67] _c (1990)	Randomised; DB; PC (WSD)	2 M; Range 27–29 y	Unclear	Smoked Cannabis Cigarettes (2.57% THC)	“4 x Cigarette” (Dose Unknown) ⁿ	Two Letter Search Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Logical Reasoning Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Digit Recall Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Serial Addition and Subtraction Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
						Circular Lights Task	BL, 0.5, 1, 2, 3.5, 4.5, 5 & 7 h	Results not adequately reported.
Leirer <i>et al.</i> [68] _a (1989)	Randomised; DB; PC (WSD)	9 (Sex NS); 26 y, Range: 18–29 y	Unclear	Smoked Cannabis Cigarettes	10	Simulated Flying	1, 4 & 8 h	No significant effects
Leirer <i>et al.</i> [68] _b (1989)	Randomised; DB; PC (WSD)	9 (Sex NS); 26 y, Range: 18–29 y	Unclear	Smoked Cannabis Cigarettes	20	Simulated Flying	1, 4 & 8 h	THC ↓ performance (‘turbulent’) at 1 & 4 h
Leirer <i>et al.</i> [68] _c (1989)	Randomised; DB; PC (WSD)	9 (Sex NS); 38 y, Range: 30–48 y	Unclear	Smoked Cannabis Cigarettes	10	Simulated Flying	1, 4 & 8 h	No significant effects
Leirer <i>et al.</i> [68] _d (1989)	Randomised; DB; PC (WSD)	9 (Sex NS); 38 y, Range: 30–48 y	Unclear	Smoked Cannabis Cigarettes	20	Simulated Flying	1, 4 & 8 h	THC ↓ performance (‘turbulent’) at 1 & 4 h
Barnett <i>et al.</i> [69] _a (1985)	“Blinded” ^l ; PC (WSD)	8 M; Range: 22–33 y	Unclear	Smoked Cannabis Cigarettes	100 µg·kg ⁻¹	Visual Search Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b

				(700 mg; 1% THC)	(6.8–7.3 mg)	Divided Attention Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
						Critical Tracking Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
Barnett <i>et al.</i> [69]_b (1985)	“Blinded” ^j ; PC (WSD)	8 M; Range: 22–33 y	Unclear	Smoked Cannabis Cigarettes (700 mg; 1% THC)	200 µg·kg ⁻¹ (14–15 mg)	Visual Search Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
						Divided Attention Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
						Critical Tracking Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
Barnett <i>et al.</i> [69]_c (1985)	“Blinded” ^j ; PC (WSD)	8 M; Range: 22–33 y	Unclear	Smoked Cannabis Cigarettes (700 mg; 1% THC)	250 µg·kg ⁻¹ (17–18 mg)	Visual Search Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
						Divided Attention Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
						Critical Tracking Task	0.2, 0.8, 1.5, 2.2, 2.8, 3.5, 4.2, 6 & 8	No relevant analyses ^b
Chait <i>et al.</i> [70]_a (1985)	“Blinded” ^j ; PC (WSD)	13 M; 25 y, Range: 21–35 y	Infrequent–Daily	Smoked Cannabis Cigarettes (1 g; 2.9% THC)	"Ten Puffs" (Dose Unknown)	Card Sorting Task	BL, 25 min & 70 min	THC ↑ Time to Complete (Simple) at 25 min^l
						Free Recall Task	BL, 25 min & 70 min	THC ↓ Immediate Recall at 25 min^l
						DSST	BL, 25 min & 70 min	No significant effects ^l
						Time Production Task	BL, 25 min & 70 min	THC ↑ Time Interval (30 s) at 25 min compared to Target.
Chait <i>et al.</i> [70]_b (1985)	“Blinded” ^j ; PC (WSD)	6 M; age NS	Unclear	Smoked Cannabis Cigarettes (1 g; 2.9% THC)	"Five Puffs" (Dose Unknown)	Card Sorting Task	BL & 25 min	Results not reported.
						Free Recall Task	BL & 25 min	Results not reported.
						DSST	BL & 25 min	Results not reported.
						Time Production Task	BL & 25 min	Results not reported.
Yesavage <i>et al.</i> [71] (1985)	Pre/Post Trial	10 (Sex NS); 29 y	Unclear	Smoked Cannabis Cigarettes	19	Simulated Flying	1 & 4 h	THC negatively impacted all eight measures of flying performance at 1 h and six of these eight measures at 4 h.
Rafaelsen <i>et al.</i> [72]_a (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	8	Simulated Driving	Shortly Post-Treatment	No significant effects ^p
Rafaelsen <i>et al.</i> [72]_b (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	12	Simulated Driving	Shortly Post-Treatment	No significant effects ^p
Rafaelsen <i>et al.</i> [72]_c (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	12	Simulated Driving	Shortly Post-Treatment	THC ↑ Break Time^p
Rafaelsen <i>et al.</i> [72]_d (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	16	Simulated Driving	Shortly Post-Treatment	THC ↑ Break Time and Start Time^p
Rafaelsen <i>et al.</i> [1]_a (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	8	Digit Span Task (Direction NS)	Shortly Post-Treatment	No significant effects ^l
						Addition Test	Shortly Post-Treatment	No significant effects ^l
						Subtract Serial Sevens Task	Shortly Post-Treatment	No significant effects ^l
						Finger Labyrinths Task	Shortly Post-Treatment	No significant effects ^l
						Bourdon's Cancellation Test	Shortly Post-Treatment	No significant effects ^l
Rafaelsen <i>et al.</i> [1]_b (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	12	Digit Span Task (Direction NS)	Shortly Post-Treatment	No significant effects ^l
						Addition Test	Shortly Post-Treatment	THC ↑ Time to Complete^l
						Subtract Serial Sevens Task	Shortly Post-Treatment	THC ↑ Time to Complete^l
						Finger Labyrinths Task	Shortly Post-Treatment	THC ↑ Time to Complete^l
						Bourdon's Cancellation Test	Shortly Post-Treatment	No significant effects ^l
Rafaelsen <i>et al.</i> [1]_c (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	12	Digit Span Task (Direction NS)	Shortly Post-Treatment	No significant effects ^l
						Addition Test	Shortly Post-Treatment	No significant effects ^l
						Subtract Serial Sevens Task	Shortly Post-Treatment	THC ↑ Time to Complete^l
						Finger Labyrinths Task	Shortly Post-Treatment	THC ↑ Time to Complete^l
						Bourdon's Cancellation Test	Shortly Post-Treatment	No significant effects ^l
Rafaelsen <i>et al.</i> [1]_d (1973)	Randomised; DB; PC (WSD)	8 M; Range 21–29 y	Unclear	Oral Cannabis (Baked into Cake)	16	Digit Span Task (Direction NS)	Shortly Post-Treatment	No significant effects ^l
						Addition Test	Shortly Post-Treatment	THC ↑ Time to Complete^l

						Subtract Serial Sevens Task	Shortly Post-Treatment	THC ↑ Time to Complete ^l
						Finger Labyrinths Task	Shortly Post-Treatment	THC ↑ Time to Complete ^l
						Bourdon's Cancellation Test	Shortly Post-Treatment	No significant effects ^l
Kielholz <i>et al.</i> [2]_a (1973)	DB; PC (BSD)	54 ^p (Sex NS); 34 y	Unclear	THC Capsules	350 µg·kg ⁻¹ (~24.5 mg ^q)	Tapping Task	BL, 1 & 4 h	Results not adequately reported.
						Spiral Rotor Task	BL, 1 & 4 h	Results not adequately reported.
						The Compensation Apparatus	BL, 1 & 4 h	Results not adequately reported.
						The Tracking Apparatus	BL, 1 & 4 h	Results not adequately reported.
Kielholz <i>et al.</i> [2]_b (1973)	DB; PC (BSD)	54 ^p (Sex NS); 34 y	Unclear	THC Capsules	400 µg·kg ⁻¹ (~28 mg ^q)	Tapping Task	BL, 1 & 4 h	Results not adequately reported.
						Spiral Rotor Task	BL, 1 & 4 h	Results not adequately reported.
						The Compensation Apparatus	BL, 1 & 4 h	Results not adequately reported.
						The Tracking Apparatus	BL, 1 & 4 h	Results not adequately reported.
Kielholz <i>et al.</i> [2]_c (1973)	DB; PC (BSD)	54 ^p (Sex NS); 34 y	Unclear	THC Capsules	450 µg·kg ⁻¹ (~31.5 mg ^q)	Tapping Task	BL, 1 & 4 h	Results not adequately reported.
						Spiral Rotor Task	BL, 1 & 4 h	Results not adequately reported.
						The Compensation Apparatus	BL, 1 & 4 h	Results not adequately reported.
						The Tracking Apparatus	BL, 1 & 4 h	Results not adequately reported.

All 'Effects of THC' are in comparison to placebo unless otherwise stated; comparisons to baseline are only reported when those to placebo were not conducted or not reported. Significant effects are in **bold text**. BL: Baseline; BSD: Between Subject Design; C: Control Group; CBD: Cannabidiol; CBN: Cannabinol; CPT: Continuous Performance Test; DB: Double Blind; DSST: Digit Symbol Substitution Test; HVLT-R: Hopkins Verbal Learning Test Revised; I: Intervention Group; M: Male Participants; NS: Not Specified; PC: Placebo Controlled; PVT: Psychomotor Vigilance Task; RVIPT: Rapid Visual Information Processing Task; SB: Single Blind; SDLP: Standard Deviation of Lane Position; WSD: Within Subject Design. a: Cigarettes were smoked *ad libitum*; b: The authors modelled the 'behavioural pharmacokinetics' of THC rather than investigating its effect at specific times post-treatment; c: Though 'double-blinded', participants had to demonstrate a capacity to distinguish between THC and placebo (in a 'Quantification Phase') to be eligible for inclusion; d: Only 35 of these participants were included in the analyses investigating THC's effects on cognitive function; e: Only the 'minimum' and 'maximum' performance scores were presented and subjected to statistical analysis; f: Presumed to be significant based on the following text: "The effect of dronabinol 10mg was also similar to placebo, whereas dronabinol 30 mg was associated with a slight decrease (<10%) in performance starting at 3 h post dose and continuing up to 6 h post dose"; g: It is unclear whether six or eight participants completed the cognitive function tests; h: It is unclear how the time parameter was handled in these statistical analyses (see also Sect. 3.4 'Next Day Effects of THC'); i: The authors indicate that THC decreased pursuit speeds at 1.75-hours but do not clearly describe its effects at the other time points; j: The authors do not state whether a single or double-blind design was used; k: Participants completed a total of five smoking periods involving "eight puffs" each: (1) 9 PM Friday; (2) 3 PM Saturday; (3) 9 PM Saturday; (4) 3 PM Sunday; (5) 9 PM Sunday; cognitive function was assessed 12-hours after each evening (9 PM) smoking period; l: We presume these comparisons are against placebo (but could they could be baseline); m: the first cigarette was administered 4 hours before the second; n: the first two cigarettes were administered 4 hours before the second two; p: Total number across all four treatment groups; q: Value estimated at a body weight of 70 kg.

Reference List

1. Rafaelsen, L., et al., *Effects of cannabis and alcohol on psychological tests*. *Nature*, 1973. **242**(5393): p. 117-118.
2. Kielholz, P., et al., *An experimental investigation about the effect of cannabis on car driving behaviour*. *Pharmacopsychiatry*, 1973. **6**(01): p. 91-103.
3. McCartney, D., et al., *Determining the magnitude and duration of acute Δ 9-tetrahydrocannabinol (Δ 9-THC)-induced driving and cognitive impairment: A systematic and meta-analytic review*. *Neuroscience & Biobehavioral Reviews*, 2021. **126**: p. 175-193.
4. Deadwyler, S., C. Heyser, and R. Hampson, *Complete adaptation to the memory disruptive effects of delta-9-THC following 35 days of exposure*. *Neuroscience Research Communications*, 1995. **17**(1): p. 9-18.
5. Harder, S. and S. Rietbrock, *Concentration-effect relationship of Δ 9-tetrahydrocannabinol and prediction of psychotropic effects after smoking marijuana*. *International Journal of Clinical Pharmacology and Therapeutics*, 1997. **35**(4): p. 155-159.
6. Brien, R., et al. *The acute and residual effects of cannabis on driving performance, cognition, attention and fatigue*. in *DRUG AND ALCOHOL REVIEW*. 2011. WILEY-BLACKWELL COMMERCE PLACE, 350 MAIN ST, MALDEN 02148, MA USA.
7. Heishman, S., et al., *Acute and residual effects of smoked marijuana on human performance*. *NIDA RESEARCH MONOGRAPH*, 1993. **132**: p. 270-270.
8. Bhardwaj, A.K., et al., *Randomised Controlled Trial (RCT) of cannabinoid replacement therapy (Nabiximols) for the management of treatment-resistant cannabis dependent patients: A study protocol*. *BMC Psychiatry*, 2018. **18**(1).
9. Pope Jr, H.G., A.J. Gruber, and D. Yurgelun-Todd, *The residual neuropsychological effects of cannabis: the current status of research*. *Drug and Alcohol Dependence*, 1995. **38**(1): p. 25-34.
10. Grant, I., et al., *Non-acute (residual) neurocognitive effects of cannabis use: a meta-analytic study*. *Journal of the International Neuropsychological Society*, 2003. **9**(5): p. 679-689.
11. Carbuto, M., et al., *The safety of studies with intravenous Δ 9- tetrahydrocannabinol in humans, with case histories*. *Psychopharmacology*, 2012. **219**(3): p. 885-896.
12. Zhornitsky, S., et al., *Acute effects of partial CB1 receptor agonists on cognition—A meta-analysis of human studies*. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 2021. **104**: p. 110063.
13. Leirer, V.O., J.A. Yesavage, and D.G. Morrow, *MARIJUANA CARRY-OVER EFFECTS ON PSYCHOMOTOR PERFORMANCE - A CHRONICLE OF RESEARCH*. *CANNABIS: PHYSIOPATHOLOGY, EPIDEMIOLOGY, DETECTION*. 1993. 47-&.
14. Leirer, V.O., J.A. Yesavage, and D.G. Morrow, *Marijuana carry-over effects on psychomotor performance: A chronicle of research*, in *Cannabis Physiopathology Epidemiology Detection*. 2017. p. 47-60.
15. Pope Jr, H.G., *Cannabis, cognition, and residual confounding*. *Jama*, 2002. **287**(9): p. 1172-1174.
16. Lee, D., et al., *Oral fluid cannabinoids in chronic, daily cannabis smokers during sustained, monitored abstinence*. *Clinical Chemistry*, 2011. **57**(8): p. 1127-1136.
17. Mauzay, D., E.M. LaFrance, and C. Cuttler, *Acute Effects of Cannabis on Symptoms of Obsessive-Compulsive Disorder*. *Journal of Affective Disorders*, 2021. **279**: p. 158-163.
18. Pope, H.G. and D. Yurgelun-Todd, *The residual cognitive effects of heavy marijuana use in college students*. *Jama*, 1996. **275**(7): p. 521-527.
19. Varma, V.K., et al., *Cannabis and cognitive functions: A prospective study*. *Drug and Alcohol Dependence*, 1988. **21**(2): p. 147-152.

20. Ahmed, A.I.A., et al., *Safety, pharmacodynamics, and pharmacokinetics of multiple oral doses of delta-9-tetrahydrocannabinol in older persons with dementia*. *Psychopharmacology*, 2015. **232**(14): p. 2587-2595.
21. Hill, K.P., et al., *Nabilone pharmacotherapy for cannabis dependence: A randomized, controlled pilot study*. *American Journal on Addictions*, 2017. **26**(8): p. 795-801.
22. Johnson, J.R., et al., *An open-label extension study to investigate the long-term safety and tolerability of THC/CBD oromucosal spray and oromucosal THC spray in patients with terminal cancer-related pain refractory to strong opioid analgesics*. *Journal of Pain and Symptom Management*, 2013. **46**(2): p. 207-218.
23. Zajicek, J.P., et al., *Multiple sclerosis and extract of cannabis: Results of the MUSEC trial*. *Journal of Neurology, Neurosurgery and Psychiatry*, 2012. **83**(11): p. 1125-1132.
24. Rabinak, C.A., et al., *Effects of acute Δ 9-tetrahydrocannabinol on next-day extinction recall is mediated by post-extinction resting-state brain dynamics*. *Neuropharmacology*, 2018. **143**: p. 289-298.
25. Juckel, G., et al., *Acute effects of Δ 9-tetrahydrocannabinol and standardized cannabis extract on the auditory evoked mismatch negativity*. *Schizophrenia Research*, 2007. **97**(1-3): p. 109-117.
26. Trigo, J.M., et al., *Nabiximols combined with motivational enhancement/cognitive behavioral therapy for the treatment of cannabis dependence: A pilot randomized clinical trial*. *PLoS ONE*, 2018. **13**(1).
27. McDonald, J., et al., *Effects of THC on behavioral measures of impulsivity in humans*. *Neuropsychopharmacology*, 2003. **28**(7): p. 1356-1365.
28. Lintzeris, N., et al., *Cannabis use in patients 3 months after ceasing nabiximols for the treatment of cannabis dependence: Results from a placebo-controlled randomised trial*. *Drug and Alcohol Dependence*, 2020. **215**.
29. Cooper, Z.D., S.D. Comer, and M. Haney, *Comparison of the analgesic effects of dronabinol and smoked marijuana in daily marijuana smokers*. *Neuropsychopharmacology*, 2013. **38**(10): p. 1984-1992.
30. Reichenbach, Z.W., et al., *A 4-week Pilot Study with the Cannabinoid Receptor Agonist Dronabinol and Its Effect on Metabolic Parameters in a Randomized Trial*. *Clinical Therapeutics*, 2015. **37**(10): p. 2267-2274.
31. Hunault, C.C., et al., *Acute subjective effects after smoking joints containing up to 69 mg Δ 9-tetrahydrocannabinol in recreational users: A randomized, crossover clinical trial*. *Psychopharmacology*, 2014. **231**(24): p. 4723-4733.
32. Cheshier, G.B., et al., *The effects of orally administered Δ 9-Tetrahydrocannabinol in man on mood and performance measures: A dose-response study*. *Pharmacology, Biochemistry and Behavior*, 1990. **35**(4): p. 861-864.
33. Shahidi Zandi, A., et al., *Preliminary eye-tracking data as a nonintrusive marker for blood Δ -9-tetrahydrocannabinol concentration and drugged driving*. *Cannabis and cannabinoid research*, 2021. **6**(6): p. 537-547.
34. Wilsey, B., et al., *An Exploratory Human Laboratory Experiment Evaluating Vaporized Cannabis in the Treatment of Neuropathic Pain From Spinal Cord Injury and Disease*. *Journal of Pain*, 2016. **17**(9): p. 982-1000.
35. Braff, D.L., et al., *Impaired speed of visual information processing in marijuana intoxication*. *American Journal of Psychiatry*, 1981. **138**(5): p. 613-617.
36. Guy, G.W. and M.E. Flint, *A single centre, placebo-controlled, four period, crossover, tolerability study assessing, pharmacodynamic effects, pharmacokinetic characteristics and cognitive profiles of a single dose of three formulations of Cannabis Based Medicine Extracts (CBMEs) (GWPD9901), (see abstract)*. *Journal of Cannabis Therapeutics*, 2003. **3**(3): p. 35-77.
37. Ramaekers, J.G., et al., *Neurocognitive performance during acute THC intoxication in heavy and occasional cannabis users*. *Journal of psychopharmacology*, 2009. **23**(3): p. 266-277.

38. Zacny, J.P. and L.D. Chait, *Response to marijuana as a function of potency and breathhold duration*. *Psychopharmacology*, 1991. **103**(2): p. 223-226.
39. Adam, K.C.S., et al., *Δ 9-Tetrahydrocannabinol (THC) impairs visual working memory performance: a randomized crossover trial*. *Neuropsychopharmacology*, 2020. **45**(11): p. 1807-1816.
40. Hollister, L.E., R.K. Richards, and H.K. Gillespie, *Comparison of tetra hydrocannabinol and synhexyl in man*. *Clinical Pharmacology & Therapeutics*, 1968. **9**(6): p. 783-791.
41. Hollister, L.E. and B.A. Hampton Gillespie, *Interactions in man of delta-9-tetrahydrocannabinol. II. Cannabinol and cannabidiol*. *Clinical Pharmacology and Therapeutics*, 1975. **18**(1): p. 80-83.
42. Lieving, L.M., et al., *Effects of marijuana on temporal discriminations in humans*. *Behavioural Pharmacology*, 2006. **17**(2): p. 173-183.
43. Colizzi, M., et al., *Modulation of acute effects of delta-9-tetrahydrocannabinol on psychotomimetic effects, cognition and brain function by previous cannabis exposure*. *European Neuropsychopharmacology*, 2018. **28**(7): p. 850-862.
44. Colizzi, M., et al., *Previous cannabis exposure modulates the acute effects of delta-9-tetrahydrocannabinol on attentional salience and fear processing*. *Experimental and clinical psychopharmacology*, 2018. **26**(6): p. 582.
45. Fried, P.A., B. Watkinson, and R. Gray, *Neurocognitive consequences of cigarette smoking in young adults-a comparison with pre-drug performance*. *Neurotoxicology and Teratology*, 2006. **28**(4): p. 517-525.
46. Hicks, R.E., et al., *Cannabis, atropine, and temporal information processing*. *Neuropsychobiology*, 1984. **12**(4): p. 229-237.
47. Miller, R.E., et al., *Impact of cannabis and low alcohol concentration on divided attention tasks during driving*. *Traffic Injury Prevention*, 2020. **21**(S1): p. S123-S129.
48. Block, R.I., R. Farinpour, and K. Braverman, *Acute effects of marijuana on cognition: Relationships to chronic effects and smoking techniques*. *Pharmacology, Biochemistry and Behavior*, 1992. **43**(3): p. 907-917.
49. Hartman, R.L., et al., *Cannabis effects on driving lateral control with and without alcohol*. *Drug and Alcohol Dependence*, 2015. **154**: p. 25-37.
50. Hartman, R.L., et al., *Effect of blood collection time on measured Δ 9-tetrahydrocannabinol concentrations: implications for driving interpretation and drug policy*. *Clinical chemistry*, 2016. **62**(2): p. 367-377.
51. Heishman, S.J., M.L. Stitzer, and J.E. Yingling, *Effects of tetrahydrocannabinol content on marijuana smoking behavior, subjective reports, and performance*. *Pharmacology, Biochemistry and Behavior*, 1989. **34**(1): p. 173-179.
52. Lunn, S., et al., *Human Pharmacokinetic Parameters of Orally Administered Δ 9-Tetrahydrocannabinol Capsules Are Altered by Fed Versus Fasted Conditions and Sex Differences*. *Cannabis and Cannabinoid Research*, 2019. **4**(4): p. 255-264.
53. Arkell, T.R., et al., *Effect of Cannabidiol and Delta(9)-Tetrahydrocannabinol on Driving Performance A Randomized Clinical Trial*. *JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION*, 2020. **324**(21): p. 2177-2186.
54. Müller-Vahl, K.R., et al., *Treatment of tourette syndrome with delta-9-tetrahydrocannabinol (Δ 9-THC): No influence on neuropsychological performance*. *Neuropsychopharmacology*, 2003. **28**(2): p. 384-388.
55. Matheson, J., et al., *Acute and residual mood and cognitive performance of young adults following smoked cannabis*. *Pharmacology Biochemistry and Behavior*, 2020. **194**.
56. Brands, B., et al., *Acute and residual effects of smoked cannabis: Impact on driving speed and lateral control, heart rate, and self-reported drug effects*. *Drug and alcohol dependence*, 2019. **205**: p. 107641.

57. Hartley, S., et al., *Effect of smoked cannabis on vigilance and accident risk using simulated driving in occasional and chronic users and the pharmacokinetic-pharmacodynamic relationship*. *Clinical Chemistry*, 2019. **65**(5): p. 684-693.
58. Schoedel, K.A., et al., *Abuse potential assessment of cannabidiol (CBD) in recreational polydrug users: a randomized, double-blind, controlled trial*. *Epilepsy & Behavior*, 2018. **88**: p. 162-171.
59. Ronen, A., et al., *Effects of THC on driving performance, physiological state and subjective feelings relative to alcohol*. *Accident Analysis & Prevention*, 2008. **40**(3): p. 926-934.
60. Ménétrey, A., et al., *Assessment of driving capability through the use of clinical and psychomotor tests in relation to blood cannabinoids levels following oral administration of 20 mg dronabinol or of a cannabis decoction made with 20 or 60 mg Δ 9-THC*. *Journal of analytical toxicology*, 2005. **29**(5): p. 327-338.
61. Nicholson, A.N., et al., *Effect of Δ -9-tetrahydrocannabinol and cannabidiol on nocturnal sleep and early-morning behavior in young adults*. *Journal of Clinical Psychopharmacology*, 2004. **24**(3): p. 305-313.
62. Curran, V.H., et al., *Cognitive and subjective dose-response effects of acute oral Δ 9-tetrahydrocannabinol (THC) in infrequent cannabis users*. *Psychopharmacology*, 2002. **164**(1): p. 61-70.
63. Fant, R.V., et al., *Acute and residual effects of marijuana in humans*. *Pharmacology Biochemistry and Behavior*, 1998. **60**(4): p. 777-784.
64. Chait, L.D. and J.L. Perry, *Acute and residual effects of alcohol and marijuana, alone and in combination, on mood and performance*. *Psychopharmacology*, 1994. **115**(3): p. 340-349.
65. Leirer, V.O., J.A. Yesavage, and D.G. Morrow, *Marijuana carry-over effects on aircraft pilot performance*. *Aviation Space and Environmental Medicine*, 1991. **62**(3): p. 221-227.
66. Chait, L.D., *Subjective and behavioral effects of marijuana the morning after smoking*. *Psychopharmacology*, 1990. **100**(3): p. 328-333.
67. Heishman, S.J., et al., *Acute and residual effects of marijuana: Profiles of plasma THC levels, physiological, subjective, and performance measures*. *Pharmacology Biochemistry and Behavior*, 1990. **37**(3): p. 561-565.
68. Leirer, V.O., J. Yesavage, and D.G. Morrow, *Marijuana, aging, and task difficulty effects on pilot performance*. *Aviation, space, and environmental medicine*, 1989. **60**(12): p. 1145-1152.
69. Barnett, G., V. Licko, and T. Thompson, *Behavioral pharmacokinetics of marijuana*. *Psychopharmacology*, 1985. **85**(1): p. 51-56.
70. Chait, L.D., M.W. Fischman, and C.R. Schuster, *'Hangover' effects the morning after marijuana smoking*. *Drug and Alcohol Dependence*, 1985. **15**(3): p. 229-238.
71. Yesavage, J.A., et al., *Carry-over effects of marijuana intoxication on aircraft pilot performance: A preliminary report*. *American Journal of Psychiatry*, 1985. **142**(11): p. 1325-1329.
72. Rafaelsen, O.J., et al., *Cannabis and alcohol: Effects on simulated car driving*. *Science*, 1973. **179**(4076): p. 920-923.