



Original Investigation

Choice and Variety-Seeking of E-liquids and Flavor Categories by New Zealand Smokers Using an Electronic Cigarette: A Longitudinal Study

Mei-Ling Blank MPH^{1,✉}, Janet Hoek PhD^{2,✉}

¹Department of Preventive and Social Medicine, University of Otago, Dunedin, New Zealand; ²Department of Public Health, University of Otago, Wellington, New Zealand

Corresponding Author: Mei-Ling Blank, Department of Preventive and Social Medicine, University of Otago, PO Box 56, Dunedin 9054, New Zealand. Tel: +64 3 470 3419; Fax: +64 3 479 7298; E-mail: meiling.blank@otago.ac.nz

Abstract

Background: Little is currently known about how e-liquid flavor use evolves among electronic cigarette users. We describe patterns of e-liquid and flavor category use, and variety-seeking, among New Zealand adult smokers attempting to transition from smoking to e-cigarettes.

Methods: Data were collected in 2018–19, using a longitudinal design comprising up to five in-depth interviews over a 12–20 week period. Participants ($n = 32$) were current smokers aged ≥ 18 years, who were not currently using an e-cigarette once a week or more often, and were willing to use an e-cigarette in an attempt to stop smoking. We purchased participants a starter e-cigarette of their choice; they supplied their own e-liquids throughout the study. We extracted e-liquid use data from the verbatim interview transcripts, categorized these into flavor categories, and then explored these data for the whole sample, and by flavor category purchased at intake.

Results: Most participants ($n = 12$) selected a tobacco flavored e-liquid at intake; fruit ($n = 7$), mint/menthol ($n = 6$), and dessert/sweets and non-alcoholic beverage (both $n = 5$) were also popular. Most participants were still using their initially chosen flavor category at study exit, however, many described variety-seeking behaviors, which typically occurred during the first 12 weeks of enrolment.

Conclusion: Most participants did not follow a straightforward e-liquid or flavor category pathway. Evidence of a variety-seeking continuum, typically occurring within the first 12 weeks, suggests possible opportunities at specialist e-cigarette stores to couple e-liquid purchasing occasions with cessation advice.

Implications: Variety-seeking behavior was common and typically reported within the first 12 weeks of participants' e-cigarette-assisted attempt to transition away from smoking. Policies allowing diverse e-liquid flavors at specialist stores only could support users' variety-seeking and potentially create opportunities to couple e-liquid purchasing occasions with cessation advice during the first months of a transition attempt.

Introduction

In many countries, e-liquids for electronic cigarettes are available in a bewildering array of flavors,¹ despite restrictions on “characterizing flavors” in combusted tobacco products.²⁻⁴ While uncertainties remain about whether flavors assist smokers to transition from smoking to e-cigarettes,⁵⁻¹⁰ several studies report e-cigarette users' preferences for non-tobacco flavors such as fruit, candy, and dessert,^{8,11-16} though a substantial minority, particularly smokers, prefer tobacco flavored liquids.^{6,8,11-16} Studies have also documented e-cigarettes' appeal to young people,^{8,13} with evidence that adolescents, young people, and non-smokers prefer non-tobacco flavors such as fruit, mint, and candy.^{12,16-20} These findings have led to calls for restrictions on diverse, non-tobacco flavors,²¹ and several countries are developing policies to address these concerns.

Legislation enacted in 2020 by the New Zealand (NZ) Parliament will restrict e-liquid flavors sold by “generic” (eg, convenience stores and service stations) and online-only e-cigarette retailers to tobacco, menthol, and mint.²² Specialist retailers (at least 70% of a specialist store's total sales to come from the sale of e-cigarette products; in special cases this threshold will be 60% of total sales) would be allowed to continue selling an unlimited number of flavors (excluding e-liquids deemed to contain “harmful constituents”).²²

Restricting e-liquid flavors is unpopular with e-cigarette advocates, who argue that flavor variety is essential for the transition from smoking.^{23,24} They suggest flavor use evolves as smokers wish to distance themselves from the physical experience of smoking and that flavor choices offer an additional reward that differentiates e-cigarette use from smoking.²⁵⁻²⁸ These assertions draw on consumer behavior theory that presents variety-seeking as a tendency “to seek diversity in...choices of services or goods” (p. 139).²⁹ Kahn suggests variety-seeking arises from three motivations: an intrinsic desire for variety; a response to external constraints (such as product discontinuations); or a desire to develop choice repertoires that ensure a preferred option remains available, should marketplace offerings change.²⁹ Of these motivations, advocates' arguments align most closely with the first, which suggests flavor satiation occurs rapidly and drives demand for different flavors. However, there has been little discussion or debate about how to define or measure variety-seeking among e-cigarette users, despite the apparent usefulness of this construct in understanding users' flavor choices.

Currently, little is known about the evolution of e-liquid flavor choices among smokers using an e-cigarette to try and stop smoking. A multinational online survey among visitors to an e-cigarette advocacy website who had been using an e-cigarette on average for 12 months found participants commonly reported using tobacco flavors at initiation but had switched to other flavors at the time of the survey, with fruit flavors more popular.⁵ An industry-funded study, using a convenience sample of participants recruited from e-cigarette advocacy organizations in the US, found that adult users who self-reported transitioning from exclusive smoking to exclusive e-cigarette use were more likely to have used non-tobacco flavors at initiation, or to have transitioned from tobacco to non-tobacco flavors.⁹ A cross-sectional study using a convenience sample of predominantly long-term e-cigarette users (mean duration of use 3.9 years) also described a similar shift from tobacco to non-tobacco flavors.³⁰ While tobacco was the most common flavor category at e-cigarette initiation, fruit, sweet, and food flavors were most popular at the time of the survey.

Given these varying findings, limited knowledge of flavor choice patterns over time, and on-going debates in many countries about

policies proposing flavor restrictions, we believe it is timely to explore flavor choice and variety-seeking among e-cigarette users. We aimed to describe patterns of e-liquid and flavor category choice, and variety-seeking, among NZ adult smokers attempting to move from smoking to e-cigarettes, over 12–20 weeks.

Methods

Overview of Smoking-to-Vaping Study Methods

Data were collected in Dunedin, New Zealand from May to December 2018 and March to September 2019 as part of the longitudinal mixed-methods Smoking-to-Vaping Study (S2V). Full details of the S2V study are described in the methods report.³¹ In brief, enrolled participants were at least 18 years old, smoked at least one cigarette per week, did not currently use an e-cigarette once a week or more often, were not currently trying to quit using any means (including nicotine replacement therapy and “cold turkey”), had never stopped smoking for 30 or more days with the aid of an e-cigarette, and were willing to embark on an e-cigarette-assisted attempt to stop smoking. Participants were purposively sampled to try and obtain a diverse sample in terms of age, gender, ethnicities, and cigarettes-per-day at baseline.

Participants attended up to five in-depth, in-person face-to-face interviews (intake, and approximately 2, 6, 12, and 18 weeks after intake) over approximately 18–20 weeks. During the intake session, participants selected an e-cigarette starter kit (up to NZ\$80 value purchased with research funds and gifted to the participant) from a collaborating retailer. They could sample various non-nicotine e-liquids in-store (approximately 39 individual e-liquid flavors, depending on the specific tester e-cigarettes available (ie, tester e-cigarettes were sufficiently charged) and e-liquid introductions and deletions over the study period) before purchasing the flavor(s) and nicotine concentration(s) of their choice. Shop staff often discussed flavor preferences with participants and suggested specific flavors to sample. Researchers recorded e-liquid names sampled and purchased by participants during this visit. During each follow-up interview, researchers asked open-ended questions about the e-liquid participants had used since their last visit (specific e-liquid names, or flavor descriptions when participants could not recall specific names).

Throughout the study, participants supplied their own e-liquid in the flavors and nicotine concentrations of their choice. Participants were free to purchase e-liquid from any physical or online retailer. Freebase nicotine e-liquids were available throughout the study period, while nicotine salt e-liquids were available from e-cigarette retailers from approximately August 2018. Participants were not specifically offered cessation support by the researchers, but were free to seek additional assistance if desired; they were reimbursed a maximum of NZ\$290 (in 2019; NZ\$260 in 2018) to recognize their participation in the study. Participants were considered lost to follow-up if they did not respond to at least two researcher-initiated contacts to reschedule missed interviews. Only participants who attended at least four interviews (over approximately 12 weeks) are included in this analysis ($n = 32$).

Classification of E-liquids Into Flavor Categories

We extracted proprietary e-liquid names (eg, “Caffiend,” “Sherbinator”) and verbatim flavor descriptions (eg, “melon,” “chocolate milkshake”) from each participant's transcripts. We compiled a list of all e-liquid names and flavor descriptions mentioned, and

searched online for manufacturers' flavor descriptions when specific e-liquid names were available; otherwise, we relied on participants' verbatim descriptions of their flavors. After searching the literature for existing schemes,^{5,8,9,11,13,14,18,32-35} we classified the names and descriptions into the following categories: tobacco, mint and menthol, alcoholic beverage, non-alcoholic beverage, candy, dessert/sweets, nuts/spices, fruit, and unflavored. See [Table 1](#) for category descriptions and specific examples from participants.

Where the e-liquid name or flavor description comprised multiple flavor categories (eg, fruit and dessert), we adapted the prioritization scheme described by Yingst³³ based on the e-liquid name and manufacturers' or participants' flavor description (see [Table 1](#) for the prioritisation order). We independently double-coded the list of e-liquid names and flavor descriptions with disagreements resolved through discussion. See [Supplementary File 1](#) for the prioritized classifications used in this study.

Variety-Seeking

We assessed the e-liquid and flavor category variety-seeking in several ways ([Table 2](#)). Between participants, we looked across all interviews (individually, and by subgroup according to flavor category purchased at intake: tobacco, and only non-tobacco flavors. We also explored interview-specific e-liquid and flavor category use. We used modes as the measure of central tendency; means were inappropriate given the data's skewed nature. Medians were also inappropriate as, by definition, 50% of participants would be classified as variety-seeking, regardless of the median value.

Across all interviews, we compared each participant's total number of unique e-liquid/ flavor descriptions (and flavor categories) to the sample's overall e-liquid (and flavor category) mode. We classified participants as "overall e-liquid variety-seeking" (or "overall flavor category variety-seeking") when their respective totals were above the sample's respective mode. When there was more than one modal value, we used the highest mode to classify participants. We also applied these classifications and definitions by subgroup, according to the e-liquid flavor category purchased at intake (tobacco, and only non-tobacco flavors).

For each interview, we followed a similar classification procedure and definitions, substituting interview-specific participant totals and sample modes ("interview-specific e-liquid variety-seeking," "interview-specific flavor category variety-seeking"). We also explored "within-person flavor category variety-seeking" by comparing

flavor categories reported at later interviews with categories reported at earlier interviews. Where applicable, we noted category changes at specific interviews.

Results

Forty-five participants attended an intake session; 32 completed at least four interviews over approximately 12 weeks and are included in the current analysis ($n = 29$ completed all five interviews over approximately 18–20 weeks). [Table 3](#) describes the included participants' characteristics. The sample ranged from 19–56 years, 18 were female, and nine self-identified as Māori (indigenous peoples of New Zealand). Cigarettes per day at baseline ranged from 1 to 44, with one participant also smoking dokha, a Middle Eastern tobacco product smoked in a midwakh pipe.³⁶ Before study intake, 20 had tried e-cigarettes (≥ 1 puff) at least once, including two who had unsuccessfully used a first generation e-cigarette in attempts to stop smoking. At their final interview, 13 reported smoking daily, and four reported social, or occasional, smoking only.

E-liquids and Flavor Categories

[Figure 1](#) shows the number of individual e-liquids or flavor descriptions, and flavor categories (color coded), purchased at intake and reported at each follow-up interview, by the participant. For example, "Bonnie" purchased a single e-liquid classified as a non-alcoholic beverage at her intake session. Approximately two weeks later, at her second interview, she reported using seven different e-liquids or verbatim flavor descriptions, which were classified into five flavor categories (non-alcoholic beverage, tobacco, candy, alcoholic beverage, dessert/sweets).

[Table 4](#) shows the modes, ranges, and the number of participants classified as variety-seeking for e-liquid use and flavor categories, reported for the overall sample ($n = 32$), and by subsample according to flavor category purchased at intake (tobacco, $n = 12$; only non-tobacco, $n = 20$); across all interviews, and for each interview.

[Supplementary File 2](#) lists the proprietary e-liquid names, and verbatim flavor descriptions, reported by each participant at each interview. For example, "Bonnie" (p. 3) purchased a proprietary "Cherry Cola" e-liquid at her intake session, and at her second interview reported using five proprietary e-liquids (Cherry Cola, Cream, Vanilla Bean, Shalin's Milk, Hasseltoff) and two liquids where she provided flavor descriptions only ("whisky" and "cigar").

Table 1. E-liquid flavor classification categories and prioritization order

Category name	Description	Examples of proprietary e-liquids and verbatim flavor descriptions reported by participants ^a
Tobacco	With or without characterizing flavors (eg, spices, rum)	Mild Black, "cigar"
Mint and menthol	Mint and menthol, without characterizing flavors	So Fresh So Clean, "mint"
Alcoholic beverage		"Kahlua and dark chocolate", "mojito"
Non-alcoholic beverage		Caffiend, "cola"
Candy	Sweet food items normally eaten with fingers/hands	Sour Patch, "marshmallow"
Dessert/sweets	Sweet food items normally eaten with utensils	Custard Cure, "marshmallow chocolate meringue"
Nuts/spices		Hazelmel
Fruit		Stoned Fruits, "apple papaya"
Unflavored	No added flavoring ingredients	Nude

^aQuote marks (" ") denote participants' verbatim flavor descriptions.

Table 2. Between-participant and within-participant variety-seeking definitions used in the study

Between-participant e-liquid/flavor description, and flavor category, variety-seeking		
<i>Across all interviews</i>	Analysis	Classified as variety-seeking if:
• Overall e-liquid variety-seeking	• Total number of unique e-liquids/flavor descriptions reported by participant across all interviews compared to the overall sample's e-liquid mode	• Participant's total number of e-liquids > overall sample's mode
• Overall flavor category variety-seeking	• Total number of flavor categories reported by participant across all interviews compared to the overall sample's flavor category mode	• Participant's total number of flavor categories > overall sample's mode
<i>Interview-specific</i>	Analysis	Classified as variety-seeking if:
• Interview-specific e-liquid variety-seeking	• Interview-specific number of unique e-liquids/flavor descriptions reported by participant compared to the overall sample's interview-specific e-liquid mode	• Participant's interview-specific number of e-liquids > overall sample's interview-specific mode
• Interview-specific flavor category variety-seeking	• Interview-specific number of flavor categories reported by participant compared to the overall sample's interview-specific flavor category mode	• Participant's interview-specific number of flavor categories > overall sample's interview-specific mode

All measures reported for the overall sample ($n = 32$), and subgroups according to e-liquid flavor category purchased at intake (tobacco, $n = 12$; only non-tobacco, $n = 20$).

Within-participant flavor category variety-seeking across all interviews

We compared flavor categories reported at later interviews with categories reported at earlier interviews. Where applicable, we noted changes in categories at specific interviews.

Over the study period, participants named or described 118 individual e-liquids and flavor descriptions; however, some descriptions may have referred to named proprietary e-liquids (eg, “lemoncake” may have referred to “Sansa's Lemoncake” e-liquid, or another unnamed e-liquid). In these cases, we itemized the supplied description as a separate e-liquid for coding purposes. We do not know the total number of e-liquids available for purchase during the study period as participants were free to purchase liquids from any physical or online retailer.

Figure 1 and Table 4 show that across interviews for the whole sample, participants reported using one to more than 20 different e-liquids or flavor descriptions (mode: 4; $n = 16$ participants classified as “overall e-liquid variety-seeking”), and 1–6 flavor categories (mode: 2; $n = 18$ classified as “overall flavor category variety-seeking”). The most commonly reported flavor categories were fruit (used by $n = 24$ participants over the study period) and tobacco ($n = 18$), followed by dessert/sweets ($n = 15$), mint/menthol ($n = 12$), candy ($n = 11$), and non-alcoholic beverages ($n = 10$). All other flavor categories had two or fewer participants reporting use over the study period.

Table 4 shows that, by interview for the overall sample, the number of participants classified as “interview-specific variety-seeking” increased after intake for both e-liquids and flavor categories. Participants who purchased only non-tobacco flavored e-liquids at intake ($n = 20$) drove these increases over time for both measures, especially from intake to interview 2 (approximately two weeks after intake), when the number of these participants classified as variety-seeking increased two to three fold. By contrast, the number of participants classified as variety-seeking among those who purchased a tobacco flavored e-liquid at intake remained reasonably steady over time for both measures.

Exploring “within-person flavor category variety-seeking” across interviews, the Figure shows that six participants reported no additional flavor categories at later interviews. Among the 26 participants reporting ≥ 1 category additional to those purchased at intake, 11 first reported a new category at interview 2, eight first reported at interview 3, seven at interview 4, and none at interview 5. Among these

26 participants, most reported a new category at only one or two interviews, and only one reported new categories at every follow-up interview.

Study Intake E-liquid Trial and Purchase ($n = 32$)

During each participants' intake session, approximately 39 individual e-liquid flavors were available to sample at the specialist e-cigarette retailer; however, the exact number may have varied slightly depending on the specific testers available, and e-liquid introductions and deletions over the study period.

During the shop visit (data not shown), participants sampled 0–13 individual e-liquids (modes: 4 and 5), and sampled 0–6 flavor categories (modes: 1 and 3). The most commonly sampled categories were tobacco ($n = 17$ participants), fruit ($n = 20$), dessert/sweets ($n = 15$), non-alcoholic beverages ($n = 10$), and mint/menthol ($n = 8$).

Participants purchased 1–3 e-liquids (mode: 1; $n = 10$ participants “intake-specific e-liquid variety-seeking”), and 1–3 flavor categories (mode: 1; $n = 7$ “intake-specific flavor category variety-seeking”). The most commonly purchased categories were tobacco ($n = 12$ participants), fruit ($n = 7$), mint/menthol ($n = 6$), and dessert/sweets and non-alcoholic beverages (both $n = 5$). Generally, participants reported continuing use of the flavor categories purchased at intake during their follow-up interviews, although the specific proprietary e-liquids and flavor descriptions within those categories often changed over time. Seven participants abandoned their initially purchased flavor category or categories by their last interview.

E-liquid Pathways Among Purchasers of Tobacco Flavored E-liquids at Intake ($n = 12$)

Of the 12 participants who bought a tobacco flavored e-liquid at intake, nine purchased only a tobacco flavor, while three also purchased an additional one or two non-tobacco flavor categories at intake. Across interviews, the total number of unique e-liquids/flavor descriptions ranged from 1–8 (mode: 2), with up to five reported at specific interviews. The total number of flavor categories ranged from 1–4 (mode: 2), with up to four reported at specific interviews.

Table 3. Characteristics of the participants included in the current analysis (n = 32)

Pseudonym	Gender	Age ^a	Highest completed education	Ethnicity	# Cigarettes/day reported at intake	Time to first cigarette at intake	E-cigarette experience before intake	Smoking reported at last interview
Clara	F	19	High school	Māori	42-44	≤5 min	No	Yes
Lily ^b	F	19	Certificate/diploma	NZE	14-15	6-30 min	No	Occasional only
Abigail	F	22	High school	NZE	1	>60 min	Yes	No
Louise ^b	F	23	High school	NZE	6	6-30 min	Yes	Yes
Amanda ^b	F	26	Bachelor's degree	Asian	4	>60 min	Yes	Yes
Charlotte ^b	F	27	No formal qualification	Māori, NZE	20	≤5 min	Yes	No
Andrea ^b	F	29	High school	Māori, NZE	22-27	≤5 min	Yes	Yes
Bonnie ^b	F	31	Bachelor's degree	NZE	7-9	≤5 min	Yes	Yes
Jasmine ^b	F	37	Bachelor's degree	NZE	22-23	≤5 min	Yes	Yes
Lottie ^b	F	38	No formal qualification	Māori	12-14	6-30 min	No	No
Helen ^b	F	44	High school	European	5-8	31-60 min	Yes	Yes
Evie ^b	F	45	High school	Māori	9-13	>60 min	No	No
Sonya ^b	F	47	High school	NZE	18-24	≤5 min	Yes	Yes
Ella ^b	F	50	Certificate/diploma	Māori, NZE	29	≤5 min	No	Social only
Lexie	F	51	Bachelor's degree	NZE	17-18	6-30 min	Yes, quit attempt	Yes
Eleanor	F	52	Certificate/diploma	NZE	14-15	≤5 min	Yes	No
Nancy	F	52	High school	NZE	10-11	>60 mins	Yes, quit attempt	No
Hannah ^b	F	55	Certificate/diploma	Māori, NZE	19-21	≤5 min	Yes	No
Oscar ^b	M	20	High school	Asian	3, plus 3 dokha bowls ^c	6-30 min	No	No
George ^b	M	20	High school	NZE	9-10	31-60 min	Yes	Yes
Noah ^b	M	24	High school	NZE	13	6-30 min	Yes	Yes
Ryan	M	26	Bachelor's degree	NZE	10-14	6-30 min	Yes	No
Teddy ^b	M	31	High school	Māori	12	≤5 min	Yes	No
Tyler	M	32	High school	NZE	18-24	≤5 min	Yes	Social only
Arthur ^b	M	36	Bachelor's degree	NZE	5	>60 min	Yes	Social only
Dylan	M	39	Certificate/diploma	NZE	24-28	6-30 min	No	No
Andrew ^b	M	40	Certificate/diploma	European	11-15	≤5 min	No	No
Michael ^b	M	48	High school	Māori	12-13	>60 min	Yes	No
Leo ^b	M	49	Post-graduate degree	European	14-17	>60 min	No	No
Blake	M	52	Certificate/diploma	European	22	6-30 min	No	Yes
Logan ^b	M	53	No formal qualification	NZE	34- >36	6-30 min	No	Yes
Mason	M	56	High school	NZE	11-12	≤5 min	No	No

NZE: New Zealand European; ^aBased on birth year and year of study enrolment; ^b2018 participant; ^cDokha is a Middle Eastern tobacco product smoked in a midwakh pipe.

	Purchased at intake session	Interview 2 (approx. week 2)	Interview 3 (approx. week 6)	Interview 4 (approx. week 12)	Interview 5 (approx. week 18)	Smoking reported at last interview	Total number of unique e-liquids	Total number of flavour categories
Hannah*	1	1	2	1	1	No	3	1
Leo*	1	1	1	1	1	No	2	1
Mason	1	1	1	1	1	No	1	1
Clara	1	1	1	1	2	Yes	2	2
Blake	1	1	1	1	1	Yes	2	2
Lexie	1	1	1	2	1	Yes	3	2
Andrew*	2	1	2	2	1	No	4	3
Sonya*	1	1	2	1	–	No interview	2	2
Noah*	1	2	3	3	1	Yes	5	2
Ryan	2	2	2	2	2	No	4	3
Eleanor	2	5	3	2	3	No	8	4
Amanda*	3	1	–	1	–	Yes	4	4
Jasmine*	1	–	–	–	1	Yes	2	1
Arthur*	1	3	1	>7	2	Social only	9	5
Dylan	1	>5	4	4	4	No	>6	4
Ella*	3	3	2	1	2	Social only	6	2
Helen*	2	2	2	3	–	No interview	4	3
Bonnie*	1	7	8	5	5	Yes	18	6
Tyler	1	3	3	3	1	Social only	4	3
Michael*	1	2	1	2	2	No	3	2
George*	3	3	>3	2	1	Yes	10–11	3
Andrea*	1	4	1	7	–	Yes	10	5
Oscar*	1	5	2	4	2	No	7	4
Charlotte*	2	6	6	7	3	No	17	4
Evie*	1	1	3	1	2	No	4	2
Lottie*	1	2	5	6	5	No	13	6
Louise*	1	2	2	2	2	Yes	3	1
Nancy	3	3	1	3	1	No	7	2
Lily*	1	2	>7	>4	2	Occasional	12	3
Teddy*	1	4	4	6	–	No interview	10	4
Abigail	1	4	>8	5	>7	No	>20	5
Logan*	3	2	2	1	1	Yes	5	3

*2018 participant

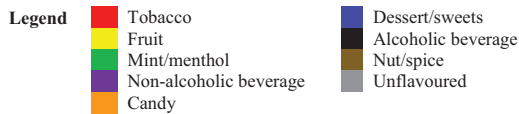


Figure 1. Individual proprietary e-liquids/verbatim flavor descriptions (number), and categorized flavor classifications (colors), reported by participants who attended at least four interviews, by initially purchased flavor category

Compared to the overall sample (Table 4), we classified 14 participants as “overall e-liquid variety-seeking,” and 14 as “overall flavor category variety-seeking.” The number of participants classified as interview-specific variety-seeking remained generally steady over time for both measures.

Eleven of these participants reported using tobacco flavors at interview 2, with eight using this category at all interviews (three used only tobacco flavors throughout the study). Across all interviews, nine participants reported additional flavor categories at least once; fruit ($n = 7$ participants) was the most popular additional category, followed by dessert/sweets ($n = 4$) and mint ($n = 3$). Three participants abandoned tobacco flavors by their final interview.

Six participants in this subsample reported smoking daily at their final interview.

E-liquid Pathways Among Purchasers of Only Non-Tobacco Flavored E-liquids at Intake ($n = 20$)

Among the 20 participants who purchased only non-tobacco flavored e-liquid at intake, fruit ($n = 6$ participants), non-alcoholic beverage ($n = 5$), mint/menthol ($n = 5$), dessert/sweets ($n = 4$), and candy ($n = 3$) flavors were all reported. Across interviews, the total number of unique e-liquids/flavor descriptions ranged from two to more than 20 (mode: 4), with up to “more than eight” reported at

specific interviews. The total number of flavor categories ranged from 1–6 (mode: 3), with up to five reported at specific interviews. Compared to the overall sample (Table 4), we classified 14 participants as “overall e-liquid variety-seeking,” and 14 as “overall flavor category variety-seeking.” The number of participants classified as interview-specific variety-seeking increased substantially (a three-fold increase) from intake to interview two, and remained relatively high at later interviews.

Flavor category use was heterogeneous among this group. However, most participants ($n = 13$) continued using the flavor category purchased at intake at all interviews. Six participants reported using a tobacco flavor at least once after intake, however, only two used this category at every subsequent interview. Only one person reported using only one (non-tobacco) flavor category at every interview.

Seven participants in this subsample reported smoking daily at their final interview, with four smoking socially, or occasionally, only.

Discussion

Among the 32 participants analyzed, tobacco flavored e-liquids were the most commonly purchased individual flavor category at intake. Most participants who selected these e-liquids still used this category at their last interview, either alone or alternating with other,

Table 4. Unique proprietary e-liquid/verbatim flavor descriptions and flavor category modes, ranges and number of participants classified as variety-seeking, across all interviews, and by interview, for the overall sample (n = 32), and subgroups according to e-liquid flavor category purchased at intake (tobacco n = 12; only non-tobacco n = 20)

Interview	By flavor category purchased at intake					
	Tobacco (n = 12)			Only non-tobacco (n = 20)		
	Overall sample's (n = 32), mode (range)	# Variety-seeking ^a participants	Mode (range)	# Variety-seeking ^a participants	Mode (range)	# Variety-seeking ^a participants
<i>Unique proprietary e-liquids/flavor descriptions</i>						
All interviews	4 (1-“> 20” ^b)	16	2 (1-8)	2	4 (2-“> 20”)	14
Intake	1 (1-3)	10	1 (1-3)	4	1 (1-3)	6
#2 (approx. week 2)	1 (0-7)	21	1 (1-5)	3	2 (0-7)	18
#3 (approx. week 6)	1 & 2 (0-“>8”)	12	1 (0-3)	2	2 (0-“> 8”)	10
#4 (approx. week 12)	1 (0-“> 7”)	21	1 (1-3)	5	1, 2, 3 (0-“> 7”)	16
#5 (approx. week 18) [†]	1 (0-“> 7”)	15 (n = 29)	1 (0-3)	3 (n = 11)	2 (0-“> 7”)	12 (n = 18)
<i>Flavor categories</i>						
All interviews	2 (1-6)	18	2 (1-4)	4	3 (1-6)	14
Intake	1 (1-3)	7	1 (1-3)	3	1 (1-2)	4
#2 (approx. week 2)	1 (0-5)	15	1 (1-4)	3	1 (0-5)	12
#3 (approx. week 6)	1 (0-4)	18	1 (0-3)	5	1 & 2 (0-4)	13
#4 (approx. week 12)	1 (0-4)	19	1 (1-2)	4	3 (0-4)	15
#5 (approx. week 18) [‡]	1 (0-4)	11 (n = 29)	1 (0-3)	3 (n = 11)	1 (0-4)	8 (n = 18)

^aNumber of participants reporting greater than the overall sample's (highest) mode; ^bQuote marks (“ ”) denote when participants were unable to specify an exact number; [†]n = 3 participants lost to follow up before interview 5.

non-tobacco, flavor categories. Other flavors commonly chosen at intake were fruit, mint/menthol, dessert/sweets, and non-alcoholic beverages. Among participants who chose only non-tobacco flavored e-liquids at intake, a minority also used tobacco flavored e-liquids after their intake sessions, usually reporting use at only one or two interviews before reverting to the sole use of non-tobacco flavor categories. Regardless of the flavor category chosen at intake, most participants were still using this category at study exit, although the specific e-liquids and flavor descriptions reported within those categories often changed over time. By subgroup according to flavor categories chosen at intake, participants who chose only non-tobacco flavored e-liquids were classified as “variety-seeking” more often than those who chose tobacco flavored liquids. Very few participants used only a single flavor category across all interviews; those who did often selected a tobacco flavor at intake. Our within-person findings suggest a variety-seeking continuum.

Few published studies explore e-liquid flavor use over time, and this analysis is the first to our knowledge to follow smokers from the beginning of an attempt to transition from smoking to e-cigarette use. Our study is also the first to use an intensive follow-up design, where assessments were separated by weeks rather than years. The findings mirror a study by Du et al. using two waves of data collected online across several years (2012–2014 and 2017–2019).¹⁰ This study used a sample of existing e-cigarette users (84% were exclusive users at baseline; 21% study retention) and found tobacco, menthol, and mint flavors were the most commonly preferred flavors at baseline, while chocolate, candy, and other sweets were most preferred at follow-up. The authors also reported consistent proportions of participants preferred menthol, mint, fruit, non-alcoholic beverages, clove/spice, and alcoholic beverage flavors; a large decline in the proportion preferring tobacco; and a large increase in the proportion preferring chocolate, candy, and other sweets, or “all other flavors.” A substantial minority preferred the same flavor category at follow-up as at baseline. While these results suggest some movement from tobacco flavors to non-tobacco flavors, most participants were exclusive e-cigarette users at baseline, thus the study provides limited insights into flavor choices among smokers at the beginning of a transition to e-cigarettes.

A longitudinal study of young adults also analyzed two waves of data but did not explicitly collect information on the use of tobacco flavored e-liquids (inferring use of this category based on responses to other questions).³⁷ This study found the proportion of participants at wave two reporting non-tobacco and non-menthol flavored e-liquids was higher for both those who did not report past-month e-cigarette use at wave one and those who were past-month smokers at wave one.

While tentative, these early findings suggest more nuanced e-liquid flavor pathways than those espoused by e-cigarette advocates, who have argued that people using an e-cigarette to switch from smoking start with tobacco flavored e-liquids and diversify from there.^{23–28} Like Du et al.¹⁰ we found evidence of flavor diversification; nonetheless, a substantial minority of our participants preferred tobacco flavors throughout the study period.

Advocates' arguments assume that intrinsically-motivated variety-seeking remains constant over time,²⁹ hence smokers should have access to a wide variety of e-liquid flavors to motivate uptake and continued use. However, our findings suggest flavor use among e-cigarette users exists on a variety-seeking continuum, with few participants at either extreme (ie, only one e-liquid or flavor category ever reported vs. new e-liquids and flavor categories reported at every

interview) and most describing variety-seeking choices between approximately 2 and 12 weeks after commencing e-cigarette use.

Our findings suggest policies allowing diverse flavors at specialist stores only would support the variety-seeking we observed. This policy could also create opportunities to couple e-liquid purchasing occasions with cessation advice during the important first months of a transition attempt, including the possible need for experimentation to identify appealing flavors, and satisfying nicotine levels and device settings. Earlier work has documented the role specialist e-cigarette retailers may play in assisting smokers,^{38,39} and providing peer-based (ie, salesperson) point-of-sale behavioral support during the first few months of an e-cigarette-assisted transition attempt could increase the odds of transition.

Our study has several limitations and some strengths. The analysis was restricted to participants who completed at least four interviews, meaning 13 of the 45 enrolled participants (29%) were lost to follow-up before this milestone. Aside from the recording of e-liquid flavors during the initial shop visit, all data were self-reported and, although participants were asked to bring their current e-liquids to interviews, many did not. We thus could not conduct any validity checking of participants' e-liquid use and did not use biochemical verification of their self-reported smoking status. We often relied on participants' verbatim descriptions of flavors, which might not be accurate characterizations, though, conversely, reflect what participants thought they were tasting. Our study design makes it difficult to know if participants reported all e-liquids or flavors used, with a few expressly unable to recall all flavors tried. Recommendations from shop staff may have influenced participants' flavor choices if they chose to buy e-liquid from a physical retailer. However, such interactions are indicative of real life decision making processes many e-cigarette users will encounter. While participants were able to sample from approximately 39 different e-liquid flavors during their initial shop visit, the sample flavors were predominately fruit and dessert/sweets, which may have influenced participants' choices. However, all flavor categories used in this analysis were available for in-shop sampling during the initial shop visit. During follow-up interviews, we probed why participants had selected specific flavors and how they made these choices; however, participants' self-awareness and insight varied. We therefore lack systematically reported information on how social (eg, peer and family) and marketing factors (eg, discounts, promotions, advertising) influenced flavor choices. Finally, the findings arising from a secondary analysis of interview transcripts from the "parent" Smoking-to-Vaping study, which was designed primarily as an in-depth qualitative exploration of smoking-to-vaping transitions.³¹ Thus, theoretical saturation, rather than statistical power, drove the study's sample size considerations, and the small sample means we lack sufficient power to conduct inferential analyses, such as formal assessment of participants' baseline characteristics and their association with the findings. The small sample size also means we are unable to assess associations of flavor choices and smoking status at study exit, although we note that a recent study reported current use of tobacco or menthol flavors may be associated with dual use.⁴⁰

Despite these limitations, we believe our study makes two important contributions. The intensive longitudinal approach provided a novel opportunity to explore patterns with much more granularity than other published studies, which typically are cross-sectional in design, or assess e-liquid flavor use at only two, widely separated, periods. To the best of our knowledge, our study is the first to propose an empirical definition of variety-seeking.

We hope that this data-derived definition will stimulate discussion, debate, and further research, and lead to robust measures of this important construct.

While our study does not allow us to draw conclusions about flavor use and smoking outcomes, future research with much larger sample sizes could explore associations between flavor choices and cessation outcomes. Qualitative studies using Kahn's variety-seeking framework could also explore motivations for flavor use and whether variety-seeking reflects an on-going search for satiation or indicates satisficing.²⁹ Knowledge from studies such as these could clarify the role flavor variety plays in transitions from smoking to e-cigarette use and identify the groups for which variety is important. For policymakers operating in the absence of such evidence, our findings support a nuanced regulatory approach that recognizes variety-seeking while mitigating the effects widely available diverse flavors have on e-cigarette appeal among young people and non-smokers.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

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Declaration of Interests

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Ethical approval

University of Otago Human Ethics Committee (Health) (HECH 18/014).

Māori consultation

University of Otago Ngāi Tahu Research Consultation Committee.

Author Contributions

MB and JH conceptualised this project. MB led the analysis, data interpretation and drafting of the manuscript. JH reviewed data interpretation and provided critical feedback on the manuscript. MB is the guarantor.

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