

A longitudinal study of risk perceptions and e-cigarette initiation among college students: Interactions with smoking status

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E-cigarette Use in Young Adults

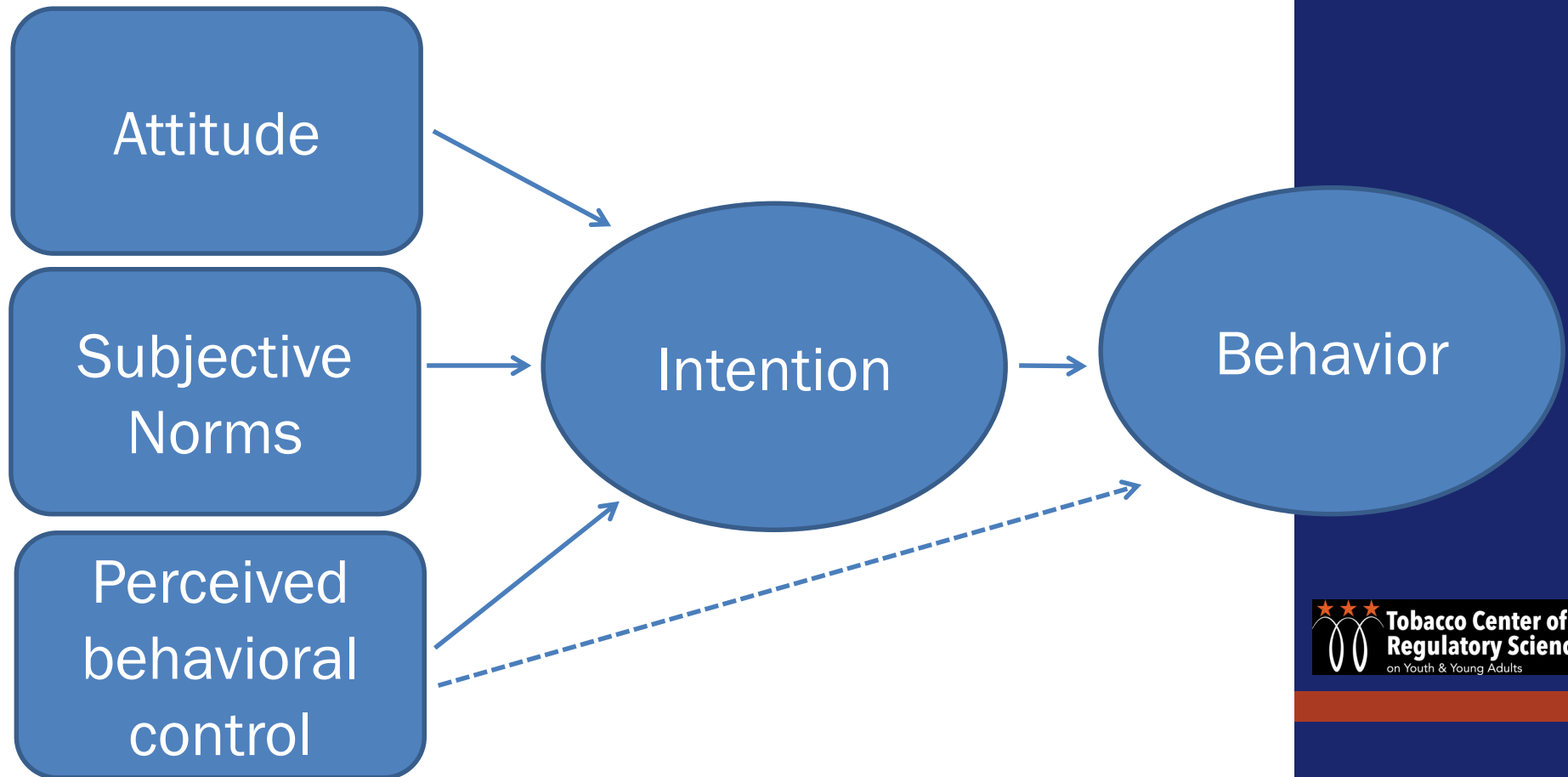
E-cigarette use is rapidly climbing, especially among young adults. In 2013-2014, those aged 18-24 made up $\frac{1}{4}$ of adult e-cigarette users

Risk for young adults: increased susceptibility to nicotine addiction; exposure to e-cigarette aerosol; increased likelihood of transitioning to combustible tobacco products

The perception of e-cigarettes as less harmful than conventional cigarettes has been found to be particularly prevalent among young adults

Perceptions of Risk and Addictiveness of E-cigarettes Among College Students

Theory of Planned Behavior



Perceptions of Harm and Addictiveness of E-cigarettes Among College Students

Estimated risks are related to substance use, including cigarette use (Murphy-Hoefer et al., 2004) and e-cigarette use in young adults (Choi & Forster 2014; Sutfin et al., 2013)

In rankings of harmfulness of the full spectrum of tobacco products, e-cigarettes are consistently found to be rated as least harmful among young adults (Berg et al. 2014; Wackowski et al. 2015)

Little research on perceived addictiveness of e-cigarettes in young adults

Perceptions of Harm and Addictiveness of E-cigarettes Among College Students

The temporality of this relationship is not well-understood

Current evidence reveals contrary findings

Berg et al. (2015): Lower perceived harm at baseline did not predict subsequent use of alternative tobacco products among young adults

Choi and Forster (2014): Lower harm perceptions of e-cigarettes relative to cigarettes predicted e-cigarette use at one-year follow up, but beliefs that e-cigarettes were less addictive than cigarettes did not among young adults

Cigarette Smoking as a Moderator?

Most studies examining the association between risk perceptions and e-cigarette use considers conventional cigarette use as a confounder in the relationship, few have considered cigarette smoking as a moderator

One exception is the study by Choi and Forster (2014): harm perceptions assessed in 2010/2011 influenced subsequent e-cigarette use in 2011/2012 equally among young adult smokers and non-smokers

Study Aims

The degree to which the relationship between risk perceptions and subsequent e-cigarette use varies by smoking status warrants additional exploration

Young adults who currently smoke cigarettes may not evaluate the risks associated with e-cigarettes in the same way as those who do not

Research question: do perceptions of 1) harmfulness of e-cigarettes to health, and 2) addictiveness of e-cigarettes, predict future e-cigarette use up to two years later in a longitudinal study of tobacco use on college campuses? We test whether these relationships vary by current cigarette smoking status.

Methods

Study Design

This study consists of a longitudinal analysis of data collected from waves 1 – 5 from the “Marketing and Promotions across Colleges in Texas project (Project M-PACT).

Restricted to students ages 18-25 who had complete data on at least one follow up wave and had never used e-cigarettes at baseline (n=2,565)

Retention rates were 89.3% at wave 2 (n=2,290), 88.2% at wave 3 (n=2,263), 90.9% at wave 4 (n=2,332), and 88.0% at wave 5 (n=2,258).

Methods

Time-to-Event Analysis

Time of first e-cigarette use (asked at each wave) was the event of interest

Multilevel discrete-time hazard models (Singer & Willett 2003)

- Models contained four discrete time periods, which were the four six month periods in between the five survey assessments
- The model was fit to a person-period data set that contained a dummy variable for each of the four six month periods (e.g., between wave 1 to wave 2) and did not contain an intercept.

Methods

Time-to-Event Analysis: Covariates

Risk perceptions: The question asks “How harmful are ENDS to health?” Response options range from “not at all harmful” to “extremely harmful.” -- Lagged 1 time period

Perceived addictiveness: The question asks, “How addictive are ENDS products?” Response options range from “not at all addictive” to “very addictive.” -- Lagged 1 time period

Models also controlled for: race/ethnicity, sex, type of college, age, current use of cigarettes, current use of other tobacco products, and other substance use; respondents were nested within college

Two way interactions were calculated as the product between each perception variable and current smoking (0=no / 1=yes)

	All participants (n=2,565)	Never E-cigarette Users (n=2,047)	E-cigarette Initiators (n=518)
Age Mean (95% CI)	20.04 (19.97 - 20.11)	20.0 (19.92 - 20.07)	20.23* (20.05 - 20.40)
Sex % female (95% CI)	66.43% (64.58% - 68.24%)	67.66% (65.60% - 69.65%)	61.58%** (57.31% - 65.68%)
Race % (95% CI)			
Non-Hispanic White	33.88% (32.07% - 35.74%)	34.59% (32.56% - 36.68%)	31.08% (27.24% - 35.21%)
Hispanic/Latino	27.88% (26.17% - 29.64%)	26.48% (24.61% - 28.43%)	33.40%** (29.46% - 37.58%)
African American	8.50% (7.48% - 9.64%)	8.70% (7.55% - 10.00%)	7.72% (5.71% - 10.36%)
Asian	22.34% (20.77% - 23.99%)	22.96% (21.19% - 24.83%)	19.88% (16.66% - 23.55%)
Other	7.41% (6.45% - 8.49%)	7.28% (6.23% - 8.49%)	7.92% (5.88% - 10.58%)
School Level % 4-year (95% CI)	93.45% (92.42% - 94.35%)	93.45% (92.30% - 94.45%)	93.44% (90.95% - 95.28%)
Perceived Harmfulness to Health of E-cigarettes ^a Mean (95% CI)	2.84 (2.80 - 2.87)	2.86 (2.82 - 2.90)	2.75* (2.68 - 2.83)
Perceived Addictiveness of E-cigarettes ^b Mean (95% CI)	2.26 (2.23 - 2.28)	2.28 (2.26 - 2.31)	2.16*** (2.10 - 2.21)
Current Cigarette Use % yes (95% CI)	5.11% (4.32% - 6.03%)	2.49% (1.90% - 3.26%)	15.44%*** (12.58% - 18.82%)
Other Tobacco Product Use ^c % yes (95% CI)			
1 product	5.96% (5.11% - 6.95%)	3.86% (3.11% - 4.79%)	14.29%*** (11.52% - 17.58%)
2+ products	1.29% (0.92% - 1.80%)	0.59% (0.33% - 0.01%)	4.05*** (2.66% - 6.14%)
Other Substance Use ^d % yes (95% CI)			
1 substance	16.49% (15.10% - 17.98%)	12.46% (11.09% - 13.96%)	32.43%*** (28.53% - 36.59%)
2 substances	3.51% (2.86% - 4.30%)	2.10% (1.56% - 2.82%)	9.07%*** (6.88% - 11.87%)

Results

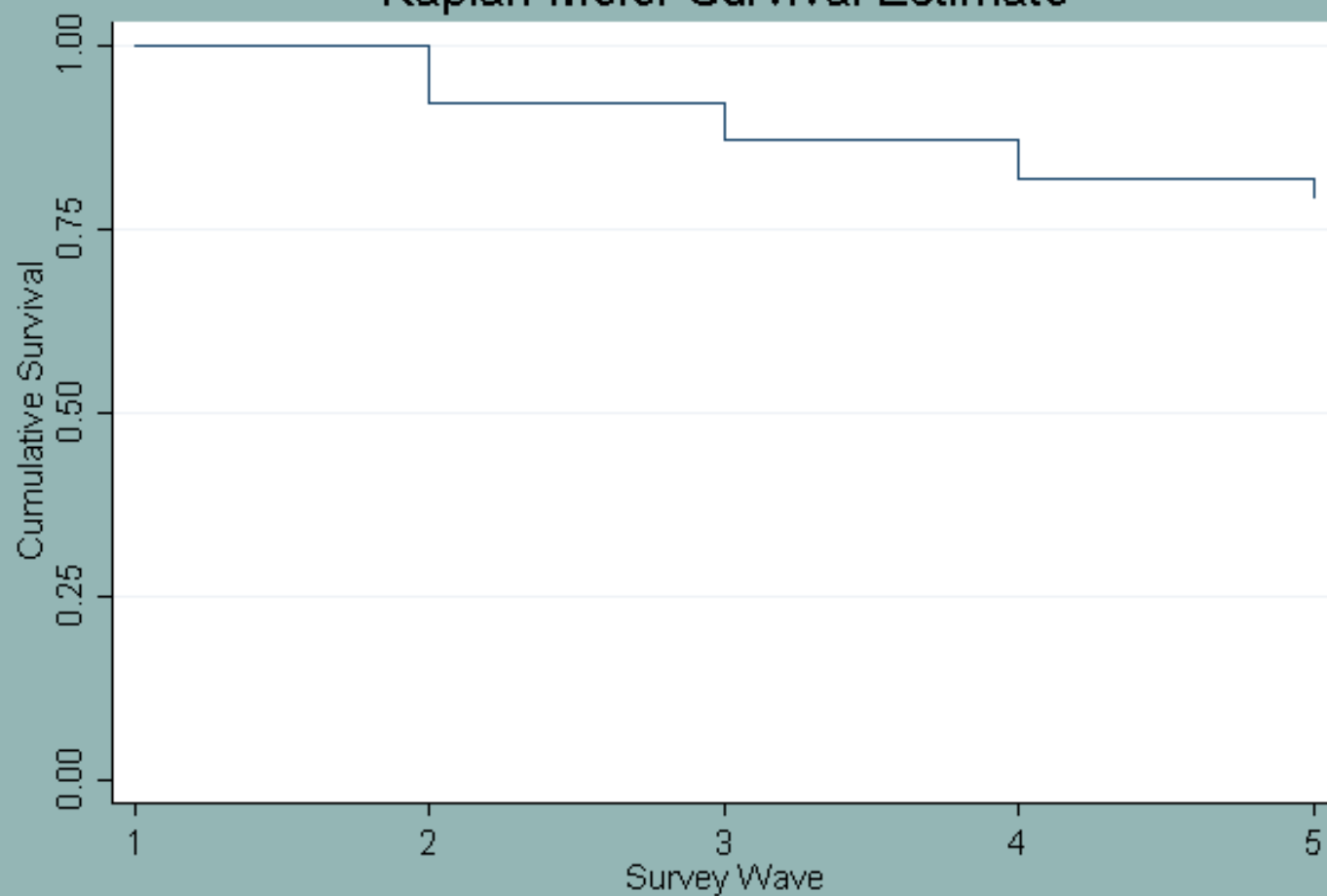
Life Table

By wave 5, 518 of the 2,565 (21%) young adults initiated e-cigarette use

Estimated hazards were calculated for each time interval

Interval Time	Beginning Total	Number of E-cigarette Users	Survival (95% CI)	Cumulative Failure (95% CI)	Hazard (95% CI)
Wave 1 – Wave 2	2565	197	0.92 (0.91 - 0.93)	0.08 (0.07 - 0.09)	0.08 (0.07 - 0.09)
Wave 2 – Wave 3	2298	130	0.87 (0.86 - 0.88)	0.13 (0.12 - 0.14)	0.06 (0.05 - 0.07)
Wave 3 – Wave 4	2112	129	0.82 (0.80 - 0.83)	0.18 (0.17 - 0.20)	0.06 (0.05 - 0.07)
Wave 4 – Wave 5	1858	62	0.79 (0.77 - 0.81)	0.21 (0.12 - 0.23)	0.03 (0.03 - 0.04)

Kaplan-Meier Survival Estimate



79% of students
remained never
users of e-cigs
over 2 years

Results – Hazard Models (*Perceived Harm*)

	Perceived Harm		Perceived Harm with Interaction	
Covariate	Parameter Estimate	Odds Ratio (95% CI)	Parameter Estimate	Odds Ratio (95% CI)
Period 1	-3.54	0.03*** (0.01 - 0.10)	-3.68	0.03*** (0.01 - 0.09)
Period 2	-3.85	0.02*** (0.01 - 0.08)	-4.00	0.02*** (0.01 - 0.07)
Period 3	-3.78	0.02*** (0.01 - 0.08)	-3.93	0.02*** (0.01 - 0.07)
Period 4	-4.52	0.01*** (0.00 - 0.04)	-4.67	0.01*** (0.00 - 0.04)
Perceived harm (T-1)	0.06	1.06 (0.95 - 1.18)	.12	1.13* (1.00 - 1.27)
Current Cigarette Use x Perceived harm (T-1)	--	--	-0.37	0.69* (0.51 - 0.92)
Age	0.02	1.02 (0.97 - 1.08)	0.02	1.02 (0.97 - 1.08)
Sex	-0.12	0.89 (0.73 - 1.09)	-0.11	0.89 (0.73 - 1.09)
Race/ethnicity				
Non-Hispanic White (ref)	--	1.00	--	1.00
Hispanic/Latino	0.34	1.41** (1.10 - 1.79)	0.34	1.40** (1.10 - 1.79)
African-American	0.03	1.03 (0.69 - 1.53)	0.04	1.04 (0.70 - 1.55)
Asian	0.08	1.08 (0.82 - 1.42)	0.10	1.10 (0.84 - 1.45)
Other	0.31	1.36 (0.94 - 1.97)	0.32	1.38 (0.95 - 2.00)
School level	-0.05	.95 (0.64 - 1.42)	-0.06	0.95 (0.63 - 1.41)
Current Cigarette Use	1.05	2.84*** (2.09 - 3.86)	1.85	6.39*** (3.21 - 12.73)
Other Tobacco				
None (ref)	--	1.00	--	1.00
1 product	1.08	2.93*** (2.21 - 3.89)	1.09	2.98*** (2.25 - 3.96)
2+ products	1.30	3.69*** (2.12 - 6.44)	1.40	4.04*** (2.31 - 7.05)
Other Substances				
None (ref)	--	1.00	--	1.00
1 substance	0.92	2.53*** (2.03 - 3.15)	0.93	2.53*** (2.03 - 3.15)
2 substances	1.21	3.35*** (2.38 - 4.73)	1.21	3.35*** (2.37 - 4.71)

Results – Hazard Models (*Perceived Harm*)

	Perceived Harm		Perceived Harm with Interaction	
Covariate	Parameter Estimate	Odds Ratio (95% CI)	Parameter Estimate	Odds Ratio (95% CI)
Period 1	-3.54	0.03*** (0.01 - 0.10)	-3.68	0.03*** (0.01 - 0.09)
Period 2	-3.85	0.02*** (0.01 - 0.08)	-4.00	0.02*** (0.01 - 0.07)
Period 3	-3.78	0.02*** (0.01 - 0.08)	-3.93	0.02*** (0.01 - 0.07)
Period 4	-4.52	0.01*** (0.00 - 0.04)	-4.67	0.01*** (0.00 - 0.04)
Perceived harm (T-1)	0.06	1.06 (0.95 - 1.18)	.12	1.13* (1.00 - 1.27)
Current Cigarette Use x Perceived harm (T-1)	--	--	-0.37	0.69* (0.51 - 0.92)
Age	0.02	1.02 (0.97 - 1.08)	0.02	1.02 (0.97 - 1.08)
Sex	-0.12	0.89 (0.73 - 1.09)	-0.11	0.89 (0.73 - 1.09)
Race/ethnicity				
Non-Hispanic White (ref)	--	1.00	--	1.00
Hispanic/Latino	0.34	1.41** (1.10 - 1.79)	0.34	1.40** (1.10 - 1.79)
African-American	0.03	1.03 (0.69 - 1.53)	0.04	1.04 (0.70 - 1.55)
Asian	0.08	1.08 (0.82 - 1.42)	0.10	1.10 (0.84 - 1.45)
Other	0.31	1.36 (0.94 - 1.97)	0.32	1.38 (0.95 - 2.00)
School level	-0.05	.95 (0.64 - 1.42)	-0.06	0.95 (0.63 - 1.41)
Current Cigarette Use	1.05	2.84*** (2.09 - 3.86)	1.85	6.39*** (3.21 - 12.73)
Other Tobacco				
None (ref)	--	1.00	--	1.00
1 product	1.08	2.93*** (2.21 - 3.89)	1.09	2.98*** (2.25 - 3.96)
2+ products	1.30	3.69*** (2.12 - 6.44)	1.40	4.04*** (2.31 - 7.05)
Other Substances				
None (ref)	--	1.00	--	1.00
1 substance	0.92	2.53*** (2.03 - 3.15)	0.93	2.53*** (2.03 - 3.15)
2 substances	1.21	3.35*** (2.38 - 4.73)	1.21	3.35*** (2.37 - 4.71)

Results – Hazard Models (*Perceived Addictiveness*)

	Perceived Addictiveness		Perceived Addictiveness with Interaction	
Covariate	Parameter Estimate	Odds Ratio (95% CI)	Parameter Estimate	Odds Ratio (95% CI)
Period 1	-3.81	0.02*** (0.01 - 0.08)	-3.89	0.02*** (0.01 - 0.07)
Period 2	-4.12	0.02*** (0.00 - 0.06)	-4.21	0.01*** (0.00 - 0.05)
Period 3	-4.05	0.02*** (0.00 - 0.06)	-4.13	0.02*** (0.00 - 0.06)
Period 4	-4.79	0.01*** (0.00 - 0.03)	-4.87	0.01*** (0.00 - 0.03)
Perceived addictiveness (T-1)	0.23	1.26** (1.08 - 1.46)	0.30	1.34*** (1.14 - 1.58)
Current Cigarette Use x Perceived Addictiveness (T-1)	--	--	-0.41	0.67* (0.45 - 0.99)
Age	0.02	1.02 (0.97 - 1.08)	0.02	1.02 (0.97 - 1.08)
Sex	-0.12	0.89 (0.73 - 1.08)	-0.13	0.88 (0.72 - 1.07)
Race/ethnicity				
Non-Hispanic White (ref)	--	1.00	--	1.00
Hispanic/Latino	0.31	1.36 (1.07 - 1.74)	0.31	1.36* (1.07 - 1.73)
African-American	0.00	1.00 (0.67 - 1.49)	0.00	1.00 (0.67 - 1.49)
Asian	0.05	1.05 (0.80 - 1.39)	0.05	1.05 (0.80 - 1.39)
Other	0.30	1.35 (0.93 - 1.95)	0.30	1.36 (0.93 - 1.97)
School level	-0.06	0.95 (0.63 - 1.41)	-0.07	0.94 (0.63 - 1.40)
Current Cigarette Use	1.03	2.80*** (2.06 - 3.80)	1.79	5.99*** (2.70 - 13.26)
Other Tobacco	.			
None (ref)	--	1.00	--	1.00
1 product	1.07	2.92*** (2.20 - 3.87)	1.06	2.90*** (2.18 - 3.84)
2+ products	1.30	3.65*** (2.09 - 6.38)	1.33	3.80*** (2.18 - 6.61)
Other Substances				
None (ref)	--	1.00	--	1.00
1 substance	0.91	2.49*** (2.00 - 3.11)	0.91	2.50*** (2.00 - 3.11)
2 substances	1.19	3.27*** (2.32 - 4.61)	1.19	3.31*** (2.35 - 4.66)

Results – Hazard Models (*Perceived Addictiveness*)

	Perceived Addictiveness		Perceived Addictiveness with Interaction	
Covariate	Parameter Estimate	Odds Ratio (95% CI)	Parameter Estimate	Odds Ratio (95% CI)
Period 1	-3.81	0.02*** (0.01 - 0.08)	-3.89	0.02*** (0.01 - 0.07)
Period 2	-4.12	0.02*** (0.00 - 0.06)	-4.21	0.01*** (0.00 - 0.05)
Period 3	-4.05	0.02*** (0.00 - 0.06)	-4.13	0.02*** (0.00 - 0.06)
Period 4	-4.79	0.01*** (0.00 - 0.03)	-4.87	0.01*** (0.00 - 0.03)
Perceived addictiveness (T-1)	0.23	1.26** (1.08 - 1.46)	0.30	1.34*** (1.14 - 1.58)
Current Cigarette Use x Perceived Addictiveness (T-1)	–	–	-0.41	0.67* (0.45 - 0.99)
Age	0.02	1.02 (0.97 - 1.08)	0.02	1.02 (0.97 - 1.08)
Sex	-0.12	0.89 (0.73 - 1.08)	-0.13	0.88 (0.72 - 1.07)
Race/ethnicity				
Non-Hispanic White (ref)	–	1.00	–	1.00
Hispanic/Latino	0.31	1.36 (1.07 - 1.74)	0.31	1.36* (1.07 - 1.73)
African-American	0.00	1.00 (0.67 - 1.49)	0.00	1.00 (0.67 - 1.49)
Asian	0.05	1.05 (0.80 - 1.39)	0.05	1.05 (0.80 - 1.39)
Other	0.30	1.35 (0.93 - 1.95)	0.30	1.36 (0.93 - 1.97)
School level	-0.06	0.95 (0.63 - 1.41)	-0.07	0.94 (0.63 - 1.40)
Current Cigarette Use	1.03	2.80*** (2.06 - 3.80)	1.79	5.99*** (2.70 - 13.26)
Other Tobacco	.			
None (ref)	–	1.00	–	1.00
1 product	1.07	2.92*** (2.20 - 3.87)	1.06	2.90*** (2.18 - 3.84)
2+ products	1.30	3.65*** (2.09 - 6.38)	1.33	3.80*** (2.18 - 6.61)
Other Substances				
None (ref)	–	1.00	–	1.00
1 substance	0.91	2.49*** (2.00 - 3.11)	0.91	2.50*** (2.00 - 3.11)
2 substances	1.19	3.27*** (2.32 - 4.61)	1.19	3.31*** (2.35 - 4.66)

Discussion

After testing interactions with current smoking status, significant moderating effects were found for both perceived harmfulness to health and perceived addictiveness.

Lower perceptions on both variables predicted e-cigarette initiation among non-smoking college students, but not among current smokers

Potential explanations for the differential findings include 1) the role of nicotine dependence and 2) the use of e-cigarettes for smoking cessation

Discussion

The Role of Nicotine Dependence:

- Current smokers likely already exhibit symptoms of nicotine dependence
- Outweigh other risk factors in the initiation of other nicotine products

E-cigarettes for Cessation:

- Camenga et al. (2016): Harm perceptions of e-cigarettes (e.g. “e-cigarettes are harmful to health”) were not associated with using e-cigarettes as cessation devices

Discussion

Current study differs from previous longitudinal research

- Measures perceptions on an absolute scale, rather than comparing them to conventional cigarettes
- The significant interaction could be the result of larger sample size/power to detect an effect

Implications for E-cigarette Regulation and Prevention

Until recently, e-cigarettes were not regulated by the federal government

- Research supports the need to continue regulating e-cigarettes; more longitudinal research will assess how regulations may affect harm perceptions over time

Prevention programs important for college students too; about 1/5 of e-cigarette-naïve students used for the first time in young adulthood