Appendix A: Baseline characteristics, total study sample.

Variable	Ontario (n = 438,731)	British Columbia (n = 124,101)	Newfoundland and Labrador (n = 21,928)
Age (mean ± SD)[a]	30.89 ± 15.51*	32.78 ± 15.80$_a$	32.78 ± 15.16$_a$
Gender[b]			
Female	276,240 (63.0%)*	79,611 (64.1%)*	15,579 (71.0%)*
Male	156,233 (35.6%)*	42,185 (34.0%)*	6110 (27.9%)*
Other	6258 (1.4%)*	2305 (1.9%)*	239 (1.1%)*
Household Income (CAD/year)[b]			
< 20,000	33,773 (7.7%)*	4831 (3.9%)*	1467 (6.7%)
20,000 > 40,000	45,997 (10.5%)*	7449 (6.0%)*	1984 (9.0%)
40,000 > 60,000	54,928 (12.5%)*	9643 (7.8%)*	2272 (10.4%)*
60,000 > 80,000	46,020 (10.5%)*	7759 (6.3%)*	1935 (8.8%)*
80,000 > 100,000	37,526 (8.6%)*	6091 (4.9%)*	1773 (8.1%)
100,000 > 150,000	40,476 (9.2%)*	6864 (5.5%)*	2188 (10.0%)*
≥ 150,000	28,637 (6.5%)*	3859 (3.1%)*	1403 (6.4%)*
Didn't Complete Survey	4023 (0.9%)*	416 (0.3%)*	154 (0.7%)
Don't Know	14,107 (3.2%)*	1823 (1.5%)*	493 (2.2%)*
Rather Not Say	52,209 (11.9%)*	9207 (7.4%)*	2560 (11.7%)*
NA	81,035 (18.5%)*	66,159 (53.3%)*	5699 (26.0%)
Loyalty Rewards Program[b]			
Aeroplan® Miles	63,553 (14.5%)*	20,053 (16.2%)*	5891 (26.9%)*
Drop Points	19,512 (4.4%)*	3799 (3.1%)*	979 (4.5%)
More Rewards®	726 (0.2%)*	16,857 (13.6%)*	57 (0.2%)*
Petro-Points™	50,187 (11.4%)*	7913 (6.4%)*	150 (0.7%)*
RBC Rewards®	9152 (2.1%)*	3199 (2.5%)*	341 (1.6%)*
SCENE Points®	295,601 (67.4%)*	72,280 (58.2%)*	14,510 (66.1%)
Baseline step count[c] *(steps/day; mean ± SD)*[a]	5780 ± 3818*	5922 ± 3636*	5283 ± 3435*

Note. *SD* = standard deviation. *CAD* = Canadian dollars. Means sharing a common subscript were not significantly different at $p < .05$ according to the Independent-Samples Kruskal-Wallis test. [a] = Independent-Samples Kruskal-Wallis Test; [b] = Chi-squared test of independence; [c] = mean daily step count 14-days prior to Week 1. * = $p < .05$.

Appendix B:

Table 1. Estimated weekly mean daily step count intercepts and slopes (within provinces), total sample.

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\hat{B}$	*SE*	95% CI	$\hat{B}$	*SE*	95% CI	$\hat{B}$	*SE*	95% CI
Intercept									
Intervention[a]	6070**	4.062	[6062, 6078]	6319**	7.496	[6304, 6333]	5555**	18.85	[5518, 5592]
Post-[b]	5911**	3.872	[5904, 5919]	6230**	7.920	[6215, 6246]	5515**	17.95	[5479, 5550]
Slope									
Intervention[c]	-48.19**	0.333	[-48.84, -47.54]	-31.79**	0.665	[-33.09, -30.49]	-41.33**	1.598	[-44.46, -38.20]
Post-[d]	5.941**	0.667	[4.63, 7.25]	-5.551**	1.049	[-7.61, -3.50]	-2.810	2.989	[-8.67, 3.05]

Note. $\hat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = week 12; [b] = week 21; [c] = weeks 1 - 12; [d] = weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Table 2. Estimated weekly mean daily step count intercepts and slopes (between provinces), total sample.

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]	-248.7**	8.526	[-265.4, -232.0]	514.7**	19.28	[476.9, 552.4]	763.4**	20.28	[723.6, 803.1]
Post-[b]	-318.9**	8.816	[-336.2, -301.6]	396.8**	18.36	[360.8, 432.8]	715.7**	19.62	[677.2, 754.1]
Slope									
Intervention[c]	-16.40**	0.744	[-17.86, -14.94]	-6.863**	1.632	[-10.06, -3.66]	9.536**	1.731	[6.14, 12.93]
Post-[d]	11.49**	1.243	[9.06, 13.93]	8.751**	3.063	[2.75, 14.75]	-2.741	3.168	[-8.95, 3.47]

Note. $\hat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = week 12; [b] = week 21; [c] = weeks 1 - 12; [d] = weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Appendix C: Results of secondary (covariate) analyses.

Table 1. Estimated weekly mean daily step count intercepts and slopes by application engagement (within provinces), complete cases sample.

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI
Intercept									
Intervention[a]									
Low[b]	6263**	11.84	[6239, 6286]	6636**	40.47	[6556, 6715]	5622**	52.40	[5519, 5725]
Medium[b]	6255**	10.35	[6235, 6275]	6629**	35.95	[6559, 6700]	5632**	45.83	[5543, 5722]
High[b]	6149**	4.117	[6141, 6157]	6526**	10.35	[6506, 6546]	5552**	18.11	[5517, 5588]
Post-[c]									
Low[b]	6052**	19.13	[6015, 6090]	6704**	52.28	[6601, 6806]	5742**	88.63	[5568, 5916]
Medium[b]	6036**	16.74	[6003, 6069]	6680**	46.48	[6589, 6771]	5719**	77.68	[5566, 5871]
High[b]	5821**	6.547	[5808, 5833]	6400**	13.69	[6373, 6427]	5520**	29.60	[5462, 5578]
Slope									
Intervention[d]									
Low[b]	-46.63**	1.608	[-49.78, -43.48]	-20.81**	5.482	[-31.56, -10.07]	-52.55**	7.971	[-68.17, -36.92]
Medium[b]	-60.44**	1.436	[-63.25, -57.62]	-39.25**	3.987	[-47.06, -31.43]	-46.17**	6.458	[-58.83, -33.52]
High[b]	-64.55**	0.516	[-65.56, -63.54]	-43.35**	1.279	[-45.86, -40.85]	-64.82**	2.419	[-69.56, -60.08]

Table 1 (continued).

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI
Slope Post-[e]									
Low[b]	24.23**	4.417	[15.58, 32.89]	6.018	11.44	[-16.41, 28.45]	8.503	18.16	[-27.09, 44.10]
Medium[b]	10.99**	3.471	[4.19, 17.80]	4.828	7.669	[-10.20, 19.86]	1.691	14.57	[-26.87, 30.25]
High[b]	7.538**	0.860	[5.85, 9.22]	-5.512*	2.018	[-9.47, -1.56]	-3.004	3.688	[-10.23, 4.23]

Note. $\widehat{B}$ = unstandardized regression coefficient; SE = robust standard error; CI = confidence interval.

[a] = study week 12; [b] = 0 ≤ 4, 5 ≤ 8, and 9 ≤ 12 weeks the application was opened at least once pre-intervention for low, medium, and high engagement, respectively; [c] = study week 21; [d] = study weeks 1 - 12; [e] = study weeks 18 - 25.

* = $p < .05$; ** = $p < .01$.

Table 2. Estimated weekly mean daily step count intercepts and slopes by application engagement (between provinces), complete cases sample.

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI
Intercept									
Intervention[a]									
Low[b]	-373.1**	42.16	[-455.8, -290.5]	640.4**	53.72	[535.1, 745.7]	1014**	66.20	[883.8, 1143]
Medium[b]	-374.5**	37.41	[-447.9, -301.2]	622.5**	46.98	[530.4, 714.6]	997.1**	58.25	[882.9, 1111]
High[b]	-377.3**	11.14	[-399.1, -355.5]	596.3**	18.57	[559.9, 632.7]	973.6**	20.86	[932.7, 1014]
Post-[c]									
Low[b]	-651.7**	55.67	[-760.8, -542.6]	310.5**	90.67	[132.7, 488.2]	962.2**	102.9	[760.5, 1164]
Medium[b]	-643.5**	49.40	[-740.3, -546.7]	317.7**	79.46	[161.9, 473.4]	961.2**	90.52	[783.8, 1139]
High[b]	-579.8**	15.18	[609.5, -550.0]	300.7**	30.32	[241.2, 360.1]	880.4**	32.61	[816.5, 944.3]
Slope									
Intervention[d]									
Low[b]	-25.82**	5.713	[-37.02, -14.62]	5.912	8.132	[-10.03, 21.85]	31.73**	9.674	[12.77, 50.69]
Medium[b]	-21.19**	4.238	[-29.50, -12.88]	-14.26*	6.616	[-27.23, -1.30]	6.926	7.590	[-7.95, 21.80]
High[b]	-21.20**	1.379	[-23.90, -18.49]	0.272	2.473	[-4.58, 5.12]	21.47**	2.736	[16.11, 26.83]

Table 2 (continued).

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Slope									
Post-[e]									
Low[b]	18.21	12.27	[-5.83, 42.26]	15.73	18.69	[-20.90, 52.36]	-2.485	21.47	[-44.56, 39.59]
Medium[b]	6.167	8.418	[-10.33, 22.67]	9.304	14.98	[-20.06, 38.67]	3.137	16.47	[-29.14, 35.41]
High[b]	13.05**	2.194	[8.75, 17.35]	10.54*	3.787	[3.12, 17.96]	-2.508	4.204	[-10.75, 5.73]

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = weeks 1 – 12; [b] = 0 ≤ 4, 5 ≤ 8, and 9 ≤ 12 weeks the application was opened at least once pre-intervention for low, medium, and high engagement, respectively; [c] = weeks 18 - 25; [d] = week 12; [e] = week 21.
* = $p < .05$; ** = $p < .01$.

Table 3. Estimated weekly mean daily step count intercepts and slopes by pre-intervention level of physical activity (within provinces), complete cases sample.

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]									
Sedentary[b]	3827**	5.658	[3816, 3838]	4025**	13.68	[3998, 4052]	3508**	21.23	[3466, 3549]
Low Active[b]	4504**	4.437	[4496, 4513]	4694**	10.66	[4673, 4715]	4131**	17.81	[4096, 4166]
Physically Active[b]	5469**	4.774	[5460, 5478]	5852**	11.59	[5829, 5874]	4939**	20.41	[4899, 4979]
Post-[c]									
Sedentary[b]	3934**	6.710	[3920, 3947]	4259**	16.30	[4227, 4291]	3695**	25.87	[3644, 3746]
Low Active[b]	4480**	5.183	[4470, 4490]	4818**	12.35	[4794, 4843]	4254**	21.32	[4212, 4295]
Physically Active[b]	5237**	5.700	[5226, 5249]	5805**	13.24	[5779, 5831]	4935**	24.33	[4888, 4983]
Slope									
Intervention[d]									
Sedentary[b]	-38.25**	0.516	[-39.26, -37.24]	-15.89**	1.279	[-18.40, -13.38]	-35.00**	2.096	[-39.11, -30.89]
Low Active[b]	-69.06**	0.777	[-70.58, -67.54]	-43.87**	1.909	[-47.62, -40.13]	-72.91**	4.367	[-58.83, -33.52]
Physically Active[b]	-85.97**	1.189	[-88.31, -83.64]	-65.88**	2.826	[-71.42, -60.34]	-103.3**	6.487	[-116.0, -90.61]

Table 3 (continued).

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\hat{B}$	*SE*	95% CI	$\hat{B}$	*SE*	95% CI	$\hat{B}$	*SE*	95% CI
Slope Post-[e]									
Sedentary[b]	24.75**	1.076	[22.64, 26.86]	13.77**	2.669	[8.54, 19.00]	11.23	3.932	[3.53, 18.94]
Low Active[b]	7.934**	1.309	[5.37, 20.50]	-1.65	2.993	[-7.52, 4.22]	-7.398	6.657	[-20.45, 5.65]
Physically Active[b]	-10.98**	1.957	[-14.82, -7.15]	-24.57*	4.226	[-32.85, -16.29]	-18.20	10.09	[-37.97, 1.56]

Note. $\hat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = pre-intervention average of weekly mean daily step count of < 5000, 5000 – 7499, and ≥ 7500 for sedentary, low active, and physically active users, respectively; [c] = study week 21; [d] = study weeks 1 – 12; [e] = study weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Table 4. Estimated weekly mean daily step count intercepts and slopes by pre-intervention level of physical activity (between provinces), complete cases sample.

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]									
Sedentary[b]	-197.6**	14.80	[-226.7, -168.6]	319.6**	21.98	[276.6, 362.7]	517.3**	25.26	[467.8, 566.8]
Low Active[b]	-189.7**	11.54	[-212.4, -167.1]	373.7**	18.35	[337.7, 409.7]	563.4**	20.75	[522.8, 604.1]
Physically Active[b]	-382.6**	12.54	[-407.2, -358.1]	530.5**	20.96	[489.4, 571.6]	913.1**	23.48	[867.1, 959.1]
Post-[c]									
Sedentary[b]	-325.4**	17.62	[-360.0, -290.9]	238.7**	26.73	[186.3, 291.1]	564.1**	30.57	[504.2, 624.0]
Low Active[b]	-338.1**	13.39	[-364.3, -311.8]	226.6**	13.39	[200.4, 252.9]	564.7**	24.64	[516.4, 613.0]
Physically Active[b]	-568.1**	14.42	[-596.3, -539.8]	302.0**	24.99	[253.0, 350.9]	870.0**	27.70	[815.8, 924.3]
Slope									
Intervention[d]									
Sedentary[b]	-22.36**	1.379	[-25.06, -19.66]	-3.246	2.159	[-7.48, -0.99]	19.11**	2.455	[14.30, 23.93]
Low Active[b]	-25.19**	2.061	[-29.23, -21.15]	3.848	4.436	[-4.85, 12.54]	29.04**	4.766	[19.69, 38.38]
Physically Active[b]	-20.10**	3.066	[-26.11, -14.09]	17.35	6.595	[4.42, 30.27]	37.44**	7.076	[23.57, 51.31]

Table 4 (continued).

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Slope Post-[e]									
Sedentary[b]	10.98**	2.878	[5.34, 16.62]	13.52**	4.077	[5.53, 21.51]	2.536	4.752	[-6.78, 11.85]
Low Active[b]	9.584**	3.267	[3.18, 15.99]	15.33*	6.784	[2.04, 28.63]	5.748	7.299	[-8.56, 20.05]
Physically Active[b]	13.59**	4.657	[4.46, 22.71]	7.219	10.27	[-12.92, 27.35]	-6.368	10.94	[-27.80, 15.06]

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = pre-intervention average of weekly mean daily step count of < 5000, 5000 – 7499, and ≥ 7500 for sedentary, low active, and physically active users, respectively; [c] = study week 21; [d] = study weeks 1 – 12; [e] = study weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Table 5. Estimated weekly mean daily step count intercepts and slopes by application experience (within provinces), complete cases sample.

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]									
Low[b]	6064**	7.557	[6050, 6079]	6457**	23.68	[6411, 6504]	5425**	43.80	[5340, 5511]
Medium[b]	6093**	5.466	[6082, 6104]	6473**	18.56	[6436, 6509]	5455**	34.06	[5388, 5521]
High[b]	6125**	4.198	[6117, 6133]	6520**	9.764	[6501, 6539]	5545**	18.66	[5508, 5581]
Post-[c]									
Low[b]	5679**	11.59	[5657, 5702]	6310**	31.44	[6248, 6372]	5285**	64.77	[5158, 5412]
Medium[b]	5712**	8.265	[5696, 5728]	6324**	24.61	[6276, 6372]	5332**	50.14	[5234, 5431]
High[b]	5754**	6.250	[5742, 5767]	6352**	12.87	[6327, 6378]	5432**	26.58	[5380, 5484]
Slope									
Intervention[d]									
Low[b]	-77.75**	1.258	[-80.21, -75.28]	-56.84**	4.139	[-64.96, -48.73]	-90.36**	7.592	[-105.2, -75.48]
Medium[b]	-63.39**	0.816	[-64.99, -61.79]	-46.29**	2.404	[-51.01, -41.58]	-66.38**	4.597	[-75.39, -57.37]
High[b]	-57.87**	0.642	[-59.12, -56.61]	-38.05**	1.458	[-40.91, -35.19]	-56.36**	2.648	[-61.55, -51.17]

Table 5 (continued).

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Slope									
Post-[e]									
Low[b]	2.894	2.238	[-1.49, 7.28]	-11.05	6.158	[-23.12, 1.02]	13.51	11.94	[-9.90, 36.91]
Medium[b]	6.416**	1.445	[3.59, 9.25]	-7.260	3.956	[-15.01, 0.49]	-6.314	7.333	[-20.69, 8.06]
High[b]	10.85**	1.119	[8.65, 13.04]	-2.225	2.361	[2.40, -0.94]	-2.847	4.255	[-11.19, 5.49]

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = < 6, 6 ≤ 12, and > 12 months between the date that the "Steps" program was enabled and week 12 for low, medium, and high experience, respectively; [c] = study week 21; [d] = study weeks 1 - 12; [e] = study weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Table 6. Estimated weekly mean daily step count intercepts and slopes by application experience (between provinces), complete cases sample.

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]									
Low[b]	-393.0**	24.86	[-441.7, -344.3]	639.0**	44.45	[551.9, 726.1]	1032**	49.80	[934.4, 1130]
Medium[b]	-379.9**	19.35	[-417.8, -342.0]	638.1**	34.50	[570.5, 705.8]	1018**	38.79	[942.0, 1094]
High[b]	-395.1**	10.63	[-416.0, -374.3]	580.4**	19.12	[542.9, 617.8]	975.5**	21.06	[934.2, 1017]
Post-[c]									
Low[b]	-630.7**	33.51	[-696.4, -565.0]	394.3**	65.80	[265.4, 523.3]	1025**	72.00	[883.9, 1166]
Medium[b]	-612.1**	25.96	[-663.0, -561.2]	379.4**	50.81	[279.8, 479.0]	991.5**	55.85	[882.0, 1101]
High[b]	-598.1**	14.30	[-626.2, -570.1]	322.0**	27.30	[268.5, 375.5]	920.1**	29.53	[862.3, 978.0]
Slope									
Intervention[d]									
Low[b]	-20.90**	4.326	[-29.38, -12.42]	12.62	7.696	[-2.47, 27.70]	33.52**	8.647	[16.57, 50.47]
Medium[b]	-17.10**	2.539	[-22.07, -12.12]	2.991	4.669	[-6.16, -12.14]	20.09**	5.188	[9.92, 30.26]
High[b]	-19.82**	1.593	[-22.94, -16.70]	-1.505	2.725	[-6.85, 3.84]	18.31**	3.023	[12.39, 24.24]

Table 6 (continued).

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Slope									
Post-[e]									
Low[b]	13.95*	6.552	[1.11, 26.79]	-10.61	12.15	[-34.42, 13.20]	-24.56	13.44	[-50.89, 1.78]
Medium[b]	13.68**	4.212	[5.42, 21.93]	12.73	7.474	[-1.92, 27.38]	-0.946	8.332	[-17.28, 15.38]
High[b]	13.07**	2.613	[7.95, 18.19]	13.69**	4.400	[5.07, 22.32]	0.622	4.866	[-8.92, 10.16]

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = < 6, 6 ≤ 12, and > 12 months between the date that the "Steps" program was enabled and week 12 for low, medium, and high experience, respectively; [c] = study week 21; [d] = study weeks 1 - 12; [e] = study weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Table 7. Estimated weekly mean daily step count intercepts and slopes by age (within provinces), complete cases sample.

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervent.[a]									
13 - 17	6105**	11.11	[6084, 6127]	6415**	35.12	[6346, 6483]	5520**	49.84	[5422, 5618]
18 - 25	6112**	8.233	[6096, 6128]	6431**	28.04	[6376, 6486]	5536**	39.88	[5458, 5614]
26 - 35	6118**	7.895	[6103, 6134]	6453**	24.31	[6405, 6500]	5533**	36.29	[5462, 5604]
36 – 45	6120**	9.164	[6102, 6138]	6447**	28.22	[6391, 6502]	5541**	39.16	[5464, 5617]
46 – 55	6113**	9.828	[6094, 6132]	6430**	30.42	[6371, 6490]	5525**	42.72	[5441, 5609]
56 – 65	6110**	10.48	[6089, 6130]	6431**	32.13	[6368, 6494]	5516**	46.74	[5425, 5608]
66 – 75	6106**	10.97	[6085, 6128]	6416**	34.36	[6348, 6483]	5523**	49.22	[5427, 5620]
76 – 85	6105**	11.10	[6084, 6127]	6415**	35.05	[6346, 6484]	5520**	49.81	[5423, 5618]
> 85	6105**	11.10	[6084, 2127]	6415**	35.09	[6346, 6484]	5520**	49.80	[5422, 5618]
Post-[b]									
13 - 17	5617**	16.48	[5585, 5650]	6367**	57.13	[6255, 6479]	5510**	80.68	[5351, 5668]
18 - 25	5677**	12.15	[5653, 5700]	6370**	45.41	[6281, 6459]	5502**	63.73	[5377, 5627]
26 - 35	5671**	11.67	[5648, 5694]	6362**	39.30	[6285, 6439]	5507**	58.43	[5392, 5621]
36 – 45	5652**	13.60	[5625, 5679]	6373**	45.84	[6283, 6463]	5502**	63.05	[5378, 5625]
46 – 55	5633**	14.59	[5604, 5661]	6374**	49.44	[6277, 6470]	5498**	68.94	[5363, 5634]
56 – 65	5622**	15.56	[5591, 5652]	6358**	52.25	[6256, 6460]	5505**	75.63	[5357, 5654]
66 – 75	5619**	16.28	[5587, 5651]	6364**	55.89	[6254, 6473]	5515**	79.68	[5359, 5671]
76 - 85	5618**	16.47	[5585, 5650]	6366**	57.02	[6255, 6478]	5510**	80.64	[5352, 5668]
> 85	5618**	16.48	[5585, 5650]	6366**	57.09	[6254, 6478]	5510**	80.63	[5352, 5668]

Table 7 (continued).

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Slope									
Intervent.[c]									
13 - 17	-66.21**	1.902	[-69.94, -62.48]	-54.00**	6.050	[-65.86, -42.15]	-62.44**	8.239	[-78.59, -46.29]
18 - 25	-65.07**	0.850	[-66.74, -63.41]	-46.83**	2.464	[-51.66, -42.00]	-53.60**	4.342	[-62.11, -45.09]
26 - 35	-62.23**	0.876	[-64.95, -61.52]	-40.68**	2.158	[-44.91, -36.45]	-62.11**	3.998	[-69.95, -54.28]
36 – 45	-58.85**	1.068	[-60.94, -56.75]	-36.60**	2.491	[-41.49, -31.72]	-60.49**	4.536	[-69.38, -51.60]
46 – 55	-62.30**	1.390	[-65.02, -59.57]	-45.57**	3.402	[-52.24, -38.90]	-69.88**	6.301	[-82.23, -57.53]
56 – 65	-62.78**	2.146	[-66.98, -58.57]	-35.65**	4.600	[-44.67, -26.64]	-83.76**	9.920	[-103.2, -64.31]
66 – 75	-52.95**	4.411	[-61.60, -44.31]	-55.01**	8.176	[-71.03, -38.99]	-26.12	19.77	[-64.87, 12.64]
76 – 85	-40.04**	12.55	[-64.64, -15.44]	-13.27	32.44	[-76.85, 50.32]	68.36	73.77	[-76.21, 212.9]]
> 85	-34.72	18.11	[-70.21, 0.77]	-15.20	32.96	[-79.79, 49.40]	-85.88	54.61	[-192.9, 21.16]
Post-[d]									
13 - 17	-10.02*	3.747	[-17.37, -2.68]	-5.609	11.15	[-27.45, 16.24]	-37.98*	15.81	[-68.98, -6.98]
18 - 25	-3.025	1.568	[-6.10, 0.05]	-3.981	4.262	[-12.34, 4.37]	-20.24*	7.360	[-34.67, -5.82]
26 - 35	18.75**	1.524	[15.77, 21.74]	-0.906	3.404	[-7.58, 5.77]	11.27	6.665	[-1.80, 24.33]
36 – 45	9.671**	1.850	[6.04, 13.30]	2.708	4.057	[-5.24, 10.66]	-2.049	7.136	[-16.04, 11.94]
46 – 55	9.476**	2.326	[4.92, 14.03]	-10.86	5.235	[-21.12, -0.60]	-7.537	9.037	[-25.25, 10.18]
56 – 65	14.37**	3.532	[7.45, 21.30]	-16.27	7.160	[-30.30, -2.23]	10.03	14.07	[-17.55, 37.62]
66 – 75	11.29	7.322	[-3.064, 25.64]	-26.21	13.03	[-51.74, -0.68]	75.27	42.53	[-8.08, 158.6]
76 – 85	-49.93	26.14	[-101.2, 1.31]	-33.59	42.22	[-116.3, 49.17]	87.77	107.6	[-123.2, 298.7]
> 85	6.821	28.50	[-49.04, 62.68]	23.93	45.29	[-64.83, 112.7]	-52.03	44.97	[-140.2, 36.11]

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = study week 21; [c] = study weeks 1 – 12; [d] = study weeks 18 – 25.
* = $p < .05$; ** = $p < .01$.

Table 8. Estimated weekly mean daily step count intercepts and slopes by age (between provinces), complete cases sample.

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervent.[a]									
13 - 17	-309.3**	36.83	[-384.4, -237.2]	585.4**	51.06	[485.3, 685.4]	894.6**	60.97	[775.1, 1014]
18 - 25	-318.4**	29.22	[-375.7, -261.2]	575.9**	40.72	[496.1, 655.7]	894.4**	48.74	[798.8, 989.9]
26 - 35	-334.6**	25.26	[-384.7, -284.5]	584.8**	37.14	[512.0, 657.6]	919.4**	43.68	[833.8, 1005]
36 – 45	-326.3**	29.67	[-384.5, -268.2]	579.7**	40.22	[500.8, 658.5]	906.0**	48.27	[811.4, 1001]
46 – 55	-317.5**	31.97	[-380.1, -254.8]	587.9**	43.83	[502.0, 673.8]	905.3**	52.44	[802.6, 1008]
56 – 65	-321.4**	33.80	[-387.6, -255.1]	593.4**	47.90	[499.5, 687.2]	914.7**	56.72	[803.6, 1026]
66 – 75	-309.1**	36.07	[-379.8, -238.4]	583.1**	50.43	[484.2, 681.9]	892.2**	60.03	[774.5, 1010]
76 – 85	-309.7**	36.76	[-381.7, -237.6]	585.0**	51.03	[485.0, 685.0]	894.7**	60.91	[775.3, 1014]
> 85	-309.3**	36.81	[-381.5, -237.2]	585.6**	51.03	[485.6, 685.6]	894.9**	60.93	[775.5, 1014]
Post-[b]									
13 - 17	-749.4**	59.46	[-866.0, -632.9]	107.8	82.35	[-53.63, 269.2]	857.2**	98.86	[663.4, 1051]
18 - 25	-693.1**	47.00	[-785.2, -600.9]	174.8*	64.88	[47.58, 301.9]	867.8**	78.25	[714.4, 1021]
26 - 35	-691.3**	40.99	[-771.6, -610.9]	164.3*	59.59	[47.48, 281.1]	855.6**	70.42	[717.5, 993.6]
36 – 45	-721.0**	47.81	[-814.8, -627.3]	150.3*	64.50	[23.93, 276.8]	871.4**	77.95	[718.6, 1024]
46 – 55	-740.7**	51.55	[-841.7, -639.7]	134.4	70.46	[-3.72, 272.5]	875.1**	84.83	[708.8, 1041]
56 – 65	-736.5**	54.52	[-843.4, -629.7]	116.0	77.21	[-35.30, 267.4]	852.6**	91.92	[672.4, 1033]
66 – 75	-745.0**	58.21	[-859.1, -630.9]	104.1	81.32	[-55.32, 263.5]	849.0**	97.33	[658.3, 1040]
76 - 85	-748.9**	59.35	[-865.2, -632.5]	107.4	82.31	[-53.91, 268.7]	856.3**	98.77	[662.7, 1050]

Table 8 (continued).

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Post-[b]									
> 85	-748.8**	59.42	[-865.2, -623.3]	108.1	82.29	[-53.23, 269.3]	856.8**	98.79	[663.2, 1050]
Slope									
Pre-[c]									
13 - 17	12.21	6.342	[-24.64, 0.22]	-3.770	8.456	[-20.34, 12.80]	8.438	10.22	[-11.60, 28.47]
18 - 25	-18.24**	2.606	[-23.35, -13.13]	-11.47*	4.424	[-20.14, -2.80]	6.771	4.992	[-3.01, 16.56]
26 - 35	-22.55**	2.329	[-27.12, -17.99]	-1.120	4.093	[-9.14, 6.90]	21.43**	4.543	[12.53, 30.34]
36 – 45	-22.24**	2.710	[-27.55, -16.93]	1.642	4.660	[-7.49, 10.78]	23.88**	5.175	[13.74, 34.03]
46 – 55	-16.73**	3.675	[-23.93, -9.52]	7.585	6.452	[-5.06, 20.23]	24.31**	7.161	[10.28, 38.35]
56 – 65	-27.12**	5.076	[-37.07, 17.18]	20.98*	10.15	[1.09, 40.87]	48.10**	10.94	[26.67, 69.53]
66 – 75	2.059	9.290	[-16.15, 20.27]	-26.84	20.26	[-66.54, 12.87]	-28.89	21.40	[-70.83, 13.04]
76 – 85	-26.77	34.79	[-94.95, 41.41]	-108.4	74.83	[-255.1, 38.25]	-81.63	80.58	[-239.6, 76.31]
> 85	-19.52	37.60	[-93.23, 54.18]	51.16	57.54	[-61.61, 163.9]	70.68	63.79	[-54.34, 195.7]
Post-[d]									
13 - 17	-4.413	11.76	[-27.46, 18.63]	27.96	16.25	[-3.90, 59.81]	32.37	19.35	[-5.55, 70.29]
18 - 25	0.956	4.541	[-7.95, 9.86]	17.22*	7.525	[2.47, 31.97]	16.26	8.505	[-0.41, 32.93]
26 - 35	19.66**	3.730	[12.35, 26.97]	7.483	6.837	[-5.92, 20.88]	-12.17	7.484	[-26.84, 2.49]
36 – 45	6.963	4.459	[-1.78, 15.70]	11.72	7.372	[-2.73, 26.17]	4.757	8.209	[-11.33, 20.85]
46 – 55	20.33**	5.728	[9.11, 31.56]	17.01	9.332	[-1.28, 35.30]	-3.320	10.44	[-23.79, 17.15]
56 – 65	30.64**	7.984	[14.99, 46.28]	4.341	14.51	[-24.10, 32.78]	-26.30	15.79	[-57.24, 4.65]
66 – 75	37.50*	14.94	[8.21, 66.78]	-63.99	43.15	[-148.6, 20.59]	-101.5*	44.48	[-188.7, -14.31]
76 – 85	-16.34	49.66	[-113.7, 80.98]	-137.7	110.8	[-354.8, 79.37]	-121.4	115.6	[-347.9, 105.2]
> 85	-17.11	53.51	[-122.0, 87.77]	58.85	53.24	[-45.50, 163.2]	75.97	63.83	[-49.13, 201.1]

Table 8 (continued).

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = study week 21; [c] = study weeks 1 – 12; [d] = study weeks 18 – 25.
* = $p < .05$; ** = $p < .01$.

Table 9. Estimated weekly mean daily step count intercepts and slopes by gender (within provinces), complete cases sample.

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]									
Female	6152**	3.537	[6145, 6159]	6528**	8.574	[6511, 6545]	5583**	15.72	[5552, 5614]
Male	6153**	3.062	[6147. 6159]	6535**	7.331	[6521, 6550]	5574**	14.06	[5546, 5602]
Other[b]	6152**	3.510	[6145, 6159]	6527**	8.472	[6511, 6544]	5583**	15.65	[5552, 5614]
Post-[c]									
Female	5776**	5.281	[5765, 5786]	6368**	11.61	[6346, 6391]	5490**	23.19	[5444, 5535]
Male	5786**	4.377	[5777, 5795]	6395**	9.705	[6346, 6384]	5481**	19.84	[5442, 5520]
Other[b]	5776**	5.230	[5765, 5786]	6369**	11.47	[6347, 6392]	5490**	23.06	[5445, 5535]
Slope									
Intervention[d]									
Female	-58.14**	0.555	[-59.22, -57.05]	-39.65**	1.422	[-42.43, -36.86]	-57.03**	2.483	[-61.90, -52.17]
Male	-71.61**	0.879	[-77.33, -69.88]	-46.33**	2.274	[-50.78, -41.87]	-75.80**	4.700	[-85.01, -66.58]
Other[b]	-63.45**	4.006	[-71.31, -55.60]	-48.05**	8.115	[-63.96, -32.15]	-55.08*	20.42	[-95.11, -15.05]

Table 9 (continued).

Parameter	Ontario			British Columbia			Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Slope									
Post-[e]									
Female	11.69**	0.988	[9.75, 13.62]	-5.893*	2.293	[-10.39, -1.40]	3.571	3.955	[-4.18, 11.32]
Male	1.507	1.505	[-1.44, 4.46]	-2.037	3.635	[-9.16, 5.09]	-17.20*	7.555	[-32.01, -2.39]
Other[b]	14.78*	6.693	[1.66, 27.90]	10.63	13.74	[-16.31, 37.56]	-11.72	31.04	[-72.55, 49.11]

Note. $\widehat{B}$ = unstandardized regression coefficient; *SE* = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = identified gender not female or male; [c] = study week 21; [d] = study weeks 1 - 12; [e] = study weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Table 10. Estimated weekly mean daily step count intercepts and slopes by gender (between provinces), complete cases sample.

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI	$\widehat{B}$	*SE*	95% CI
Intercept									
Intervention[a]									
Female	-373.3**	9.275	[-394.5, -358.1]	568.9**	16.11	[537.3, 600.4]	945.2**	17.91	[910.1, 980.3]
Male	-382.2**	7.945	[-397.8, -366.7]	579.1**	14.39	[550.9, 607.4]	961.4**	15.86	[930.3, 992.5]
Other[b]	-375.6**	9.170	[-393.6, -357.6]	568.8**	16.04	[537.3, 600.2]	944.4**	17.80	[909.5, 979.3]
Post-interv.[c]									
Female	-592.8**	12.76	[-617.8, -567.8]	285.8**	23.78	[239.2, 332.4]	878.6**	25.93	[827.8, 929.5]
Male	-578.9**	10.65	[-599.7, -558.0]	305.2**	20.32	[265.4, 345.1]	884.1**	22.09	[840.8, 927.4]
Other[b]	-593.7**	12.61	[-618.4, -569.0]	285.8**	23.65	[239.5, 332.2]	879.5**	25.76	[829.0, 930.0]
Slope									
Intervention[d]									
Female	-18.49**	1.526	[-21.48, 15.50]	-1.102	2.544	[-6.09, 3.89]	17.39**	2.861	[11.78, 22.99]
Male	-25.28**	2.438	[-30.06, -20.50]	4.191	4.781	[-5.18, 13.56]	29.47**	5.221	[19.24, 39.70]
Other[b]	-15.40	9.050	[-33.14, 2.34]	-8.375	20.81	[-49.17, 32.42]	7.025	21.98	[-36.05, 50.10]

Table 10 (continued).

Parameter	Ontario and British Columbia			Ontario and Newfoundland and Labrador			British Columbia and Newfoundland and Labrador		
	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI	$\widehat{B}$	SE	95% CI
Slope Post-[e]									
Female	17.58**	2.497	[12.69, 22.47]	8.116*	4.077	[0.13, 16.11]	-9.464*	4.572	[-18.42, -0.50]
Male	3.544	3.934	[-4.17, 11.26]	18.71*	7.703	[3.61, 33.81]	15.16	8.384	[-1.27, 31.60]
Other[b]	4.155	15.29	[-25.80, 34.11]	26.50	31.75	[-35.73, 88.73]	22.35	33.94	[-44.18, 88.87]

Note. $\widehat{B}$ = unstandardized regression coefficient; SE = robust standard error; CI = confidence interval.
[a] = study week 12; [b] = identified gender not female or male; [c] = study week 21; [d] = study weeks 1 - 12; [e] = study weeks 18 - 25.
* = $p < .05$; ** = $p < .01$.

Appendix D: Research ethics board approval letter.

Western Research

Date: 26 August 2021

To: Professor Marc Mitchell

Project ID: 114790

Study Title: Examining the effect of financial incentive withdrawal on physical activity: A 24-week natural experiment of Carrot Rewards app users

Application Type: Continuing Ethics Review (CER) Form

Review Type: Delegated

REB Meeting Date: 07/Sept/2021

Date Approval Issued: 26/Aug/2021

REB Approval Expiry Date: 02/Sep/2022

Dear Professor Marc Mitchell,

The Western University Research Ethics Board has reviewed the application. This study, including all currently approved documents, has been re-approved until the expiry date noted above.

REB members involved in the research project do not participate in the review, discussion or decision.

Western University REB operates in compliance with, and is constituted in accordance with, the requirements of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The REB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to

contact us if you have any

questions. Sincerely,

The Office of Human Research Ethics

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix E: Code for primary data analysis.

```
# Figure 1. Replace X3 with CompleteCases.csv

# Create the Intervention categorical variable with four levels based on the previous exploratory plot:  weeks 1 - 12, 13, 14, 15, 16, 17 and 18 - 25
X3$Intervention <- "pre"
X3$Intervention[X3$Week == 13] <- "wk13"
X3$Intervention[X3$Week == 14] <- "wk14"
X3$Intervention[X3$Week == 15] <- "wk15"
X3$Intervention[X3$Week == 16] <- "wk16"
X3$Intervention[X3$Week == 17] <- "wk17"
X3$Intervention[X3$Week >= 18] <- "post"
X3$Intervention <- factor(X3$Intervention, levels = levels(factor(X3$Intervention))[c(2, 3, 4, 5, 6, 7, 1)])

lm2 <- lm(Average.Steps ~ Week * NewProvinceColumn * Intervention + gender + age + current_provider + income_level + first_baseline + Experience_mths + Engagement_pre + PhysicalActivity_pre, X3)

X3$fit2 <- fitted(lm2)

X3 %>%
  group_by(NewProvinceColumn, Week) %>%
  summarize(Mean = mean(Average.Steps), Fit = mean(fit2)) %>%
  ggplot(aes(x = Week)) +
  geom_line(aes(y = Mean, group = NewProvinceColumn, colour = NewProvinceColumn), size = 0.2) +
  geom_point(aes(y = Mean, group = NewProvinceColumn, colour = NewProvinceColumn), size = 2.5) +
  geom_line(aes(y = Fit, group = NewProvinceColumn)) +
  scale_color_discrete(name = "Province",
                       labels = c("British Columbia", "Ontario", "Newfoundland and Labrador")) +
  guides(col = guide_legend(order = 1)) +
  scale_x_continuous(breaks = seq(0, 25, 2)) +
  geom_rect(aes(xmin = 13, xmax = 18, ymin = -Inf, ymax = Inf, fill = "December 2, 2018 - January 5, 2019"), colour=NA, alpha = .006) +
  scale_fill_manual('Winter Holiday Period (excluded)', values = 'gray', guide = guide_legend(override.aes = list(alpha = 1))) +
  theme_classic() +
  labs(y = "Weekly Mean Daily Step Count")

#Preparing Data
# Simple linear regression model for ON
ind <- X3$Province == "ON"
Yon13 <- X3[ind, -c(1, 3, 11, 12, 15 : 17, 19, 20)]
```

```
# Include each covariate with low missing as additive effects only
# This means that the whole trend over weeks is adjusted up or down depending on the level of a covariate
lmON13 <- lm(Average.Steps ~ Week * Intervention + gender + age + income_level + current_provider + first_baseline + Experience_mths +
             Engagement_pre + PhysicalActivity_pre, Yon13, na.action = na.exclude)
Yon13$fit3 <- fitted(lmON13)


# Simple linear regression model for BC
ind <- X3$Province == "BC"
Ybc13 <- X3[ind, -c(1, 3, 11, 12, 15 : 17, 19, 20)]

# Same as the Ontario model, where each covariate with low missing is included as an additive effect only
# This means that the whole trend over weeks is adjusted up or down depending on the level of a covariate
lmBC13 <- lm(Average.Steps ~ Week * Intervention + gender + age + income_level + current_provider + first_baseline + Experience_mths +
             Engagement_pre + PhysicalActivity_pre, Ybc13, na.action = na.exclude)
Ybc13$fit3 <- fitted(lmBC13)


# Simple linear regression model for NL
ind <- X3$Province == "NL"
Ynl13 <- X3[ind, -c(1, 3, 11, 12, 15 : 17, 19, 20)]

# Same as the Ontario and BC models, where each covariate with low missing is included as an additive effect only
# This means that the whole trend over weeks is adjusted up or down depending on the level of a covariate
lmNL13 <- lm(Average.Steps ~ Week * Intervention + gender + age + income_level + current_provider + first_baseline + Experience_mths +
             Engagement_pre + PhysicalActivity_pre, Ynl13, na.action = na.exclude)
Ynl13$fit3 <- fitted(lmNL13)

tbl1 <- round(cbind(ON = summary(lmON13)$coefficients[, 1], BC = summary(lmBC13)$coefficients[, 1],
                    NL = summary(lmNL13)$coefficients[, 1]), 1)
pander(tbl1, "Estimates of the simple linear regression model coefficients by Province")

# For each province, use emmeans to get the estimates of interest, i.e. the estimates at Week 18 and Week 13 and use the model coefficients to get the pre and post intervention slopes

province <- c("ON", "BC", "NL")
```

```
preslope <- week13 <- week18 <- diffwk18.13 <- postslope <- vector("numeric", 3)

# Extract Ontario model estimates
preslope[1] <- coef(lmON13)[2]
week13[1] <- summary(emmeans(lmON13, ~ 1, at = list(Week = 13, Intervention =
"pre")))$emmean
week18[1] <- summary(emmeans(lmON13, ~ 1, at = list(Week = 18, Intervention =
"post")))$emmean
diffwk18.13[1] <- week18[1] - week13[1]
postslope[1] <- coef(lmON13)[2] + coef(lmON13)[35]

# Extract BC model estimates
preslope[2] <- coef(lmBC13)[2]
week13[2] <- summary(emmeans(lmBC13, ~ 1, at = list(Week = 13, Intervention =
"pre")))$emmean
week18[2] <- summary(emmeans(lmBC13, ~ 1, at = list(Week = 18, Intervention =
"post")))$emmean
diffwk18.13[2] <- week18[2] - week13[2]
postslope[2] <- coef(lmBC13)[2] + coef(lmBC13)[35]

# Extract NL model estimates
preslope[3] <- coef(lmNL13)[2]
week13[3] <- summary(emmeans(lmNL13, ~ 1, at = list(Week = 13, Intervention =
"pre")))$emmean
week18[3] <- summary(emmeans(lmNL13, ~ 1, at = list(Week = 18, Intervention =
"post")))$emmean
diffwk18.13[3] <- week18[3] - week13[3]
postslope[3] <- coef(lmNL13)[2] + coef(lmNL13)[35]

est1 <- data.frame(province, diffwk18.13, preslope, postslope)
pander(est1, "The difference in the mean Average.Steps between weeks 18 and 13
(diffwdk18.13) and the pre and post intervention rate of change in Average.Steps over weeks
(preslope and postslope respectively) by province")

# Robust covariance for the simple linear regression models
## Inference of the model parameter estimates

# Shown here for the lmNL simple linear regression model that was fit
# Refit the model removing the NA cases for Experience_mths
ind <- !is.na(Ynl13$Experience_mths)
lmNL.4.13 <- lm(Average.Steps ~ Week * Intervention + gender + age + income_level +
current_provider + first_baseline + Experience_mths + Engagement_pre + PhysicalActivity_pre,
droplevels(Ynl13[ind, ]))
V.robust.NL.13 <- vcovCR(lmNL.4.13, cluster = droplevels(Ynl13$user_id[ind]), type = "CR0")

# Use V.robust.NL to get SEs for the model estimates
```

```
# Note, any interactions that include Week with the wk16 or wk17 Intervention levels will be
NA.  These need to be removed from betahat
ind <- is.na(coef(lmNL.4.13))
betahatNL <- coef(lmNL.4.13)[!ind]
seNL <- sqrt(diag(V.robust.NL.13))
z.alpha <- qnorm(0.05 / 2, lower.tail = F)
lowerNL <- betahatNL - (z.alpha * seNL)
upperNL <- betahatNL + (z.alpha * seNL)
zNL <- betahatNL / seNL
pvNL <- 2 * pnorm(q = abs(zNL), lower.tail = FALSE)

tblNL13 <- round(cbind(Estimate = betahatNL, Std.Error = seNL, lower.CI = lowerNL, upper.CI
= upperNL, z.value = zNL,
                  p.value = pvNL), 3)

panderOptions("table.split.table", 90)

pander(tblNL13, "For NL, estimates of the simple linear regression model coefficients, robust
standard errors, lower and upper limits of the 95% confidence interval (CI) for the estimates, and
hypothesis tests that the model coefficients equal zero")

# BC
ind <- !is.na(Ybc13$Experience_mths)
lmBC.4.13 <- lm(Average.Steps ~ Week * Intervention + gender + age + income_level +
current_provider + first_baseline + Experience_mths + Engagement_pre + PhysicalActivity_pre,
droplevels(Ybc13[ind, ]))
V.robust.BC.13 <- vcovCR(lmBC.4.13, cluster = droplevels(Ybc13$user_id[ind]), type =
"CR0")

ind <- is.na(coef(lmBC.4.13))
betahatBC <- coef(lmBC.4.13)[!ind]
seBC <- sqrt(diag(V.robust.BC.13))
lowerBC <- betahatBC - (z.alpha * seBC)
upperBC <- betahatBC + (z.alpha * seBC)
zBC <- betahatBC / seBC
pvBC <- 2 * pnorm(q = abs(zBC), lower.tail = FALSE)

tblBC13 <- round(cbind(Estimate = betahatBC, Std.Error = seBC, lower.CI = lowerBC, upper.CI
= upperBC, z.value = zBC,
                  p.value = pvBC), 4)

pander(tblBC13, "For BC, estimates of the simple linear regression model coefficients, robust
standard errors, lower and upper limits of the 95% confidence interval (CI) for the estimates, and
hypothesis tests that the model coefficients equal zero")

# ON
```

```
ind <- !is.na(Yon13$Experience_mths)
lmON.4.13 <- lm(Average.Steps ~ Week * Intervention + gender + age + income_level +
current_provider + first_baseline + Experience_mths + Engagement_pre + PhysicalActivity_pre,
droplevels(Yon13[ind, ]))
V.robust.ON.13 <- vcovCR(lmON.4.13, cluster = droplevels(Yon13$user_id[ind]), type =
"CR0")

ind <- is.na(coef(lmON.4.13))
betahatON <- coef(lmON.4.13)[!ind]
seON <- sqrt(diag(V.robust.ON.13))
lowerON <- betahatON - (z.alpha * seON)
upperON <- betahatON + (z.alpha * seON)
zON <- betahatON / seON
pvON <- 2 * pnorm(q = abs(zON), lower.tail = FALSE)

tblON13 <- round(cbind(Estimate = betahatON, Std.Error = seON, lower.CI = lowerON,
upper.CI = upperON, z.value = zON,
                  p.value = pvON), 4)

pander(tblON13, "For ON, estimates of the simple linear regression model coefficients, robust
standard errors, lower and upper limits of the 95% confidence interval (CI) for the estimates, and
hypothesis tests that the model coefficients equal zero")

## Inference of the post-intervention rate of change
# A linear combination of the model coefficients is needed to get the post-intervention rate of
change and its standard error.  And the vector L is used to specify the parameters needed from
betahat to get the appropriate combination.  Note that this means that L must be the same length
as betahat.  Only for those models that have a two-way interaction between Week and
Intervention and all covariates included as additive effects only (i.e. no 3-way interactions), the
contrast L must include 1's at the indices in betahat for Week and Week:Interventionpost.

# NL
L <- rep(0, length(betahatNL))
ind <- names(betahatNL) %in% c("Week")
L[ind] <- 1

estimate <- L %*% betahatNL
SE <- sqrt(t(L) %*% V.robust.NL.13 %*% L)
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
preNL13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

# BC
```

```
L <- rep(0, length(betahatBC))
ind <- names(betahatBC) %in% c("Week")
L[ind] <- 1
estimate <- L %*% betahatBC
SE <- sqrt(t(L) %*% V.robust.BC.13 %*% L)
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
preBC13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

#ON
L <- rep(0, length(betahatON))
ind <- names(betahatON) %in% c("Week")
L[ind] <- 1
estimate <- L %*% betahatON
SE <- sqrt(t(L) %*% V.robust.ON.13 %*% L)
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
preON13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

pander(rbind(preNL13, preBC13, preON13), "95% CI and hypothesis test for the post-
intervention rate of change in average steps for NL, BC, and ON")

# NL
L <- rep(0, length(betahatNL))
ind <- names(betahatNL) %in% c("Week", "Week:Interventionpost")
L[ind] <- 1

estimate <- L %*% betahatNL
SE <- sqrt(t(L) %*% V.robust.NL.13 %*% L)
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
postNL13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

# BC
L <- rep(0, length(betahatBC))
ind <- names(betahatBC) %in% c("Week", "Week:Interventionpost")
L[ind] <- 1
```

```
estimate <- L %*% betahatBC
SE <- sqrt(t(L) %*% V.robust.BC.13 %*% L)
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
postBC13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

#ON
L <- rep(0, length(betahatON))
ind <- names(betahatON) %in% c("Week", "Week:Interventionpost")
L[ind] <- 1
estimate <- L %*% betahatON
SE <- sqrt(t(L) %*% V.robust.ON.13 %*% L)
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
postON13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

pander(rbind(postNL13, postBC13, postON13), "95% CI and hypothesis test for the post-
intervention rate of change in average steps for NL, BC, and ON")

## Comparing estimated slopes
estimate <- postBC13[1] - postNL13[1]
SEpooled <- sqrt((postBC13[2] ^ 2) + (postNL13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tbl13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tbl13) <- c("Difference", names(postBC13)[2 : 6])

estimate <- postON13[1] - postBC13[1]
SEpooled <- sqrt((postON13[2] ^ 2) + (postBC13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tbl13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tbl13) <- c("Difference", names(postON13)[2 : 6])
```

```
estimate <- postON13[1] - postNL13[1]
SEpooled <- sqrt((postON13[2] ^ 2) + (postNL13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tbl13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tbl13) <- c("Difference", names(postON13)[2 : 6])

#Intercept
#Within
#Pre
#NL
LIntPre <- matrix(c(1, 12, 0, 0, 0, 0, 0, 0, 0.272, .009, 35.78, .137, .09, .118, .138, .120, .110, .01,
.029, .161, .048, .002, .007, .017, .66, 5307, 17.93, 9.38, 5863, 0), nrow = 1)

estimate <- LIntPre %*% betahatNL
SE <- sqrt(LIntPre %*% V.robust.NL.13 %*% t(LIntPre))
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
preIntNL13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

#BC
LIntPre <- matrix(c(1, 12, 0, 0, 0, 0, 0, 0, 0.312, .02, 36.51, .121, .07, .125, .164, .135, .106, .007,
.031, .159, .034, .103, .063, .022, .597, 5883, 17.54, 10.11, 6712, 0), nrow = 1)

estimate <- LIntPre %*% betahatBC
SE <- sqrt(LIntPre %*% V.robust.BC.13 %*% t(LIntPre))
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
preIntBC13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

#ON
LIntPre <- matrix(c(1, 12, 0, 0, 0, 0, 0, 0, 0.339, .015, 33.92, .114, .083, .124, .151, .129, .105,
.012, .04, .148, .045, .01, .109, .021, .676, 5751, 12.75, 9.37, 6431, 0), nrow = 1)

estimate <- LIntPre %*% betahatON
SE <- sqrt(LIntPre %*% V.robust.ON.13 %*% t(LIntPre))
lower <- estimate - (z.alpha * SE)
```

```
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
preIntON13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI = upper,
z.value = z, p.value = pv), 3)

PreInt <- rbind(preIntNL13, preIntBC13, preIntON13)

#Post
LIntPost <- matrix(c(1, 21, 0, 0, 0, 0, 0, 1, 0.272, .009, 35.78, .137, .09, .118, .138, .120, .110,
.01, .029, .161, .048, .002, .007, .017, .66, 5307, 17.93, 9.38, 5863, 21), nrow = 1)

estimate <- LIntPost %*% betahatNL
SE <- sqrt(LIntPost %*% V.robust.NL.13 %*% t(LIntPost))
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
postIntNL13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI =
upper, z.value = z, p.value = pv), 3)

#BC
LIntPost <- matrix(c(1, 21, 0, 0, 0, 0, 0, 1, 0.312, .02, 36.51, .121, .07, .125, .164, .135, .106,
.007, .031, .159, .034, .103, .063, .022, .597, 5883, 17.54, 10.11, 6712, 21), nrow = 1)

estimate <- LIntPost %*% betahatBC
SE <- sqrt(LIntPost %*% V.robust.BC.13 %*% t(LIntPost))
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
postIntBC13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI =
upper, z.value = z, p.value = pv), 3)

#ON
LIntPost <- matrix(c(1, 21, 0, 0, 0, 0, 0, 1, 0.339, .015, 33.92, .114, .083, .124, .151, .129, .105,
.012, .04, .148, .045, .01, .109, .021, .676, 5751, 12.75, 9.37, 6431, 21), nrow = 1)

estimate <- LIntPost %*% betahatON
SE <- sqrt(LIntPost %*% V.robust.ON.13 %*% t(LIntPost))
lower <- estimate - (z.alpha * SE)
upper <- estimate + (z.alpha * SE)
z <- estimate / SE
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
postIntON13 <- round(c(Estimate = estimate, Std.Error = SE, lower.CI = lower, upper.CI =
upper, z.value = z, p.value = pv), 3)
```

```
PostInt <- rbind(postIntNL13, postIntBC13, postIntON13)

#Between
#Pre
estimate <- preIntON13[1] - preIntBC13[1]
SEpooled <- sqrt((preIntON13[2] ^ 2) + (preIntBC13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tblpreIntONBC13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tblpreIntONBC13) <- c("Difference", names(preIntON13)[2 : 6])

#ON-NL
estimate <- preIntON13[1] - preIntNL13[1]
SEpooled <- sqrt((preIntON13[2] ^ 2) + (preIntNL13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tblpreIntONNL13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tblpreIntONNL13) <- c("Difference", names(preIntON13)[2 : 6])

#BC-NL
estimate <- preIntBC13[1] - preIntNL13[1]
SEpooled <- sqrt((preIntBC13[2] ^ 2) + (preIntNL13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tblpreIntBCNL13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tblpreIntBCNL13) <- c("Difference", names(preIntBC13)[2 : 6])

#Post
#ON-BC
estimate <- postIntON13[1] - postIntBC13[1]
SEpooled <- sqrt((postIntON13[2] ^ 2) + (postIntBC13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)
```

```
tblpostIntONBC13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tblpostIntONBC13) <- c("Difference", names(postIntON13)[2 : 6])

#ON-NL
estimate <- postIntON13[1] - postIntNL13[1]
SEpooled <- sqrt((postIntON13[2] ^ 2) + (postIntNL13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tblpostIntONNL13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tblpostIntONNL13) <- c("Difference", names(postIntON13)[2 : 6])

#BC-NL
estimate <- postIntBC13[1] - postIntNL13[1]
SEpooled <- sqrt((postIntBC13[2] ^ 2) + (postIntNL13[2] ^ 2))
lower <- estimate - (z.alpha * SEpooled)
upper <- estimate + (z.alpha * SEpooled)
z <- estimate / SEpooled
pv <- 2 * pnorm(q = abs(z), lower.tail = FALSE)

tblpostIntBCNL13 <- matrix(round(c(estimate, SEpooled, lower, upper, z, pv), 3), 1, 6)
colnames(tblpostIntBCNL13) <- c("Difference", names(postIntBC13)[2 : 6])
```