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**Smoking Diffusion through Networks of Diverse, Urban American Adolescents over the High School Period**

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APPENDIX A

*Description of Measures*

*Cigarette smoking initiation.* Lifetime cigarette smoking was assessed with the question “*Have you ever tried cigarette smoking, even one or two puffs?”* (*yes* / *no*). If participants reported that they had tried cigarette smoking, they were coded has having initiated smoking at that wave and at all subsequent waves (1 = *initiated cigarette smoking*, 0 = *has not initiated cigarette smoking*).

*Past-month cigarette smoking.* Participants responded to the question “*During the past 30 days, on how many days did you smoke cigarettes?*” with 7 response options ranging from “*0 days”* to “*all 30 days*”. Because of the low prevalence of past month smoking, responses were recoded as 1 = *1 or more days* and 0 = *0 days*.

*Race/ethnicity.* Participants indicated whether they identified with 20 different racial and ethnic categoriesthat was used to identify participants as 1 = *Latino/Hispanic* or 0 = *not Latino/Hispanic*.

*Socio-economic status.* Thiswas assessed based on participant response to the items “*Does your family own its home or rent from a landlord”* (1 = *own*, 2 = *rent*, 3 = *don’t know*), and “*Are you eligible for a free or reduced price lunch at school”* (1 = *yes*, 2 = *no*).

*School grades.* Participants reported their typical grades they had in school the previous year (9 response categories, 1 = *mostly A’s*, 2 = *mostly A’s and B’s*, and 9 = *mostly F’s*) which was recoded into a 5-point scale where 1 = lowest grades and 5 = highest grades.

*Parent/caregiver smoking*. This was assessed at each wave by the question “*Think of the two adults that you spend the most time with. How many of them smoke cigarettes every day or most days?*”, with three response options: *none*, *1 of them*, *2 of them*. Responses were recoded so that 1 = *1 or 2 of these adults smoked every day/most days* and 0 = *none of these adults smoked every day/most days*.

*Sibling smoking***.** This was assessed at each wave by the question *“Do any of your siblings (brother or sister) smoke cigarettes once a month or more?”*, with 5 response options capturing whether that were recoded so that 1 = they have any siblings that smoke, and 0 = they have no siblings that smoke.

APPENDIX B

*Description of Additional Results for Stochastic Actor Based Models (SABM) for Friendship Network and Smoking Initiation Dynamics*

Results for the full SABM that was estimated for each school is summarized in Table B1, and includes estimates for the following effects that were included as controls when predicting the network dynamics.

*Effects of covariates on network dynamics.* Covariates significantly predicted friendship network dynamics. In all schools, students were likely to select friends who were the same gender (effect 9: positive female same), and who had similar school grades (effect 15: positive grades similarity). Males and students with higher school grades also tended to be more popular: in all schools except School 3, students preferred to befriend males over females (effect 8: negative female alter), and in all schools students were likely to befriend students with lowerschool grades over those with higher grades (effect 14: negative grades alter) indicating that students with the best academic performance were less popular.

Race/ethnicity and socioeconomic status also significantly predicted friendship choices. In all schools except School 2 (which was 93% Hispanic) Hispanic students were significantly more likely to befriend Hispanic peers than non-Hispanic peers (effect 12: positive Hispanic same). In School 2 and School 3, students of any race/ethnicity were more likely to befriend non-Hispanic peers over Hispanic peers (effect 11: negative Hispanic alter), indicating that Hispanic youth in these two schools were less popular as friends. Socio-economic status (indicated by students’ caregivers owning their own home) was relevant to friendship choices in School 3 and School 4: in School 3 students with higher SES made more friendship nominations compared to other students (effect 16: positive own home ego); and in School 4 students with higher SES received more friendship nominations (effect 17: positive own home alter) and students tended to select friends whose SES status was the same as their own (effect 18: positive own home same).

Finally, students in all four schools were significantly more likely to befriend peers who were in their same home group class (effect 19: positive class same), although this effect was significantly stronger from W1–W2, compared to W2–W3 (effect 47: negative class same P2) and W3–W4 (effect 48: negative class same P3), as indicated by the time heterogeneity dummies for “class same.”

*Effects of network structure on friendship network dynamics.* Several structural features of the social networks predicted dynamics in the friendship networks over time. In all four schools, there were significant preferences for students to form or maintain friendships with peers who had nominated them as a friend (effect 21: positive reciprocity). This preference for reciprocity was often stronger at later waves.[[1]](#footnote-1) In all schools, network dynamics were also predicted by a significant tendency for students to befriend friends of their current friends (effect 22: positive transitive triplets) and to form local friendship hierarchies (effect 23: negative 3-cycles). The distribution of friendship ties being sent and received among students (i.e., the *network degree distribution,* which represents features of social status)also significantly predicted network dynamics. In School 1 and School 4, students who received the most friendship nominations were those who *already had* many friendship nominations (effect 24: positive indegree popularity), indicating that popular students became more popular; and in all schools, students who *received* the most friendship nominations *sent out* fewer friend nominations, indicating that students who were popular as friends were also the most selective in nominating friends (effect 25: negative indegree activity). In all schools, students who nominated the most friends (who were also students who tended to be less popular, and less selective in their friendship nominations) were also more likely *to make more friendship nominations* over time(effect 26: positive outdegree activity). Finally, in all schools there was a tendency to have a low density of friendship ties and an aversion to form or maintain friendship ties arbitrarily (effect 20: negative outdegree).

**Table B1.** Results of Full Stochastic Actor-Based Models of Friendship Network and Smoking Initiation Dynamics

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | | School 1 | | | | School 2 | | | | | | | | School 3 | | | | | | | | | School 4 | | | | | |
|  |  | | | (n = 449) | | | | (n = 288) | | | | | | | | (n = 371) | | | | | | | | | (n = 317) | | | | | |
| **#** | Model Parameter | | | PE | SE | |  | PE | | SE | | |  | | | PE | | SE | | | |  | | | PE | | SE | | |  |
|  | *Friendship network dynamics* | | |  |  | |  |  | |  | | |  | | |  | |  | | | |  | | |  | |  | | |  |
| 1 | Rate P1 | | | 15.70 | .58 | |  | 11.01 | | .64 | | |  | | | 12.37 | | .48 | | | |  | | | 17.65 | | .66 | | |  |
| 2 | Rate P2 | | | 29.28 | 2.04 | |  | 23.72 | | 1.50 | | |  | | | 19.70 | | .92 | | | |  | | | 25.00 | | 1.17 | | |  |
| 3 | Rate P3 | | | 19.29 | 1.17 | |  | 20.54 | | 1.35 | | |  | | | 15.68 | | .77 | | | |  | | | 21.71 | | 1.99 | | |  |
|  |  | *Effects of lifetime smoking* | |  |  | |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 4 |  |  | Smoke ego | .04 | .03 | |  | .02 | | .04 | | |  | | | –.08 | | | .04 | | | † | | | .02 | | .04 | | |  |
| 5 |  |  | Smoke alter | .13 | .04 | | \*\* | –.80 | | .04 | | | \* | | | .07 | | | .04 | | | † | | | .05 | | .04 | | |  |
| 6 |  |  | Smoke same | –.02 | .05 | |  | –.05 | | .05 | | |  | | | .00 | | | .05 | | |  | | | .03 | | .05 | | |  |
|  |  | *Effects of covariates* | |  |  | |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 7 |  |  | Female ego | .00 | .03 | |  | .02 | | .04 | | |  | | | .00 | | | .03 | | |  | | | –.01 | | .03 | | |  |
| 8 |  |  | Female alter | –.11 | .03 | | \*\* | –.07 | | .03 | | | \* | | | –.01 | | | .03 | | |  | | | –.12 | | .03 | | | \*\* |
| 9 |  |  | Female same | .37 | .03 | | \*\* | .45 | | .04 | | | \*\* | | | .37 | | | .03 | | | \*\* | | | .40 | | .03 | | | \*\* |
| 10 |  |  | Hispanic ego | –.02 | .04 | |  | .24 | | .12 | | | † | | | .06 | | | .04 | | |  | | | .10 | | .10 | | |  |
| 11 |  |  | Hispanic alter | .02 | .04 | |  | –.19 | | .09 | | | \* | | | –.11 | | | .04 | | | \*\* | | | –.15 | | .09 | | |  |
| 12 |  |  | Hispanic same | .25 | .03 | | \*\* | .04 | | .05 | | |  | | | .50 | | | .04 | | | \*\* | | | .20 | | .05 | | | \*\* |
| 13 |  |  | Grades ego | .00 | .01 | |  | .02 | | .01 | | |  | | | .01 | | | .02 | | |  | | | .00 | | .01 | | |  |
| 14 |  |  | Grades alter | –.02 | .01 | | \* | –.03 | | .01 | | | \* | | | .04 | | | .02 | | | \* | | | –.03 | | .01 | | | \*\* |
| 15 |  |  | Grades similarity | .27 | .08 | | \*\* | .61 | | .10 | | | \*\* | | | .66 | | | .09 | | | \*\* | | | .46 | | .08 | | | \*\* |
| 16 |  |  | Own home ego |  |  | |  | –.02 | | .04 | | |  | | | .09 | | | .03 | | | \*\* | | | .04 | | .03 | | |  |
| 17 |  |  | Own home alter |  |  | |  | .03 | | .04 | | |  | | | .02 | | | .03 | | |  | | | .07 | | .03 | | | \*\* |
| 18 |  |  | Own home same |  |  | |  | .07 | | .04 | | | † | | | .04 | | | .03 | | |  | | | .08 | | .03 | | | \*\* |
| 19 |  |  | Class same | .16 | .05 | | \*\* | .40 | | .05 | | | \*\* | | | .25 | | | .04 | | | \*\* | | | .30 | | .05 | | | \*\* |
|  |  | *Effects of network structure* | |  |  | |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 20 |  |  | Outdegree | –3.03 | .10 | | \*\* | –2.68 | | .12 | | | \*\* | | | –2.20 | | | .15 | | | \*\* | | | –2.77 | | .13 | | | \*\* |
| 21 |  |  | Reciprocity | 2.45 | .07 | | \*\* | 2.27 | | .08 | | | \*\* | | | 2.41 | | | .07 | | | \*\* | | | 2.22 | | .07 | | | \*\* |
| 22 |  |  | Transitive triplets | .54 | .03 | | \*\* | .50 | | .03 | | | \*\* | | | .56 | | | .02 | | | \*\* | | | .44 | | .03 | | | \*\* |
| 23 |  |  | 3-cycles | –.33 | .05 | | \*\* | –.36 | | .06 | | | \*\* | | | –.39 | | | .04 | | | \*\* | | | –.15 | | .06 | | | \* |
| 24 |  |  | Indegree popularity (sqrt) | .12 | .02 | | \*\* | .00 | | .03 | | |  | | | .03 | | | .03 | | |  | | | .12 | | .03 | | | \*\* |
| 25 |  |  | Indegree activity (sqrt) | –.50 | .05 | | \*\* | –.42 | | .08 | | | \*\* | | | –.82 | | | .08 | | | \*\* | | | –.59 | | .06 | | | \*\* |
| 26 |  |  | Outdegree activity (sqrt) | .17 | .02 | | \*\* | .16 | | .04 | | | \*\* | | | .16 | | | .02 | | | \*\* | | | .19 | | .02 | | | \*\* |
|  | *Smoking initiation dynamics* | | |  |  | |  |  | |  |  | |  | | | | |  | | | |  | | |  | |  | | |  |
| 27 |  | Rate P1 | | .06 | | .04 |  | .17 | | .10 | | |  | | | .06 | | | .03 | | |  | | | .05 | | .05 | | |  |
| 28 |  | Rate P2 | | .03 | | .02 |  | .15 | | .13 | | |  | | | .08 | | | .04 | | |  | | | .04 | | .04 | | |  |
| 29 |  | Rate P3 | | .04 | | .04 |  | .11 | | .11 | | |  | | | .05 | | | .03 | | |  | | | .05 | | .04 | | |  |
|  |  | *Effects of the friend network* | |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 30 |  |  | Avg. exposure to friends' smoking | 3.09 | | 1.46 | \* | .53 | | 1.83 | | |  | | | 2.76 | | | 1.13 | | | \* | | | 3.48 | | 1.91 | | | † |
|  |  | *Effects of individual covariates* | |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 31 |  |  | Female |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | | –.78 | | .36 | | | \* |
| 32 |  |  | Hispanic |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 33 |  |  | Grades | –.36 | | .09 | \*\* | –.22 | | .13 | | | † | | | .26 | | | .21 | | |  | | |  | |  | | |  |
| 34 |  |  | Own home |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 35 |  |  | Free lunch |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 36 |  |  | Parent smoke |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
| 37 |  |  | Sibling smoke |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |  |
|  | *Time heterogeneity dummies* | | |  |  | |  |  |  | |  | | |  | | |  | | |  | | |  | | |  | |  | | |
| 38 |  |  | Outdegree P1 (ref) |  | |  |  |  | |  | |  | | |  | | | |  | |  | | |  | | |  | |  | |
| 39 |  |  | Outdegree P2 | .28 | | .07 | \*\* | .80 | | .08 | | \*\* | | | .54 | | | | .09 | | \*\* | | | .14 | | | .07 | | \* | |
| 40 |  |  | Outdegree P3 | –.01 | | .08 |  | .23 | | .09 | | \*\* | | | –.30 | | | | .10 | | \*\* | | | –.27 | | | .10 | | \*\* | |
| 41 |  |  | Reciprocity P1 (ref) |  | |  |  |  | |  | |  | | |  | | | |  | |  | | |  | | |  | |  | |
| 42 |  |  | Reciprocity P2 | .54 | | .11 | \*\* | .55 | | .14 | | \*\* | | | .13 | | | | .10 | |  | | | .51 | | | .11 | | \*\* | |
| 43 |  |  | Reciprocity P3 | .29 | | .13 | \*\* | –.36 | | .14 | | \* | | | .21 | | | | .11 | |  | | | .43 | | | .14 | | \*\* | |
| 44 |  |  | Smoke same P1 (ref) |  | |  |  |  | |  | |  | | |  | | | |  | |  | | |  | | |  | |  | |
| 45 |  |  | Smoke same P2 | –.06 | | .09 |  | .00 | | .11 | | \*\* | | | –.53 | | | | .10 | | \*\* | | | –.17 | | | .10 | |  | |
| 46 |  |  | Smoke same P3 | –.13 | | .13 |  | –.35 | | .12 | | \*\* | | | –.21 | | | | .11 | | \* | | | –.03 | | | .13 | |  | |
| 47 |  |  | Class same P1 (ref) |  | |  |  |  | |  | |  | | |  | | | |  | |  | | |  | | |  | |  | |
| 48 |  |  | Class same P2 | –.26 | | .09 | \*\* | –.46 | | .09 | | \*\* | | | –.33 | | | | .09 | | \*\* | | | –.53 | | | .09 | | \*\* | |
| 49 |  |  | Class same P3 | –.66 | | .14 | \*\* | –.32 | | .12 | | \*\* | | | –.54 | | | | .12 | | \*\* | | | –.37 | | | .12 | | \*\* | |

*Note*: PE = Parameter estimate. SE = standard error. P = time period between two consecutive study waves. Avg. = average. Parameter estimates that are not included in the table were all tested during the forward selection approach used to specify the models and were excluded from the final model because they were not marginally or statistically significant. Survey data was collected from four high schools in one Los Angeles neighborhood from 2010-2013.

† *p* < .10, \* *p* < .05, \*\* *p*<.01

**Table B2.** Calculated Joint Monte Carlo Mahalanobis Distance Tests Assessing Model Goodness of Fit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Graph statistic | School 1 | School 2 | School 3 | School 4 |
| Indegree distribution | 809.8 | 106.8 | 496.1 | 1341.3 |
| Outdegree distribution | 410.8 | 119.4 | 143.3 | 389.8 |
| Triad census | 1531.3 | 660.5 | 1094.1 | 2500.5 |
| Geodesic distribution | 570.6 | 263.7 | 311.1 | 709.1 |

1. Compared to the strength of the reciprocity effect from W1–W2 (period 1), this effect was significantly stronger from W2–W3 (effect 42: positive reciprocity P2) in all schools except School 3, and it was significantly stronger from W3–W4 (effect 43: positive reciprocity P3) in Schools 1 and 4. However in School 2, preferences to reciprocate friendship ties were significantly *weaker* from W3–W4, compared to the strong positive preference from W1–W2. In School 3, there were no significant differences in the strength of the reciprocity effect over time. [↑](#footnote-ref-1)