The Effect of Positive and Negative Explicit Peer Influence on Adolescent Risky Decision-Making

Yifei Cao^{1*}, Ting Huang¹

¹School of Psychology, Northeast Normal University, Changchun, Jilin, China, 130024

* Correspondence:

Yifei Cao

caoyf255@nenu.edu.cn

Keywords: risk-taking, adolescent, peer influence, decision-making, friendship

Abstract

Adolescents are susceptible to peer influence—in particular, “explicit peer influence” (EPI)—when making decisions. However, prior research has elicited mixed findings with respect to the exact effects of positive and negative EPI. Ensuring ecological validity regarding the present examination of different types of EPI, the Stoplight Game paradigm was revised by recording an adolescent in a simulated driving task in the presence of his or her classmate. A sample of 110 Chinese middle-school students (aged between 12 and 16 years old) was used to form 60 same-sex dyads that were randomly assigned to “negative EPI” (peer encourages driver to cross intersections as traffic light turns yellow), “positive EPI” (peer discourages such behaviors), and control (peer keeps quiet) conditions. The proportion of participants crossing intersections and the number of crashes were significantly higher in the negative EPI condition than in the control and positive EPI conditions. Latency with respect to crossing in the negative EPI condition was significantly longer than in the control group. These results suggest that negative EPI encourages adolescents to take risks, while positive EPI attenuates risky behavior. The effects of friendship status and gender were found to be insignificant. Further studies are warranted to elucidate the mechanisms underlying EPI.

INTRODUCTION

Adolescence is a phase of an individual’s lifespan that begins at the time of physical puberty and ends with the assumption of adult-like levels of autonomy, and is associated with greater independence in social decision-making (Harakeh and Vollebergh, 2012). The differential

development of limbic reward systems compared with top-down control systems during this stage of life is theorized to be the biological basis for the risk-taking behavior of adolescents (Casey et al., 2011). Researchers have shown that the decision-making competence of adolescents is lower than that of adults, because the former group gives less consideration to relative risks and benefits or suggestion seeking (Halpern-Felsher and Cauffman, 2001). Furthermore, adolescents have been found to engage in wider range of risky behaviors, such as criminal acts, reckless driving, and unprotected sex, than adults (Steinberg, 2008). Seventy-four percent of adolescent deaths are caused by risky behaviors such as these, including motor vehicle crashes, unintentional injuries, homicide, and suicide (Kann et al., 2018). Furthermore, risky sexual behavior in adolescents has resulted in an increase in the number of adolescents with HIV infections (Li et al., 2013). In sum, risky decision-making is associated with behaviors that endanger health during adolescence (Kim-Spoon et al., 2016). Therefore, elucidation of the biological and psychological mechanisms underpinning increased risk-taking in adolescents is important in order to enable young people to exercise good judgement when facing risky choices.

Researchers are increasingly interested in what causes adolescents to make risky decisions. Parenting attitudes and behaviors (Caldwell et al., 2010), individual resilience (Ali et al., 2010), self-regulation (Quinn and Fromme, 2010), and context dependency (Metzler et al., 1994) have all been linked to adolescent risk-taking. Of these factors, context dependency in relation to adolescents has been subcategorized into two domains: contexts of heightened arousal or excitement, and contexts involving peers. In particular, peer influence has been emphasized in studies of adolescent decision-making. The presence of peers has been shown to improve the salience of stimuli and increase adolescents' sensitivity (Hartley and Somerville, 2015). Additionally, according to the theory of life course-persistent antisocial behavior, children's neuropsychological problems interact with their criminogenic environment, with risky peers being one example of this type of environment (Moffitt, 1993).

Some previous studies have manipulated the presence of peers in order to understand peer influence. Gardner and Steinberg (2005) designed an experiment to compare the risk preferences and risky decision-making of adolescents with and without peers, and their results suggested that adolescents are more inclined toward risky decisions and behavior with peers watching them. Kretsch and Harden (2014) studied peer influence using a simulated driving task, in which participants performed the task twice—once individually and once with peers observing. In that study too, participants' risky driving

behaviors increased while peers were watching them, a finding that suggests that peer presence causes adolescents to take more risks (Kretsch and Harden, 2014). However, the present study posits that any detailed effects arising from the application of different types of peer influence cannot be distinguished through a general manipulation of peer influence.

Prior studies have also found that adolescents report lower resistance to peer influence than adults (Steinberg and Monahan, 2007). Adolescents are more likely to engage in risky behaviors when they are with their peers; for example, greater engagement in substance abuse, criminal activities, and risky driving (Kretsch and Harden, 2014). According to Steinberg's (2010) dual system model, heightened risk-taking in adolescents may be due to the combination of their relatively higher inclination to seek rewards and their still-maturing capacity for self-control. As Smith et al. (2015) indicated, reward-related brain regions, such as the ventral striatum, exhibit increased activation in relation to reward stimuli. Accordingly, peer influence will have an obvious effect on the process of adolescent decision-making.

Peer influence can be further subcategorized into "explicit" and "implicit" forms (Smith et al., 2015), with "implicit peer influence" being the observation and imitation of a peer's behavior without any urging from others, while "explicit peer influence" (EPI) denotes direct pressure from peers. The latter is thought to primarily influence the risk-taking behavior of adolescents (Centifanti et al., 2014). However, peer pressure does not always support risk-taking behavior, and can provide both positive and negative influences. In contemporary research, however, very limited attention has been given to the positive or protective impact of EPI (Coyle et al., 2016), and the exact effect of positive EPI on adolescents' risky decision-making has not yet been established. According to Pfeffer and Hunter (2013), negative peer influence increases dangerous road-crossing behavior, while positive peer influence reduces it. However, another study found that adolescents tend to follow "risky" advice and resist "safe" advice in high-risk ventures (Haddad et al., 2014). Therefore, the exact effect of each type of EPI needs to be explored, in order that the most constructive type of unambiguous advice can be given to adolescents who may find themselves in unsafe circumstances.

Another limitation with the current research in this domain concerns how to increase the ecological validity of the studies' settings and ensuing findings. In Chein et al.'s (2011) study, adolescents were observed by a peer in an adjacent room while performing a simulated driving task. In another study, the researchers convinced participants that there were peers watching them, and there were just images to press on the screen (Haddad et al., 2014). However, peer influence in real life is not

restricted to observation; for example, peers might provide suggestions, or convey information through their facial expressions, to adolescents when the latter are facing risky choices. According to Pfeifer et al. (2011), responses to affective facial expressions comprise a combination of general and emotionally specific changes in the ventral striatum, ventromedial prefrontal cortex, and amygdalae. Moreover, increased neural activity in the ventral striatum is correlated with decreases in susceptibility to peer influence and risky behavior (Pfeifer et al., 2011). Consequently, setting an experimental situation with high ecological validity is of particular importance with regard to studying the real risk-taking behaviors of adolescents.

For the purpose of studying the specific effect of positive and negative EPI on adolescent risk-taking behavior, and to improve the ecological validity of research in this domain, the present study utilized a between-subjects experimental design. The Stoplight driving task (Chein et al., 2011) was used to measure the risky decision-making of adolescents, and an authentic situation involving a real friend or acquaintance giving instructed vocal and emotional suggestions to the simulated driver (the participant) was set. Participants were assigned into two groups, the “negative influence” group (peers encouraged the risk-taking behaviors) and the “positive influence” group (peers discouraged the risk-taking behaviors), and completed the task twice, once with peers staying silent and watching, and once with peers actively making suggestions. Through this research design, we set out to compare the specific effects of different types of peer influence. The two main goals of the study were: (1) to improve the ecological validity of current research by setting real situations with peers alongside the participants; (2) to elucidate the specific effect of negative and positive EPI on adolescent decision-making. According to previous research, the effect of positive influence (i.e., “safe” advice) from peers is uncertain (Pfeffer and Hunter, 2013; Haddad et al., 2014). Therefore, we hypothesized that participants in the negative influence group would take more risks and perform differently compared with participants in the other two groups; friendship status would increase the extent of peer influence, independent of EPI type; and, while those in the positive influence group would take fewer risks, participants in both the positive and the negative groups would show increased risk-taking behaviors overall.

MATERIALS AND METHODS

We used a between-subjects experimental design to study the effect of positive and negative EPI on adolescent risky decision-making. The paradigm we used was the Stoplight Game, a simulated driving task. Participants were divided into three groups: negative group, positive group, and control

group. By comparing participants' performance across the three groups, we attempted to understand the effect of positive EPI on adolescent risky decision-making.

Participants

Adolescents (aged between 12 and 16 years old, $M = 13.89$, $SD = 1.42$; $n = 110$, boys = 58, girls = 52) were recruited from a local junior high school in China. The number of students of each age was the same. All of the adolescents in the sample were of Han Chinese ethnicity. In regard to their socioeconomic status, participants were predominantly from working- and middle-class families.

Recruitment and Procedures

Recruitment for the study was announced by the head teacher in each class of the high school. Recruitment and the data collection occurred at the same school. Details regarding informed consent were distributed to students who were interested in participating, and they took the consent forms home to their parents in order that permission to participate could be obtained. The consent forms were returned in a few days, and the final adolescent participants were randomly chosen. The 110 selected students made up 60 pairs, with each pairing consisting of adolescents of the same age and gender. The pairs of adolescents in each age group were distributed evenly to participate in the three conditions (negative, positive, and quiet); therefore, the final study sample comprised 40 adolescents in the control group, 40 in the negative group, and 40 in the positive group.

Participants were told that they were participating in a study of "adolescent decision-making." Both participants in each dyad completed the McGill Friendship Questionnaire—Friendship Function (Mendelson and Aboud, 1997) first, to measure the relationship between the "peer" and the "participant." Next, the experimenter gave the participants and the peers instructions on how to complete the tasks. One of the participants in each pair was instructed to be a simulated "driver," while the other adolescent was designated the "codriver." Each "driver" completed a simulated driving task designed to measure risk-taking behavior, and the "codriver" watched the "driver" playing the driving game. In the positive groups, codrivers were instructed to give positive advice (i.e., encourage the driver to stop at the intersections) every time the driver crossed an intersection, while the codrivers in the negative groups gave negative advice (i.e., encouraging the driver to cross the intersections), and the codrivers in the control group just watched the driver silently. The words used by the peers were standardized. Participants were told that, the longer they remained after

finishing the game, the more money they would receive. The experimental protocol took between 10 and 15 minutes. All participants were compensated US\$5 for their time.

Measurements

Friendship Status

Friendship status was assessed using the McGill Friendship Questionnaire—Friendship Function (Mendelson and Aboud, 1997), a 30-item questionnaire that measures feelings about a friend or friendship in late adolescence and adulthood. The questionnaire is divided into six subscales based on the following functions of friendship: stimulating companionship, help, intimacy, reliable alliance, self-validation, and emotional security. Statements of friendship functions are responded to in accordance with a 9-point scale ranging from “*never*” (0) to “*always*” (8).

Research has found that friends and friendships that are characterized as being more similar have a greater influence on risk-taking behavior such as smoking and drinking (Xu and Fan, 2018). Accordingly, the friendship status of the participants and peers in the present study was measured and regarded as a control variable in the analysis.

Risk-Taking Behaviors

Risk-taking behaviors were assessed using the Stoplight Game (Chein et al., 2011), which was developed by Steinberg and his colleagues for analyzing the adolescent decision-making process. It is a simulated first-person driving task in which participants must cross 20 intersections to get to a destination within five minutes. Participants were told that, the sooner they reached the destination, the more money they would get for completing the experiment. Stoplights were set on every intersection, and these would turn to yellow and finally to red when participants were approaching a zebra crossing. Participants had to decide whether to brake or not. The possibilities of having a crash when crossing directly were varied, but the task took more time if a crash did occur. There were three possible outcomes: (1) the participant pressed the brake and stopped at the intersection, (2) the participant crossed the intersection directly without a crash, or (3) the participant crossed and had a crash (see also Figure 1). The computer recorded the total time it took each participant to complete the task, the outcome at each intersection, and the latency between the appearance of a yellow light and the application of the brakes (Kretsch and Harden, 2014).

FIGURE 1 | The Stoplight Game is a driving task that requires participants to cross 20 straight intersections in under five minutes. Participants control whether to stop at or cross the intersection while the stoplight is still yellow or red by pressing the SPACE bar as a brake. The possibility of a crash varies at different intersections, and a crash costs more time as the driver has to restart the car.

Source: Chein et al. (2011), F1.

RESULTS

The results are reported in two sections—one focusing on analyses of the effects of gender and friendship status on adolescents' risky behaviors, and the other concentrating on the effects of different types of EPI. One-way analyses of variance were used to analyze the group effects of EPI.

Simple *t*-test analyses were used to check for gender differences in latency regarding the use of brakes, the proportion of risky decisions, and the number of crashes. The results revealed no gender differences in respect of all of the study's variables, and girls were found to perform similarly to boys in the Stoplight Game.

TABLE 1 | A statistical table describing risky decisions in each dimension.

Groups	Latency <i>M (SD)</i>	Risky decision <i>M (SD)</i>	Crashing times <i>M (SD)</i>
<i>Negative group</i>	1,345.98 (370.47)	0.55 (0.20)	3.72 (1.71)
Boys	1,332.94 (264.68)	0.52 (0.17)	4.00 (1.63)
Girls	1,362.28 (492.64)	0.58 (0.24)	3.38 (1.85)
<i>Positive group</i>	1,048.08 (159.67)	0.32 (0.20)	1.56 (1.20)
Boys	1,072.27 (192.68)	0.34 (0.27)	1.33 (1.32)
Girls	1,023.89 (125.43)	0.30 (0.13)	1.78 (1.10)
<i>Quiet group</i>	1,072.21 (142.15)	0.43 (0.09)	2.53 (1.12)
Boys	1,093.86 (132.65)	0.44 (0.10)	2.90 (1.29)
Girls	1,048.14 (156.32)	0.43 (0.19)	2.11 (0.78)

We ranked the scores of participants' friendship statuses and divided them into five different levels. One-way analyses of variance were used to test the effects of friendship status on the study variables. The results indicated that adolescents in pairs featuring differing friendship statuses did not show any difference to pairs with similar friendship statuses in terms of their respective executions of the Stoplight Game.

The relative proportions of risky decisions are depicted in Figure 2. The results indicated that the adolescents in the three groups showed significant differences in their decision-making at the intersection, $F(2, 52) = 7.96$, $\eta^2 = .234$, $p < .001$. Adolescents in the negative group were more likely to cross the yellow light than those in the control group ($p < .05$) and in the positive group ($p < .01$). Furthermore, adolescents in the positive group were less likely to cross the intersection than those in control group ($p < .05$).

FIGURE 2 | Mean proportions of risky decisions in the three groups.

* $p < .05$, ** $p < .01$, *** $p < .001$

As Figure 3 illustrates, there were significant differences observed regarding latency in brake use across the three conditions, $F(2, 52) = 8.243$, $\eta^2 = .241$, $p < .001$. Post-hoc analyses using the Bonferroni correction found that it took more time for adolescents in the negative group to make the decision to brake than it did for those in the control group ($p < .01$) and the positive group ($p < .01$). There was no significant difference between the positive group and the control group.

FIGURE 3 | Mean latency of brake use in the three groups.

218 * $p < .05$, ** $p < .01$, *** $p < .001$

219

220 Moreover, as predicted, the number of crashes were different between the three conditions $F(2, 52) =$
221 11.39 , $\eta^2 = .305$, $p < .001$. Post-hoc analysis indicated that participants in the negative group
222 experienced significantly more crashes than the control group ($p < .05$) and the positive group (p
223 $< .001$). In addition, adolescents in the positive group had significantly fewer crashes than those in
224 the control group ($p < .01$).

225

226 **FIGURE 4** | Mean number of crashes in the three groups.

227 * $p < .05$, ** $p < .01$, *** $p < .001$

228

229 The present study set out to examine the effect of positive and negative EPI on adolescent decision-
230 making. Taken together, the results from this experiment reveal that adolescents tend to take more
231 risks and experience greater hesitation when they are encouraged by their peers, while positive advice
232 (i.e., discouraging risky behavior) from their peers decreased the risk-taking behaviors and moments
233 of hesitation in risky situations.

235 The present study examined the effects of positive EPI and negative EPI on risky decision-making in
236 adolescents. The results suggest that the effects of positive EPI and negative EPI are different:
237 positive EPI significantly decreased the proportion of risky decisions made; in the test, participants in
238 this group showed higher levels of application of the brakes, and a significantly lower number of
239 crashes. In comparison, negative EPI increased the proportion of risky decisions made, the latency of
240 brake use, and the number of crashes. Furthermore, our hypotheses regarding friendship status and
241 gender were unsupported, because neither variable was found to have a significant effect on the
242 decision-making process.

243 The findings did, however, support the hypothesis that negative EPI would increase risky decision-
244 making in adolescents, which is consistent with results from previous studies. In the research of
245 Reynolds et al. (2014), adolescents were found to take more risks when directly encouraged by their
246 peers. This increase in risk-taking may be prompted by various factors. First, peers' attitudes as a
247 kind of social influence have a significant effect on adolescents' risk perception (Knoll et al., 2015).
248 Therefore, an encouraging attitude from peers could change the attitude toward risk of the "driver,"
249 and facilitate risk-taking behaviors. Furthermore, as Gardner and Steinberg (2005) pointed out,
250 adolescents take greater risks and focus more on the benefits instead of the cost of risky behaviors in
251 the presence of their peers, and direct encouragement from peers could therefore further increase the
252 focus on the benefits. Another explanation for this increase in risky decision-making could be
253 attributable to feedback on health status and peer popularity (Padron et al., 2015). According to
254 Padron et al. (2015), adolescents prefer to make risky decisions when receiving feedback about any
255 negative consequences for health and positive consequences for peer popularity. The encouragement
256 provided by peers in the present study may be considered a kind of catalyst in respect of the
257 adolescents' crossing behavior, and the crossing behavior increased because adolescents regard this
258 kind of favor as pertaining to popularity among peers.

259 The findings in this study also supported the hypothesis that positive EPI could decrease risk-taking
260 behavior. However, the exact effect of EPI is still under discussion. Some researchers have found that
261 positive EPI can decrease the risk-taking behaviors of adolescents (Pfeffer and Hunter, 2013; Braams
262 et al., 2019), while others have found that adolescents will resist a "safe" suggestion from peers
263 (Haddad et al., 2014). The decrease of risky behaviors identified in the present study may be
264 explained by the dual system theory advanced by Steinberg (2010), according to which adolescents'

risky behaviors may be due to the faster maturation of the body's "reward" system compared with its "control" system. In our study, positive advice from their peers increased adolescents' function of self-control, and, thereby, increased the focus of the cost of risky behaviors, which in turn brought about a decrease in enactment of those behaviors. However, adolescents' tendency to avoid suggestion seeking is another important factor behind their risky decision-making (Halpern-Felsher and Cauffman, 2001). In the present study, peers in the positive group provided the "drivers" with positive advice directly, and thus compensated for the reduced suggestion seeking of adolescents. In addition, the effect of positive EPI varies with the types of decisions (Braams et al., 2019). Haddad and colleagues (2014) postulated that adolescents' resistance to "safe" advice from peers in their card-playing experiment might have come about because they had interpreted the card-playing game as a kind of competition with others, and so they treated the suggestions from peers as inducements to limit their own scores. In our study, we featured a real-peer context for the adolescents using a simulated driving task in the completion of which they had to work together in order to get to the destination as soon as possible, which meant that the adolescents interpreted the suggestions from their peers as being cooperative and they followed this advice.

Our third finding of interest was that the difference between the effect of EPI on boys and girls was not significant. Research about whether males or females are more susceptible to peer influence remains equivocal. In some studies, the risky behaviors of male adolescents have been interpreted as tending to be related to peer popularity (Rebellon et al., 2019), while other research has found that females are more reliant on social influence, including peer influence, but that, as time progresses, male adolescents increase the extent to which they rely on peers. The results of our study are different from those of previous investigations into the effects of peer influence; however, as we did not consider gender as a main variable in the first instance.

Furthermore, contrary to our hypothesis, friendship status did not affect the effect of EPI on adolescents' risky behavior, which is inconsistent with the findings of a previous study (Xu et al., 2018). A possible reason for this difference is that we selected students from a small-sized middle school in China with around 120 students in each grade, meaning that it is likely that these adolescents will have known each other before taking part in the experiment. In Chinese culture, individuals are far more interdependent than in other countries, and so suggestions from a known person may be as impactful as suggestions from a friend in terms of changing risky behaviors in adolescents. Therefore, future studies are needed to further explore the effect of gender and

friendship status on the effects of EPI on adolescents' risky decision-making, such as by comparing the effects of suggestions from strangers with those from friends.

In the current study, we sought to improve the ecological validity of the research and its findings by revising the Stoplight Game. We established a real-peer context in which the participating adolescents received real suggestions from their peers. Peer influence in a real context will be entirely different from that manifested in a setting in which words are shown on a computer screen, as peers in a real context will also offer suggestions through tone and expression, and these can equally alter the attitudes of adolescents (Winkielman et al., 2005). However, limitations also exist in respect to this study, as we only set pairs of participants of the same age and gender, and the standardization of the words articulated by the peers was not universalized, which might explain why the effects of gender and friendship status were not found to be significant.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

YC conceived this study and was involved in conducting the experiments, processing data, and writing the manuscript. TH was involved in data collection, processing data, and writing the manuscript.

Acknowledgments

The authors acknowledge Dr. Laurence Steinberg at Temple University for providing the computerized tasks used in the current study; Dr Lei Gu at Harvard Medical School for guiding the program; Dr. Yuetong Zhao at Northeast Normal University for her help of the experimental design; and Dr. Xiaochun Xie for modulating the manuscript. The results of the present study were presented as a poster at the Society of Personality and Social Psychology (SPSP) 2020 convention.

References

- Ali, M. M., Dwyer, D. S., Vanner, E. A., and Lopez, A. (2010). Adolescent propensity to engage in health risky behaviors: the role of individual resilience. *Int. J. Environ. Res. Public Health* 7, 2161–2176. doi: 10.3390/ijerph7052161
- Braams, B. R., Davidow, J. Y., and Somerville, L. H. (2019). Developmental patterns of change in the influence of safe and risky peer choices on risky decision-making. *Dev. Sci.* 22, e12717. doi: 10.1111/desc.12717
- Caldwell, C. H., Rafferty, J., Reischl, T. M., De Loney, E. H., and Brooks, C. L. (2010). Enhancing parenting skills among nonresident African American fathers as a strategy for preventing youth risky behaviors. *Am. J. Community Psychol.* 45, 17–35. doi: 10.1007/s10464-009-9290-4
- Casey, B. J., Hare, T. A., and Galván, A. (2011). “Risky and impulsive components of adolescent decision making,” in *Decision Making, Affect, and Learning: Attention and Performance XXIII*, eds. M. R. Delgado, E. A. Phelps, and T. W. Robbins (New York, NY: Oxford University Press), 425–444.
- Centifanti, L. C. M., Modecki, K. L., MacLellan, S., and Gowling, H. (2014). Driving under the influence of risky peers: an experimental study of adolescent risk taking. *J. Res. Adolesc.* 26, 207–222. doi: 10.1111/jora.12187
- Chein, J. M., Albert, D., O’Brien, L., Uckert, K., and Steinberg, L. (2011). Peers increase adolescent risk taking by enhancing activity in the brain’s reward circuitry. *Dev. Sci.* 14, F1–F10. doi: 10.1111/j.1467-7687.2010.01035.x
- Coyle, C., Bramham, J., Dundon, N., Moynihan, M., and Carr, A. (2016). Exploring the positive impact of peers on adolescent substance misuse. *J. Child Adolesc. Subst. Abuse* 25, 134–143. doi: 10.1080/1067828x.2014.896761
- Gardner, M., and Steinberg, L. (2005). Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood: an experimental study. *Dev. Psychol.* 41, 625–635. doi: 10.1037/0012-1649.41.4.625

349 Haddad, A. D. M., Harrison, F., Norman, T., and Lau, J. (2014). Adolescent and adult risk-taking in
350 virtual social contexts. *Front. Psychol.* 18, 1476. doi: 10.3389/fpsyg.2014.01476

351 Halpern-Felsher, B. L., and Cauffman, E. (2001). Costs and benefits of a decision: Decision-making
352 competence in adolescents and adults. *J. Appl. Dev. Psychol.* 22, 257–273. doi:
353 10.1016/S0193-3973(01)00083-1

354 Harakeh, Z., and Vollebergh, W. A. M. (2012). The impact of active and passive peer influence on
355 young adult smoking: an experimental study. *Drug Alcohol Depend.* 121, 220–223. doi:
356 10.1016/j.drugalcdep.2011.08.029

357 Hartley, C. A., and Somerville, L. H. (2015). The neuroscience of adolescent decision-making. *Curr.*
358 *Opin. Behav. Sci.* 5, 108–115. doi: 10.1016/j.cobeha.2015.09.004

359 Kann, L., McManus, T., Harris, W. A., Shanklin, S. L., Flint, K. H., Queen, B., et al. (2018). Youth
360 risk behavior surveillance – United States, 2017. *MMWR Surveill. Summ.* 67, 1–114. doi:
361 10.15585/mmwr.ss670

362 Kim-Spoon, J., Kahn, R., Deater-Deckard, K., Chiu, P., Steinberg, L., and King-Casas, B. (2016).
363 Risky decision making in a laboratory driving task is associated with health risk behaviors
364 during late adolescence but not adulthood. *Int. J. Behav. Dev.* 40, 58–63. doi:
365 10.1177/0165025415577825

366 Knoll, L. J., Magis-Weinberg, L., Speekenbrink, M., and Blakemore, S.-J. (2015). Social influence
367 on risk perception during adolescence. *Psychol. Sci.* 26, 583–592. doi:
368 10.1177/0956797615569578

369 Kretsch, N., and Harden, K. P. (2014). Pubertal development and peer influence on risky decision
370 making. *J. Early Adolesc.* 34, 339–359. doi: 10.1177/0272431613489373

371 Li, S. H., Huang, H., Xu, G., Cai, Y., Huang, F. R., and Ye, X. X. (2013). Substance use, risky sexual
372 behaviors, and their associations in a Chinese sample of senior high school students. *BMC*
373 *Public Health* 13, 295. doi: 10.1186/1471-2458-13-295

374 Metzler, C. W., Noell, J., Biglan, A., Ary, D., and Smolkowski, K. (1994). The social context for
 375 risky sexual behavior among adolescents. *J. Behav. Med.* 17, 419–438. doi:
 376 10.1007/bf01858012

377 Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: a
 378 developmental taxonomy. *Psychol. Rev.* 100, 674–701. doi: 10.1037/0033-295x.100.4.674

379 Padron, I., Jose Rodrigo, M., and De Vega, M. (2015). Feedback on health status and peer popularity
 380 influences social risk decision-making processes in adolescents and young adults. *Eur. J. Dev.*
 381 *Psychol.* 13, 241–253. doi: 10.1080/17405629.2015.1089769

382 Pfeffer, K., and Hunter, E. (2013). The effects of peer influence on adolescent pedestrian road-
 383 crossing decisions. *Traffic Inj. Prev.* 14, 434–440. doi: 10.1080/15389588.2012.725259

384 Pfeifer, J., Masten, C., Moore, W., Oswald, T., Mazziotta, J., Iacoboni, M., and Dapretto, M. (2011).
 385 Entering adolescence: resistance to peer influence, risky behavior, and neural changes in
 386 emotion reactivity. *Neuron* 69, 1029–1036. doi: 10.1016/j.neuron.2011.02.019

387 Quinn, P. D., and Fromme, K. (2010). Self-regulation as a protective factor against risky drinking
 388 and sexual behavior. *Psychol. Addict. Behav.* 24, 376–385. doi: 10.1037/a0018547

389 Rebellon, C. J., Trinkner, R., Van Gundy, K. T., and Cohn, E. S. (2019). No guts, no glory: the
 390 influence of risk-taking on adolescent popularity. *Deviant Behav.* 40, 1464–1479. doi:
 391 10.1080/01639625.2018.1519128

392 Reynolds, E. K., MacPherson, L., Schwartz, S., Fox, N. A., and Lejuez, C. W. (2014). Analogue
 393 study of peer influence on risk-taking behavior in older adolescents. *Prev. Sci.* 15, 842–849.
 394 doi: 10.1007/s11121-013-0439-x

395 Smith, A. R., Steinberg, L., Strang, N., and Chein, J. (2015). Age differences in the impact of peers
 396 on adolescents' and adults' neural response to reward. *Dev. Cogn. Neurosci.* 11, 75–82. doi:
 397 10.1016/j.dcn.2014.08.010

398 Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Dev. Rev.* 28, 78–
 399 106. doi: 10.1016/j.dr.2007.08.002

- 400 Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Dev. Psychobiol.* 52, 216–224.
401 doi: 10.1002/dev.20445
- 402 Steinberg, L., and Monahan, K. C. (2007). Age differences in resistance to peer influence. *Dev.*
403 *Psychol.* 43, 1531–1543. doi: 10.1037/0012-1649.43.6.1531
- 404 Winkielman, P., Berridge, K. C., and Wilbarger, J. L. (2005). Unconscious affective reactions to
405 masked happy versus angry faces influence consumption behavior and judgments of value.
406 *Pers. Soc. Psychol. Bull.* 31, 121–135. doi: 10.1177/0146167204271309
- 407 Xu, Y. L., and Fan, L. L. (2018). Diverse friendship networks and heterogeneous peer effects on
408 adolescent misbehaviors. *Educ. Econ.* 26, 233–252. doi:10.1080/09645292.2017.1406458