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Mechanisms underlying heightened risk taking in adolescents as compared with adults

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Abstract

Self-report surveys and behavioral tasks indicate greater risk-taking behavior in adolescents as compared with adults. However, the underlying causes of these behavioral differences remain unclear. The present study examined the possibility that adolescents may be more susceptible to immediate positive and negative outcomes than adults. We compared the behavior of adolescents and adults on a modified version of the Balloon Analogue Risk Task (Lejuez et al., 2002). The task required that participants press a button to "inflate" a series of balloons on a computer screen. Balloons inflated until either the participant released the button ("saved" balloons) or the balloon "burst." Accumulated points increased as the duration of the buttonpress increased; however, simultaneously, the likelihood that the balloon would burst also increased. Adolescents inflated balloons to a larger size prior to saving them than adults did, suggesting relatively higher levels of risk taking, although the adolescents' behavior was not uniformly risk prone. Further, in comparison with adults, behavior in adolescents was more influenced by whether a balloon was saved or had burst on the preceding trial, suggesting that sensitivity to immediate consequences is one mechanism that underlies the observed difference in risk taking.

Objective statistics examining mortality from the National Center for Health Statistics (www.cdc.gov/nchs/datawh/statab/unpubd/mortabs/lcwk1_10.htm) as well as self-report measures indicate that adolescents have a high propensity for engaging in risky behavior (see, e.g., Grunbaum et al., 1999; Jankowski, Rosenberg, Sengupta, Rosenberg, & Wolford, 2007). In the present article, *risky behavior* is defined as a behavior that may result in a positive outcome (e.g., financial reward, pleasant physical or psychological sensations), but that also carries some probability of a negative outcome (e.g., injury, financial loss). Greater risk is associated with larger probabilities of the negative outcome and larger magnitudes of the negative outcome. A number of theories have been proposed to explain age-related differences in risk taking (see Byrnes, 1998, and Reyna & Farley, 2006, for reviews). Explanations of these differences are often framed as interactions between cognitive processes, neurodevelopmental changes, and experience (e.g., Luna, Garver, Urban, Lazar, & Sweeney, 2004; Steinberg, 2007; see Sowell et al., 2004, for a review of neurodevelopmental data). These explanations suggest that adolescents behave in more risky ways because they are more sensitive to immediate outcomes (e.g., Crone, Bunge, Latenstein, & van der Molen, 2005), and that they overemphasize positive outcomes but under-emphasize negative outcomes (e.g., Crone, Vendel, & van der Molen, 2003). A related idea is that adolescents have less experience than do adults on which to construct outcome representations ("gists") that can be used to guide behavior under uncertainty. As a result, adolescents are more responsive to outcome cues in the immediate situation (Reyna, 2004).

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Behavioral tasks that measure how response preferences develop under different positive and negative outcome probabilities have been used to examine decision making in the laboratory. In combination with self-report surveys, these tasks have associated specific behavioral patterns with self-reported risk-taking behavior and may enable us to understand the mechanisms underlying age-related differences in risk-taking behavior. A widely used task of this sort is the Iowa Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994), which requires participants to select cards from four different decks. The decks differ in the size of monetary reward, the size of monetary loss, and the probability of loss. The main dependent measure is the number of cards selected before individuals learn to exclusively select cards from the “good” decks, which yield the highest positive rate of return. There are age-related changes on this task, so that young adolescents switch to select good decks more slowly than do older adolescents and adults (see, e.g., Hooper, Luciana, Conklin, & Yarger, 2004), and this difference cannot be attributed to adolescents exhibiting deficits in cognitive inhibition (Crone et al., 2003). The developmental question is: What differences between children, adolescents, and adults cause the different rates of switching from the bad decks to the good ones? Unfortunately, the available dependent measures do not permit an analysis of individual trial outcomes on behavior. These limitations make it difficult to use this task to examine how responses to trial outcomes might relate to observed age-related differences in risk taking.

The Balloon Analogue Risk Task (BART) is another decision-making task that requires learning about inherent gains and losses (Lejuez et al., 2002). In that task, participants press a button to inflate a balloon viewed on a computer screen. The larger the balloon is inflated, the more points the participant wins, but there is also a larger probability that the balloon will burst and the points will be lost. On a moment-by-moment basis, participants must decide whether to stop pressing and take the points earned or continue pressing the button and risk losing the points. Unlike the Iowa Gambling Task, which has fixed probabilities of loss for each deck, the BART can make fine-grained measures of the level of risk a participant is willing to accept on each trial. A second advantage is that the BART has a documented sensitivity to real-life measures of the propensity to engage in risky behavior. Thus, Lejuez and colleagues (Lejuez et al., 2003; Lejuez et al., 2002) reported that the mean number of presses on trials when participants did not burst the balloon was correlated strongly with the amount of self-reported alcohol and drug use in college students and inner-city adolescents. Further, Lejeuz, Simmons, Aklin, Daughters, and Dvir (2004) found that self-reported risky sexual behavior was predicted by the number of presses, over and above the variance accounted for by self-report measures of self-esteem, impulsivity, and demographics.

The present study used a modified version of the BART (the Two Balloon Inflation Task [2BIT]) to characterize similarities and differences in risk-taking behavior between adolescents and adults. The modified task involves responding to two different burst probability distributions, each represented by a different color balloon. Analyzing these responses permits us to measure both risk taking and individuals’ response sensitivity to the differences in the burst probabilities associated with the two balloon types. More importantly, with regard to identifying mechanisms contributing to differences in adolescent and adult behavior, the present design allows us to assess trial-by-trial behavior. Doing so permits us to determine the influence of positive or negative outcomes (saves and bursts, respectively) and to compare the impact of contextual cues (balloon color) learned from accumulated experience with the impact of immediately preceding events (i.e., saves and bursts). If adolescents show heightened risk taking as compared with adults, then we would expect to see adolescents inflating balloons of each type to a larger size than adults. The degree of risk taking can also be characterized by comparing average inflation sizes to the size that is optimal for earning points, but it is unclear whether heightened risk taking will be manifested in suboptimal, risk-prone behavior on the task. Data from other decision-making paradigms suggest that adolescents should show greater responsivity to immediate outcomes. This leads to the hypothesis that adolescents may inflate balloons to a greater degree if the prior balloon was saved than if it burst, whereas adults may rely to a greater degree on the contextual cues provided by the balloons' color on each trial.

METHOD

Participants

Sixteen adolescents (12 female), 14–17 years of age, and 16 adults (10 female), 35–55 years of age, were recruited via word of mouth and printed advertisements. Participants were screened over the telephone, and fluent English-speaking participants who met the age criterion were invited to participate. Table 1 shows the participants' demographic characteristics. Parents accompanied adolescents to the experimental session in order to provide consent. Parents did not accompany adolescents into the testing room, but they were given the choice to either leave or wait in a waiting room until the adolescent completed the experiment.

Procedure

After the informed-consent and assent procedures, participants completed a series of questionnaires and a computer task, as described below. Participants were then debriefed and compensated for their time ($15/h for 1.5–2 h) and for their performance on the task.

Measures

Questionnaires—Participants first completed a general health questionnaire, which included a detailed section on current and lifetime recreational drug-use history and general demographic information. Then, they completed the Shipley Institute of Living Scale (SILS; Zachary, 1991), which is a 60-item test designed to measure intellectual ability and impairment in both verbal ability and abstract reasoning. They also completed the Sensation Seeking Scale, Form V (SSS; Zuckerman, Eysenck, & Eysenck, 1978) and the Barratt Impulsiveness Scale, Version 11 (BIS; Patton, Stanford, & Barrett, 1995).

2BIT—Participants were told that they would perform a task that simulated blowing up balloons. At the beginning of each trial, an image of a deflated balloon appeared on the computer screen. When participants pressed a button, the image of the balloon increased in size, indicating that the balloon was inflating. They were told that the more they inflated a balloon, the more points they would earn, although the balloons could not get any larger than the size that would fill the computer screen. However, they would get to keep the points only if they "saved" the balloon. They were told that balloons might unpredictably "burst" and that any points accumulated for a burst balloon would be lost. They were also informed that the likelihood that a balloon would burst increased as its size increased.

Participants were not told that the exchange ratio was 1 point/60-msec inflation duration. But in order to motivate them, the consent form stated that individuals who earned above the average number of points would earn a $10 bonus and that those earning less would receive only $1. In fact, they all received $10. The number of points associated with inflating each balloon was not shown while participants were pressing the button so that they could not use this information to guide their behavior. Instead, the number of points earned on a trial appeared on the screen when participants released the button and "saved" that balloon, along with the total number of points earned so far. Participants did not see the number of points lost if the balloon burst. A new, deflated balloon then appeared. Thus, participants were faced with a conflict: Larger numbers of points were earned for continued buttonpressing; however, at the same time, the risk that all points for that trial would be lost also increased.

The 2BIT is based on the BART (Lejuez et al., 2002) but involves two types of balloons (rather than one) presented in a pseudorandom order: (1) "small" balloons (n = 150) and (2) "large" balloons (n = 150). The two types could be discriminated by color (blue and red, counterbalanced between participants). Participants were not informed about the significance of the balloon colors, nor were they told the number of trials on which each would appear. As shown in Figure 1A, the balloon types differed in their inflation distributions prior to bursting. On each trial, the maximum inflation size was randomly selected (without replacement) from the distribution associated with the balloon type. A second difference is that, although the BART uses discrete presses to inflate the balloon, the 2BIT uses a single continuous press to reduce the influence of response fatigue on final inflation size.

RESULTS

The adults and adolescents did not differ in the total number of points earned. However, the groups did differ in patterns of responding: The adolescents inflated the balloons to larger sizes and burst more balloons, suggesting more tolerance for negative outcomes.

Demographic and Questionnaire Measures

The adolescent and adult groups were similar in both their intellectual performance and their recent drug use (Table 1). Although adolescents tended to have higher scores on most of the personality measures of sensation seeking and impulsivity, only the differences in the attentional-impulsiveness subscale of the BIS and the thrill- and adventure-seeking subscale of the SSS were statistically significant. The small number of males in each group precluded analyses of gender differences.

2BIT Performance

Blocks—ANOVAs indicated some learning effects when sessions were subdivided into five blocks of 60 balloons: inflation duration, total number of points earned, and the number of balloons burst increased as a function of block. However, there were no significant interactions with any other factor (group, balloon type), and subsequent analyses included all of the task data.

Risk—Participants' risky behavior was quantified as the length of time that participants pressed the button to inflate balloons before releasing it and saving a balloon. Larger inflation durations were associated with higher risk because of the increased probability of a burst, and the larger losses were associated with increased inflation duration. Secondary analyses were conducted on the number of burst balloons, where a larger number of burst balloons implied greater risk taking due to increased probability of burst with increased inflation duration. Adolescents showed more risky behavior on both measures.

Adolescents inflated balloons to a larger size before saving them than did adults (Figure 2A) [$F(1,30) = 6.11$, $p = .02$]. Adolescents also tended to burst more balloons than did adults [$F(1,30) = 3.71$, $p = .06$; mean ± SD: 110.1 ± 34.3 vs. 87.3 ± 32.9 balloons]. Both groups burst more small than large balloons [$F(1,30) = 276.53$, $p < .001$; mean ± SD: 66.5 ± 22.7 vs. 32.2 ± 15.3 balloons].

Optimal performance—We compared the average inflation durations with the optimal inflation point. The optimal point was defined as the duration that would result in the largest number of points being earned (Figure 1B). Note that nonoptimal responding could be risk averse because average inflation durations were too brief to maximize the points earned or could be risk prone because inflation durations were too long and too many balloons were burst to maximize the points earned.

One-sample *t* tests indicated that neither group demonstrated optimal performance. As shown in Figure 2B, each group inflated the small balloons significantly larger than the size that would maximize points earned (risk-prone behavior) [adolescents, $t(15) = 5.25$, $p < .001$; adults, $t(15) = 2.13$, $p = .05$]. However, this was not the case for the large balloons. Neither group inflated the large balloons enough to maximize points earned [risk-averse behavior, although that result was not significant for adolescents, $t(15) = -1.33$, $p = .20$; adults, $t(15) = -3.74$, $p < .01$].

Although the larger inflation durations of balloons could potentially have resulted in adolescents earning significantly more points from the task than did adults, this was not the case (mean ± *SD* total points earned: 9,041 ± 741 and 9,002 ± 891 for adolescents and adults, respectively; no main effect of group, $F < 1$; nor a group × balloon type interaction, $F < 1$). Presumably, this lack of group difference was because the longer inflation durations for adolescents were offset by this group tending to burst more balloons than did adults.

2BIT Performance Conditional on Prior outcomes

In order to understand the source of the difference in inflation duration between adolescents and adults, we examined whether presses made by adolescents and adults were differentially sensitive to the positive consequences of earning points (saving a balloon by releasing the button) or the negative consequences of losing points (bursting a balloon due to continued buttonpressing). This was done by examining whether the outcome of the previous trial (balloon was saved or had burst) influenced the extent to which individuals inflated the current balloon. The impact of the prior outcome could be examined only on saved balloons because the inflation duration of burst balloons was presumably prematurely truncated by the burst. A mixed-design ANOVA showed that adolescents differed markedly from adults in the impact of the prior outcome [Figure 3A; group × prior outcome: $F(1,30) = 5.90$, $p = .02$]. Although adolescents inflated balloons more after saves than after bursts, adults did not exhibit this effect. Indeed, as shown in Figure 3, the inflation duration of the current balloon was linearly related to the number of prior saved balloons for adolescents [linear trend, $F(1,15) = 28.26$, $p < .001$]. No such linear trend existed for adults [$F(1,15) = 2.19$, $p = .16$].

DISCUSSION

Adolescents exhibited higher risk-taking propensities than did adults on a modified version of a task previously reported to correlate well with real-life measures of risky behavior (Lejuez et al., 2003; see Figure 2A). Overall, neither group showed optimum performance. As shown in Figure 2B, adolescents inflated the balloons to a larger size and burst more balloons than did adults, regardless of whether the overall responses tended to be risk prone (for small balloons) or risk averse (for large balloons). Adults exhibited a more conservative strategy. Interestingly, adolescents and adults earned similar numbers of points, suggesting that the different response strategies did not confer an advantage or disadvantage. Adolescents and adults differed in their responses to the outcome of the previous trial: If the previous balloon burst, then adolescents inflated the current balloon less than if the previous balloon was saved. Adults were unaffected by prior outcome (Figure 3).

Although there are some slight differences in certain personality traits (Table 1) between our adolescents and adults, we do not believe that these can explain the group differences in task performance. In general, the adolescents did not score differently from adults on most scales of the personality questionnaires, although they did report slightly higher scores on the attentional-impulsivity scale of the BIS and the thrill- and adventure-seeking subscale of the SSS. Indeed, it was somewhat surprising that personality questionnaire differences were not greater (see, e.g., Arnett, 1994;Stanford, Greve, Boudreaux, Mathias, & Brumbelow, 1996). One possible explanation is that adolescents were recruited using word of mouth and flyers posted around the university campus and surrounding area. Informal follow-up suggested that approximately 50% of the adolescents were participating in study programs organized by Oregon Health & Science University. Thus, it appears that the adolescent participants in the study may have been toward the less risk- taking end of the adolescent continuum as compared with expected values for children their age (Johnston, O'Malley, Bachman, & Schulenberg, 2005). Thus, the small differences in demographic and personality data suggest that age-related differences in task performance could not be attributed to the modulatory effects of drug use or to mediation by personality characteristics. We also believe that the age-related performance differences cannot be attributed to adolescents exhibiting poorer reaction times (RTs) in anticipating the point at which they wished to stop inflating the balloon. Simple RTs tend to reach adult levels by age 12, and our participants were 14–17 years old (Hale, 1990;Luna et al., 2004). More importantly, we do not believe that the heightened risk taking associated with adolescence is attributable to a failure to recognize high-risk or low-risk situations. Both the adolescents and adults responded differentially to the small and large balloon conditions, demonstrating that they were sensitive to the underlying burst distributions signaled by the red and blue balloons.

Our preferred explanation of our results is that differential reactions to preceding gains or losses contributed to the longer inflation durations (heightened risk taking) observed in adolescents (Figures 3A and 3B). In contrast, adults responded consistently to the conditional cues signaled by the balloon color, and the outcomes of the immediately preceding trial had negligible effects on their responses on the subsequent trial. Other paradigms have reported effects of prior outcomes on the behavior of adults—for example, Shiv, Loewenstein, Bechara, Damasio, and Damasio (2005), who observed that healthy, normal adults were more likely to invest money on a given round of an investment game if they had invested and won on the previous trial than if they had invested and lost (also see Levin & Hart, 2003). However, these studies did not include adolescent participants, so it is not known whether the effects of prior outcomes would have been even more pronounced in that group. Notice that the design of the present study did not permit us to determine whether adolescents had a default level of inflation that was decreased if the prior balloon burst or whether the default level was increased if the prior balloon was saved.

Although the present study does not directly speak to a specific model of risk-taking behavior, the findings are compatible with those of fuzzy trace theory (e.g., Reyna, 2004). Applying that theory to the present data suggests that adults have formed a stable representation of the balloon burst probabilities (“gist”), which will lead them to respond in a relatively stable manner. In contrast, adolescents may not rely on a precise representation; thus, their behavior is more responsive to immediate reward (balloon saves) and punishment (balloon bursts). Interestingly, both types of response strategy were equally effective in gaining points on the task. However, under real-life conditions, the greater risk taking may have considerably more adverse consequences.

In summary, our study demonstrated that adolescents exhibited more risky behavior when inflating balloons in a computer task than did adults. Note that this occurred in the absence of any social influence (see, e.g., Steinberg, 2007), suggesting that the behavioral difference was intrinsically motivated. Our study also suggests that risk taking reflects both individual differences in the willingness to engage in risk taking (inflation duration) and sensitivity to contextual cues that indicate levels of risk (i.e., color cues). Furthermore, trial-by-trial analyses suggested that the impact of experiencing a gain or a loss was more profound for adolescents than for adults on the task, which may provide an additional behavioral mechanism to explain the group differences.

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REFERENCES

Arnett J. Sensation seeking: A new conceptualization and a new scale. Personality & Individual Differences 1994;16:289–296.

Bechara A, Damasio AR, Damasio H, Anderson SW. Insensitivity to future consequences following damage to human prefrontal cortex. Cognition 1994;50:7–15. [PubMed: 8039375]

Byrnes, JP. The nature and development of decision making. Erlbaum; Hillsdale, NJ: 1998.

Crone EA, Bunge SA, Latenstein H, van der Molen MW. Characterization of children's decision making: Sensitivity to punishment frequency, not task complexity. Child Neuropsychology 2005;11:245–263. [PubMed: 16036450]

Crone EA, Vendel I, van der Molen MW. Decision-making in disinhibited adolescents and adults: Insensitivity to future consequences or driven by immediate reward? Personality & Individual Differences 2003;35:1625–1641.

Grunbaum, JA.; Kann, L.; Kinchen, SA.; Ross, JG.; Gowda, VR.; Collins, JL.; Kolbe, LJ. Youth Risk Behavior Surveillance—National Alternative School Youth Risk Behavior Survey, United States, 1998. Centers for Disease Control; Atlanta: 1999.

Hale S. A global developmental trend in cognitive processing speed. Child Development 1990;61:653–663. [PubMed: 2364741]

Hooper CJ, Luciana M, Conklin HM, Yarger RS. Adolescents' performance on the Iowa Gambling Task: Implications for the development of decision making and ventromedial prefrontal cortex. Developmental Psychology 2004;40:1148–1158. [PubMed: 15535763]

Jankowski MK, Rosenberg HJ, Sengupta A, Rosenberg SD, Wolford GL. Development of a screening tool to identify adolescents engaged in multiple problem behaviors: The Adolescent Risk Behavior Screen (ARBS). Journal of Adolescent Health 2007;40:180.e19–180.e26. [PubMed: 17259060]

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Decline in teen smoking appears to be nearing its end. 2005 [May 29, 2006]. from University of Michigan News and Information Services website: www.monitoringthefuture.org

Lejuez CW, Aklin WM, Jones HA, Richards JB, Strong DR, Kahler CW, Read JP. The Balloon Analogue Risk Task (BART) differentiates smokers and nonsmokers. Experimental & Clinical Psychopharmacology 2003;11:26–33. [PubMed: 12622341]

Lejuez CW, Read JP, Kahler CW, Richards JB, Ramsey SE, Stuart GL, et al. Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). Journal of Experimental Psychology: Applied 2002;8:75–84. [PubMed: 12075692]

Lejuez CW, Simmons BL, Aklin WM, Daughters SB, Dvir S. Risk-taking propensity and risky sexual behavior of individuals in residential substance use treatment. Addictive Behaviors 2004;29:1643–1647. [PubMed: 15451132]

Levin IP, Hart SS. Risk preferences in young children: Early evidence of individual differences in reaction to potential gains and losses. Journal of Behavioral Decision Making 2003;16:397–413.

Luna B, Garver KE, Urban TA, Lazar NA, Sweeney JA. Maturation of cognitive processes from late childhood to adulthood. Child Development 2004;75:1357–1372. [PubMed: 15369519]

Patton JH, Stanford MS, Barrett ES. Factor structure of the Barratt Impulsiveness Scale. Journal of Clinical Psychology 1995;51:768–774. [PubMed: 8778124]

Reyna VF. How people make decisions that involve risk. Current Directions in Psychological Science 2004;13:60–66.

Reyna VF, Farley F. Risk and rationality in adolescent decision making. Psychological Science in the Public Interest 2006;7:1–44.

Shiv B, Loewenstein G, Bechara A, Damasio H, Damasio AR. Investment behavior and the negative side of emotion. Psychological Science 2005;16:435–439. [PubMed: 15943668]

Sowell ER, Thompson PM, Leonard CM, Welcome SE, Kan E, Toga AW. Longitudinal mapping of cortical thickness and brain growth in normal children. Journal of Neuroscience 2004;24:8223–8231. [PubMed: 15385605]

Stanford MS, Greve KW, Boudreaux JK, Mathias CW, Brumbelow JL. Impulsiveness and risk-taking behavior: Comparison of high-school and college students using the Barratt Impulsiveness Scale. Personality & Individual Differences 1996;21:1073–1075.

Steinberg LD. Risk taking in adolescence: New perspectives from brain and behavioral science. Current Directions in Psychological Science 2007;16:55–59.

Zachary, RA. Shipley Institute of Living Scale: Revised manual. Western Psychological Services; Los Angeles: 1991.

Zuckerman M, Eysenck SB, Eysenck HJ. Sensation seeking in England and America: Cross-cultural, age, and sex comparisons. Journal of Consulting & Clinical Psychology 1978;46:139–149. [PubMed: 627648]

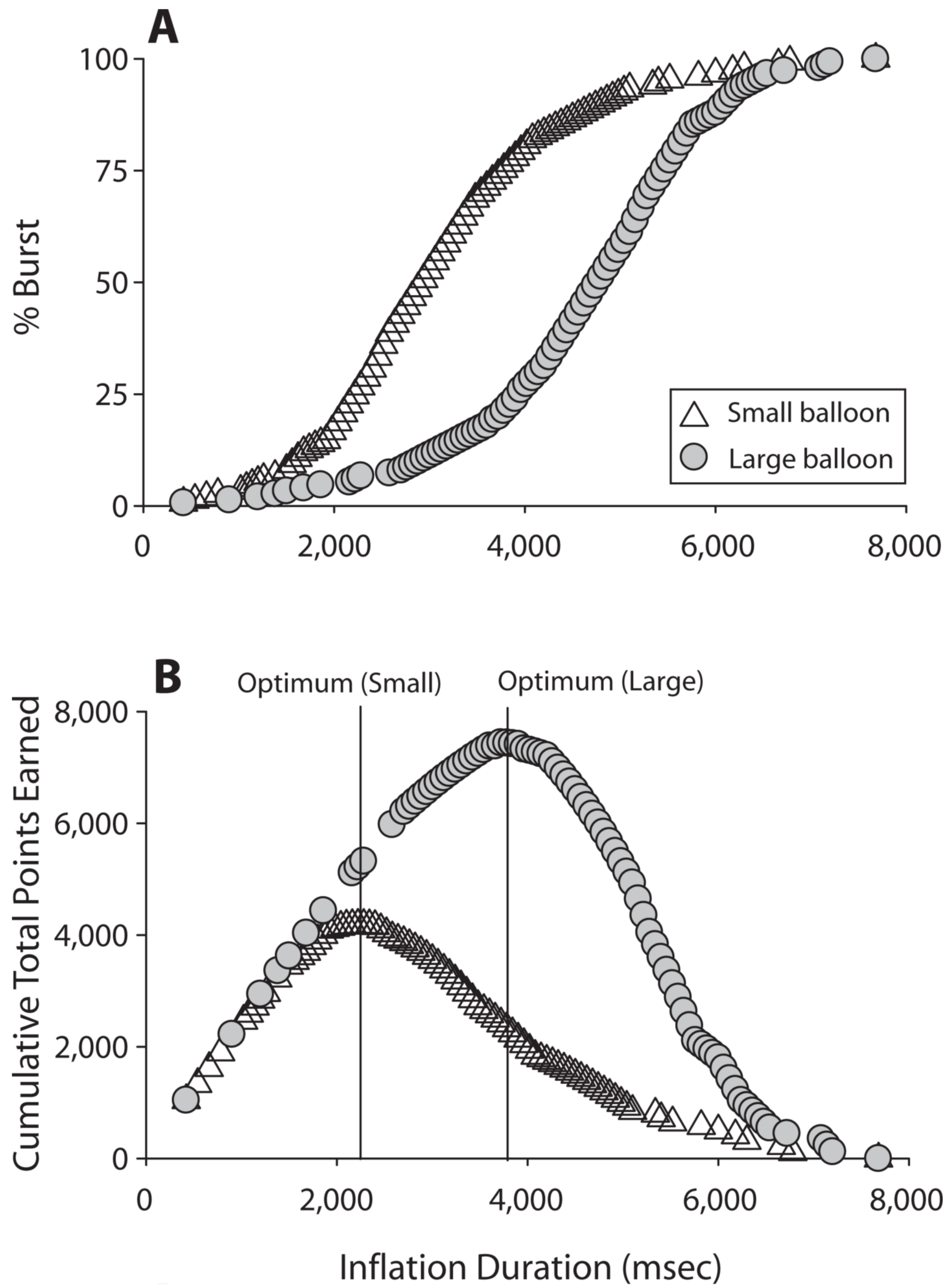

Figure 1.
(A) The mortality function for the two balloon types shows the cumulative probability that a balloon will burst as a function of the time for which it was inflated. (B) The optimality function for the two balloon types shows the cumulative number of points earned if participants stopped inflating the balloons at specific inflation durations. The greatest number of points would be earned if all small balloons were inflated for 2,220 msec and all large balloons were inflated for 3,720 msec.

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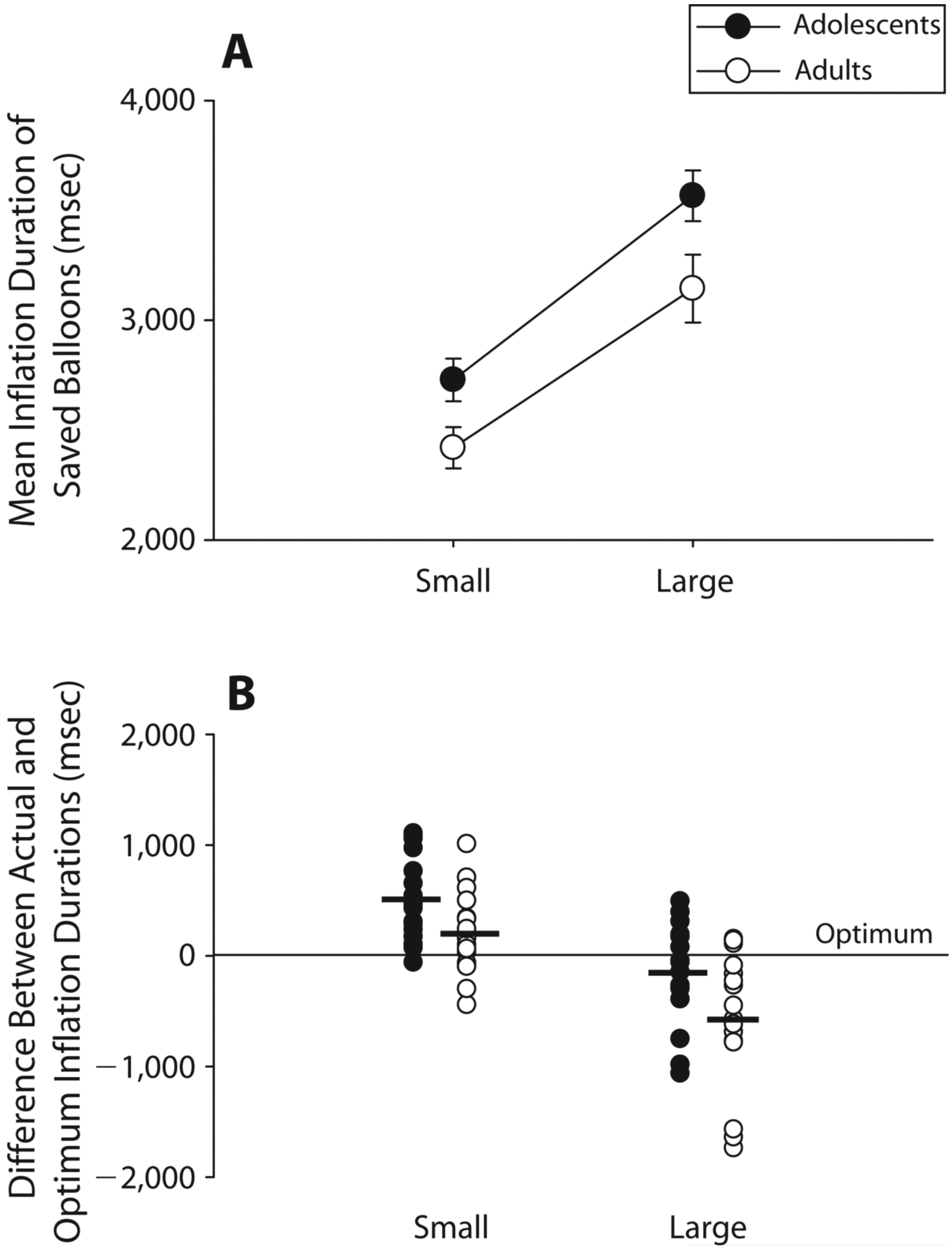

Figure 2.
(A) The mean duration for which adolescents and adults inflated small and large balloon types prior to saving them. Adolescents and adults inflated balloons from the small inflation distribution significantly less prior to saving the balloon than did those from the large distribution [main effect of balloon type, $F(1,30) = 104.78$, $p < .001$; no significant balloon type × group interaction, $F < 1.0$]. (B) Mean inflation duration for individual adolescents and adults expressed relative to the inflation duration at which the maximized number of points would be earned for each balloon type (see Figure 1B). Horizontal bars represent the mean difference in inflation duration as compared with the optimum inflation level for each group on each balloon type.

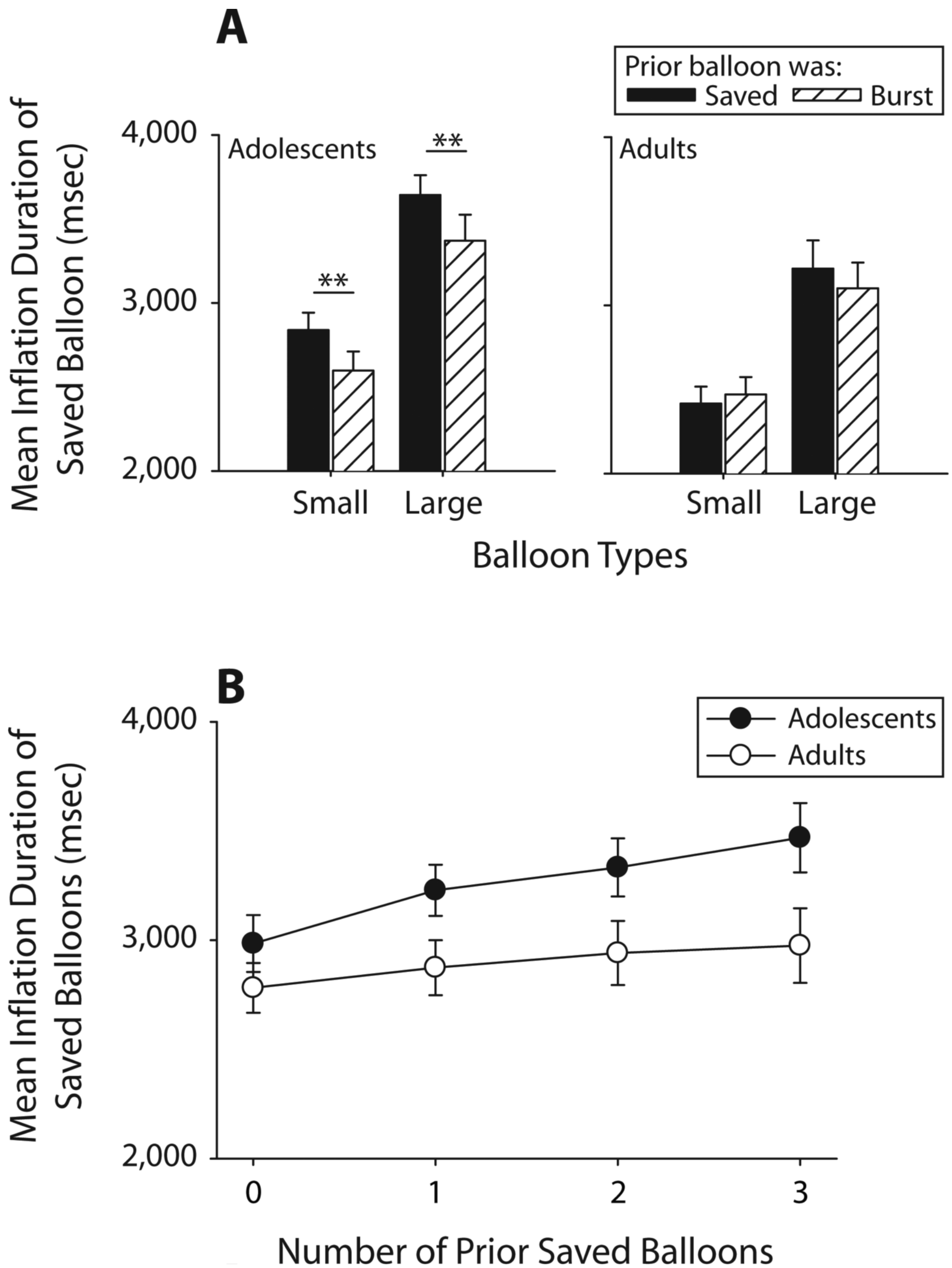

Figure 3.

(A) The mean inflation duration of saved balloons by adolescents and adults for each type of balloon as a function of whether the previous balloon had been saved or had burst. The mean number of balloons of each type experienced by participants (small prior-saved, small prior-burst, large prior-saved, large prior-burst) were 44.1, 34.1, 80.4, and 32.8 for adolescents and 60.7, 28.9, 95.9, and 27.3 for adults. (B) The mean inflation duration of saved balloons by adolescents and adults as a function of the number of prior saved balloons. Data are collapsed across balloon types in order to permit the means to be calculated on the basis of at least four observations per participant (M= 37.75, SD = 18.21). Notice that when the number of prior saved balloons is 0, the data correspond to the average of the small and the large prior-burst balloons shown in Figure 3A. ** $p < .01$ post hoc within-subjects *t* test ($df = 15$) comparing the inflation of saved balloons of each type according to the prior balloon outcome (saved or burst) for each age group.

Table 1

Means and Standard Deviations of the Demographic Characteristics of the Adolescent and Adult Participants

	Adolescents (75% female; *n* = 16)		Adults (60% female; *n* = 16)		
	M	*SD*	*M*	*SD*	p^a
Age	15.8	1.1	41.7	7.2	<.001*
Total SILS score	56.4	7.2	55.6	7.2	.77
Sensation Seeking Scale					
Boredom	3.3	2.0	2.6	2.1	.35
Disinhibition	4.8	2.4	4.4	3.1	.75
Experience seeking	6.3	2.2	6.4	2.3	.88
Thrill and adventure seeking	7.8	2.0	5.5	3.0	.02*
Barratt's Impulsiveness Scale					
Attentional impulsiveness	19.1	3.9	16.2	3.7	.04*
Motor impulsiveness	26.8	5.6	23.5	3.1	.05*
Nonplanning impulsiveness	26.1	6.4	23.3	4.8	.18
Number reporting use in last 30 days of:					
Cigarettes	3		5		.69
Alcohol	4		8		.27
Marijuana	5		4		1.00

Note—To provide a preliminary assessment of the role of these personality questionnaire measures on task performance (given the limited number of participants and the collinearity of the measures), stepwise multiple regression analyses were performed ($p < .05$ to enter; $p > .10$ to remove). For total points earned, attentional impulsiveness was the only factor entered into the model [$F(1,30) = 4.88$, $p = .04$, $\beta = -.37$]. For the total number of balloons burst, motor impulsiveness was the only factor entered [$F(1,30) = 14.21$, $p = .001$, $\beta = .57$]. For the mean inflation duration (averaged across small and large balloons), both motor impulsiveness and nonplanning impulsiveness entered into the model [$F(2,29) = 7.98$, $p = .002$, $\beta = .82$ and $-.47$, respectively]. SILS, Shipley Institute of Living Scale, a measure of intellectual functioning.

[a] Statistical tests are two-tailed between-groups *t* tests ($df = 30$) for the scale measures and Fisher's exact test ($df = 1$) for the three count-based measures of recent drug use.

* $p < .05$.