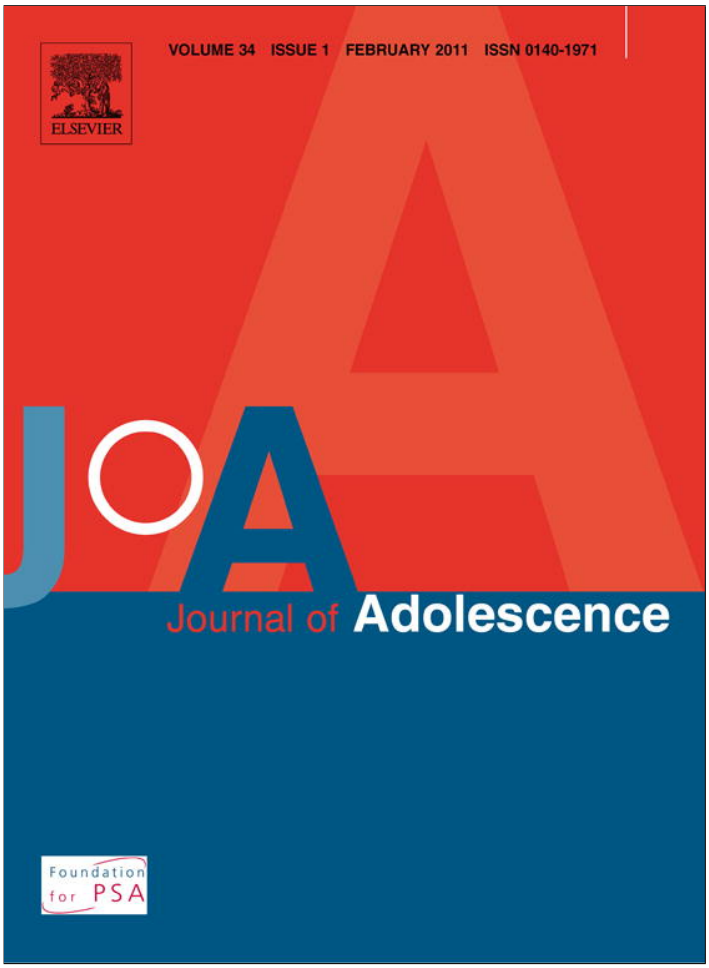

Journal of Adolescence 34 (2011) 29–37

Contents lists available at ScienceDirect

Journal of Adolescence

journal homepage: www.elsevier.com/locate/jado

Effects of positive affect on risk perceptions in adolescence and young adulthood☆

Claudia M. Haase*, Rainer K. Silbereisen

University of Jena, Germany

Keywords:
Positive affect
Risk perception
Risk taking
Impulsiveness
Adolescence
Young adulthood

A B S T R A C T

Affective influences may play a key role in adolescent risk taking, but have rarely been studied. Using an audiovisual method of affect induction, two experimental studies examined the effect of positive affect on risk perceptions in adolescence and young adulthood. Outcomes were risk perceptions regarding drinking alcohol, smoking a cigarette, riding in a car with a drunk driver, getting into a fight, and having unprotected sexual intercourse. Study 1 showed that positive affect led to lower risk perceptions than neutral affect for young adults (mean age 23). Study 2 replicated the effect for early adolescents (mean age 13), mid-adolescents (mean age 17), and young adults (mean age 23). Moreover, Study 2 showed that the effect was most pronounced at high levels of impulsiveness. Adolescents and young adults may be more risk averse in contexts that do not give rise to emotions, but have markedly lower risk perceptions under positive affect.

Binge drinking, deviant behavior, and reckless driving are risk behaviors that peak in adolescence and young adulthood (e.g., Steinberg, 2007, 2008). However, empirical studies have repeatedly shown that adolescents have cognitive capacities quite similar to adults and are sometimes even more risk averse (e.g., Beyth-Marom, Austin, Fischhoff, Palmgren, & Jacobs-Quadrel, 1993; Boyer, 2006; Millstein & Halpern-Felsher, 2002; Quadrel, Fischhoff, & Davis, 1993). One explanation for these conflicting findings is that "the factors that lead adolescents to engage in risky activities are social and emotional, not cognitive" (Steinberg, 2008, p. 3). This suggests an experimental investigation of social and affective influences on adolescent risk taking, but, to date, few studies have done so. A notable exception is an experiment (Gardner & Steinberg, 2005), which demonstrated that the mere presence of peers led to marked increases in risk taking, particularly in adolescents (for another experimental study see Ganzel, 1999). Yet, as noted by Rivers, Reyna, and Mills (2008), research on the role of affect in adolescent risk taking is scarce. To our knowledge, effects of positive affect on adolescent risk perception – a widely studied cognitive aspect of risk taking (for a review see Boyer, 2006) – have not been examined to date. This was the starting point for the present article.

Effects of positive affect on risk perceptions

Affect can profoundly alter cognition (e.g., Forgas, 2008; Hastie, 2001; Loewenstein & Lerner, 2003; Peters, Västfjäll, Gärling, & Slovic, 2006; Rivers et al., 2008). Specifically, positive affect can lead to positive cognitions, even if it stems

☆ Claudia M. Haase is now at the Institute of Personality and Social Research at the University of California, Berkeley. Rainer K. Silbereisen is at the Center for Applied Developmental Science and Department of Developmental Psychology at the University of Jena, Germany.

* Corresponding author. University of California, Institute of Personality and Social Research, 4143 Tolman Hall 5050, Berkeley, CA 94720-5050, USA. Tel.: +1 510 643 8952; fax: +1 510 643 6459.
E-mail address: claudia.haase@berkeley.edu (C.M. Haase).

0140-1971/$ – see front matter © 2010 The Association for Professionals in Services for Adolescents. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.adolescence.2010.03.004

from completely incidental sources (cf. Loewenstein & Lerner, 2003). Put differently, happy feelings can bring about happy thoughts. Major theories have predicted this effect including the affect priming theory (e.g., Bower, 1981; Bower & Forgas, 2000) and the mood-as-information model (e.g., Schwarz & Clore, 1983, 2003); and numerous empirical studies have demonstrated it (for a review see Forgas, 2008). One explanation, put forth by the affect priming theory, is that positive affect functions as a prime for positive cognitions. Another explanation, postulated by the mood-as-information model, is that individuals ask themselves "How do I feel about it?" and erroneously use their current affect as valid information to guide their thoughts. In this article, we draw from the affect infusion model (e.g., Forgas, 2002, 2008), which integrates both models and, moreover, specifies conditions under which affect "infuses" cognition and under which it does not.

Risk perceptions are a widely studied cognitive aspect of risk taking (Boyer, 2006). Studies have shown that positive affect indeed leads to lower risk perceptions (e.g., Johnson & Tversky, 1983), although not all of them have confirmed this effect (e.g., Isen & Geva, 1987). One possible reason is that not all individuals may change their risk perceptions under positive affect. Only some with certain personality characteristics may do so. This assumption builds on the affect infusion model (Forgas, 2002). Research on personality characteristics as moderators of affect-cognition effects is still rare, but previous studies show that individuals who are open and pay attention to their feelings are most influenced by them (Ciarrochi & Forgas, 2000; Gasper & Clore, 2000). From a developmental perspective, personality characteristics are particularly interesting as they may help to identify individuals who are particularly vulnerable to affective influences when thinking about risk.

The present studies

Previous studies show that risk perceptions can be profoundly altered by positive affect (e.g., Gasper & Clore, 2000; Johnson & Tversky, 1983). These studies came from disciplines outside the developmental sciences and were mostly conducted with college students. Thus, it is unknown whether positive affect leads to lower risk perceptions regarding risk behaviors typically studied in developmental research. Moreover, it is unclear whether the effect generalizes to adolescents. Finally, little is known about personality characteristics that moderate the effect. We conducted two experimental studies to investigate these questions.

In Study 1, we examined the effect of positive affect on risk perceptions regarding risk behaviors typically studied in developmental research in a sample of young adults. Previous studies examined effects of positive affect on risk perceptions regarding financial risks (Isen & Geva, 1987), uncontrollable risks such as accidents (Johnson & Tversky, 1983), or other events (Gasper & Clore, 2000). We were interested in risk perceptions regarding risk behaviors such as substance use, driving with a drunk driver, getting into a fight, and having unprotected sexual intercourse, which may involve short-term rewards, but can cause serious harm to self and others (e.g., Gardner & Steinberg, 2005; Millstein & Halpern-Felsher, 2002). Drawing from the converging prediction of major affect-cognition theories (Bower & Forgas, 2000; Forgas, 2008; Schwarz & Clore, 2003), we expected positive affect to lead to lower risk perceptions.

In Study 2, we sought to replicate this effect for early adolescents, mid-adolescents, and young adults. Previous studies focused exclusively on young adults, but it is unclear whether the findings generalize to adolescents (Rivers et al., 2008). Neurobiological findings show that adolescence is a developmental period during which subcortical systems related to affective functioning are disproportionately activated while top-down control systems are not yet fully developed (e.g., Galvan et al., 2006; for a review see Steinberg, 2008). These brain remodeling processes may continue well until young adulthood (Giedd, 2008). Study 2 involved early adolescents, mid-adolescents, and young adults. We expected positive affect to lead to lower risk perceptions in all age groups.

Moreover, in Study 2, we examined impulsiveness and sensation seeking as moderators of the effect of positive affect on risk perceptions. Both personality characteristics have repeatedly been linked to risk behavior (e.g., Boyer, 2006; Horvath & Zuckerman, 1993; Stanford et al., 2009; Steinberg et al., 2008). Drawing from the affect infusion model (e.g., Forgas, 2002) and previous studies showing that individuals who are open and pay attention to their feelings are most influenced by them (Ciarrochi & Forgas, 2000; Gasper & Clore, 2000), we expected a similar effect for individuals with low self-regulatory control. That is, we expected positive affect to lead to particularly low risk perceptions for adolescents and young adults with high impulsiveness or high sensation seeking.

In both studies, we used an audiovisual method to induce affect. Specifically, we created video clips combining norm-rated pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) with instrumental music from movie soundtracks. Audiovisual methods of affect induction have proven effective in previous research (Gross & Levenson, 1995; Hewig et al., 2005). After the affect induction, participants were presented an adapted version of the Benthin Risk Perception Measure (Benthin, Slovic, & Severson, 1993), following the example of other studies (e.g., Gardner & Steinberg, 2005; Magar, Phillips, & Hosie, 2008; Steinberg, 2004). Participants rated their risk perceptions regarding five risk behaviors (i.e., drinking alcohol, smoking a cigarette, riding in a car with a drunk driver, getting into a fight, and having unprotected sexual intercourse).

In Study 2, we added a negative affect condition for exploratory purposes. As shown by Tice, Bratslavsky, and Baumeister (2001), negative affect can lead to higher risk taking as individuals try to repair their bad mood by engaging in activities that are rewarding in the short run (but potentially harmful in the long run). Many risk behaviors provide such short-term rewards. We explored the possibility that not only positive but also negative affect would lead to lower risk perceptions compared to neutral affect.

Study 1

The aim of Study 1 was to examine the effect of positive affect on risk perceptions regarding risk behaviors such as substance use, driving with a drunk driver, getting into a fight, and having unprotected sexual intercourse in a sample of young adults. We expected positive affect to lead to lower risk perceptions compared to neutral affect.

Method

Participants

The sample consisted of 41 young adults (age in years: $M = 22.80$, $SD = 1.99$, range: 21–31; 56.1% females). The sample size was determined based on a power analysis using the software GPOWER (Erdfelder, Faul, & Buchner, 1996) and allowed for detecting large effects (Cohen, 1992) using standard statistical criteria ($\alpha = .05$, $1-\beta = .80$). Participants were recruited at a university campus in a middle-sized town in Germany, provided consent prior to the study and were compensated with sweets (worth ca. €1). As we relied on a volunteer sample, a response rate was not available.

Procedure and measures

The experiment took place in a university lab and lasted about 15 min.

Affect induction. Participants were randomly assigned to the *positive affect* or *neutral affect* condition in a between-participants design. They watched a 3-min video clip, which presented 36 positive or neutral pictures, respectively, from the International Affective Picture System (IAPS; Lang et al., 2005) combined with instrumental music from movie soundtracks. The IAPS contains norm ratings for the valence of each picture (1 = lowest valence; 9 = highest valence). For the positive affect condition, we selected 36 IAPS pictures with positive valence (e.g., happy people, fireworks; valence > 7) and the music piece "À quai" (composer: Yann Tiersen; soundtrack of "Ámelie"). For the neutral affect condition, we selected 36 IAPS pictures with neutral valence (e.g., people with neutral facial expressions, household items; 4.5 < valence < 5.5) and the music piece "Lucy's Party" (composer: Wojciech Kilar; soundtrack of "Bram Stoker's Dracula"). Following Gross and Levenson (1995), participants watched a black screen prior to the video clip for 20 s with the instruction to use this time to clear their mind of thoughts and feelings and to concentrate on the video clip.

Manipulation check. After the video clip, participants reported how they felt "right now at the moment" using the valence subscale of the Multidimensional Mood Questionnaire (Steyer, Schwenkmezger, Notz, & Eid, 1994), which consists of two items measuring positive affect (e.g., "good") and two (subsequently recoded) items measuring negative affect (e.g., "bad") (1 = not at all; 5 = very much). Internal consistency of the valence scale was satisfactory ($\alpha = .80$). An ANOVA revealed that the affect induction was effective ($F(1,39) = 5.00$, $p < .05$, $\eta_p^2 = .11$). Participants in the positive affect condition reported higher positive valence ($M = 3.95$, $SD = .82$) than participants in the neutral affect condition ($M = 3.40$, $SD = .76$). In a follow-up analysis, we analyzed items indicating positive affect and negative affect separately drawing from Watson, Clark, and Tellegen (1988). A MANOVA with positive affect and negative affect as the dependent variables revealed that the affect induction had a pronounced effect on positive affect ($F(1,39) = 8.56$, $p < .01$, $\eta_p^2 = .18$).

Risk perceptions. Participants were then presented an adapted version of the Benthin Risk Perception Measure (Benthin et al., 1993) following the example of other studies (e.g., Gardner & Steinberg, 2005; Magar et al., 2008). Participants read five hypothetical scenarios describing risk behaviors (i.e., drinking alcohol, smoking a cigarette, riding in a car with a drunk driver, getting into a fight, having unprotected sexual intercourse) and rated their risk perceptions for each risk behavior (i.e., "How risky do you find this behavior?"). Items were recoded so that higher values indicated higher risk perceptions (1 = not at all risky; 5 = very risky). We had hoped that these items would form a consistent scale as in other studies that also used few (i.e., five) items for this measure (Gardner & Steinberg, 2005). However, our five items had low internal consistency ($\alpha = .36$), which is why they were analyzed separately using a repeated-measures ANOVA.

At the end of the experiment, all participants were thanked, invited to ask questions, and dismissed.

Results

We used a repeated-measures ANOVA, treating the five risk perception items as separate repeated measures as they had not formed a consistent scale. An ANOVA with risk perceptions as the repeated-measures variable revealed an overall effect of affect (positive or neutral) on risk perceptions ($F(1,39) = 6.22$, $p < .05$, $\eta_p^2 = .14$). The effect of the affect induction was consistent across the five items as indicated by a nonsignificant item × affect interaction (Greenhouse-Geisser: $F(2.45, 95.42) = 2.00$, $p = .131$, $\eta_p^2 = .05$). Positive affect led to lower risk perceptions ($M = 3.57$, $SD = .46$) compared to neutral affect ($M = 3.95$, $SD = .51$). When repeating the analyses using a standard t-test, the findings did not change.

Discussion

Study 1 showed that positive affect led to lower risk perceptions for young adults (mean age 23 years). When feeling good, participants were less likely to perceive behaviors such as drinking alcohol or smoking a cigarette as risky. These findings

converge with predictions by major affect-cognition theories (Bower, 1981; Forgas, 2008; Schwarz & Clore, 2003) and previous studies (e.g., Johnson & Tversky, 1983). Moreover, they extend these studies showing that positive affect influences risk perceptions regarding risk behaviors widely studied in developmental research. Furthermore, Study 1 demonstrated that positive and neutral affect could be successfully induced using an audiovisual method, which combined norm-rated IAPS pictures (Lang et al., 2005) with instrumental music from movie soundtracks.

Study 1 had some limitations. Most importantly, in contrast to previous research (Gardner & Steinberg, 2005) that used similarly few items for the Benthin Risk Perception Measure, our five items did not form a consistent scale. Moreover, the order of the risk scenarios was not counterbalanced so that order effects could not be excluded.

Study 2

Study 2 had three aims. The first aim was to address the limitations by Study 1 by using a more extensive version of the Benthin Risk Perception Measure (Benthin et al., 1993) and presenting the five risk scenarios in counterbalanced order.

The second aim was to replicate the effects found in Study 1 for early adolescents, mid-adolescents, and young adults. We again expected positive affect to lead to lower risk perceptions than neutral affect and we expected this effect to apply to early adolescents, mid-adolescents, and young adults. We were not sure about the main effect of age on risk perceptions in view of the mixed findings in the literature, which showed lower, higher, or similar risk perceptions in adolescence compared to adulthood (Boyer, 2006).

The third aim was to examine whether impulsiveness and sensation seeking moderated the effect of positive affect on risk perceptions. Although the affect infusion model (e.g., Forgas, 2002) suggests that personality characteristics may be important moderators of affect-cognition effects, they have rarely been examined. We expected the effect of positive affect on risk perceptions to be particularly strong for individuals with high impulsiveness or sensation seeking.

Study 2 consisted of two parts, a home assessment of personality characteristics and a subsequent lab experiment. The experiment followed the same procedure as in Study 1. A negative affect condition was added for exploratory purposes. In sum, Study 2 examined the effects of positive, neutral, and negative affect on risk perceptions in a sample of early adolescents, mid-adolescents, and young adults.

Method

Participants

The sample consisted of 35 early adolescents from 7th grade (age in years: $M = 13.21$, $SD = .42$, range: 12–14; 42.9% females), 27 mid-adolescents from 11th grade (age in years: $M = 17.08$, $SD = .26$, range: 16–17; 55.6% females), and 27 young adults (age in years: $M = 23.36$, $SD = 2.34$, range: 20–29; 44.4% females). The sample size of 89 participants was determined based on a power analysis using the software GPOWER (Erdfelder et al., 1996) and allowed for detecting medium effects (Cohen, 1992) using standard statistical criteria ($\alpha = .05$, $1-\beta = .80$). Adolescents were recruited in a high school (Gesamtschule) and young adults at a university campus in a middle-sized town in Germany. Parental education (in years) was similar across age groups (early adolescents: $M = 11.36$, $SD = 1.26$; mid-adolescents: $M = 11.78$, $SD = 1.44$; young adults: $M = 11.44$, $SD = 1.30$). Parental consent was obtained for all adolescents. All participants provided consent and were compensated with a gift certificate (€10). Again, as we relied on a volunteer sample, a response rate was not available.

Procedure and measures

Questionnaire. Some weeks prior to the experiment, participants answered a questionnaire at home, which took about 30 min to complete and which they mailed back to us. Various measures were assessed including impulsiveness and sensation seeking.

Impulsiveness. Impulsiveness was measured using the German version of the Barratt Impulsiveness Scale (BIS-11, Patton, Stanford, & Barratt, 1995; Stanford et al., 2009). This 30-item measure consists of items measuring attentional impulsiveness (e.g., "I don't pay attention"; 8 items), behavioral impulsiveness (e.g., "I act on impulse."; 11 items) and nonplanning impulsiveness (e.g., "I plan tasks carefully." (recoded); 11 items) with answers ranging from (1) rarely/never to (4) almost always/always. Note that Patton et al. (1995) had labelled the second subscale 'motor impulsiveness' whereas we preferred the label 'behavioral impulsiveness'. Internal consistency of the impulsiveness scale was satisfactory ($\alpha = .76$).

Sensation seeking. Sensation Seeking was measured using the German version (Beauducel, Strobel, & Brocke, 2003) of the Sensation Seeking Scale (SSS-V; Zuckerman, 1994), which consists of 40 items presented in a forced choice format to limit social desirability. The scale consists of items measuring thrill and adventure seeking (e.g., "A sensible person avoids activities that are dangerous." vs. "I sometimes like to do things that are a little frightening."; 10 items), experience seeking (e.g., "I order the dishes with which I am familiar so as to avoid disappointment and unpleasantness." vs. "I like to try new foods that I have never tasted before."; 10 items), disinhibition (e.g., "I prefer quiet parties with good conversations." vs. "I like 'wild' uninhibited parties."; 10 items), and boredom susceptibility (e.g., "I find something interesting in almost every person I talk to." vs. "I have no patience with dull or boring persons."; 10 items). Answers were coded so that (1) indicated the alternative and (2) the sensation seeking option. Internal consistency of the sensation seeking scale was satisfactory ($\alpha = .82$).

Experiment. The experiment took place in a university lab and lasted about 15 min.

Affect induction. Participants were randomly assigned to the *positive affect*, *neutral affect* or *negative affect* condition in a between-participants design. A similar audiovisual method was used as in Study 1, but slightly adapted to be effective for adolescents and young adults. We changed a few IAPS pictures (Lang et al., 2005) and used different music for the positive affect condition ("Childhood and Manhood"; composer: Ennio Morricone; soundtrack of "Cinema Paradiso"). For the negative video clip, 36 IAPS pictures with low valence (e.g., sad people, destroyed houses; valence < 3) were chosen and combined with the music piece "Safe Passage" (composer: Hans Zimmer; soundtrack of "The Last Samurai"). These affect induction video clips were successfully pilot tested in an independent sample of adolescents and young adults ($N = 54$). Participants watched a black screen prior to the video clip for 20 s using the same instruction as in Study 1. In addition, they were told that they could close their eyes or watch elsewhere if they did not like some of the pictures.

Manipulation check. After the video clip, participants reported how they felt "right now at the moment" using 12 items from the Multidimensional Mood Questionnaire (Steyer et al., 1994). Items were presented on a 5-point scale (1 = not at all; 5 = very much). Drawing from Watson et al. (1988), items indicating *positive affect* (6 items; e.g., "good"; $\alpha = .88$) and *negative affect* (6 items; e.g., "bad"; $\alpha = .79$) were analyzed separately. A 3 (affect: positive or neutral or negative) $\times$ 3 (age: early adolescents or mid-adolescents or young adults) MANOVA with self-reported positive and negative affect as the dependent variables showed that the affect induction was effective. The affect induction had a significant main effect on self-reported affect ($F(4,156) = 12.47$, $p < .001$, $\eta_p^2 = .24$, Pillai's trace = .49). No main effect of age emerged ($F(4,156) = 1.07$, $p = .374$, $\eta_p^2 = .03$, Pillai's trace = .05). Importantly, the effect of the affect induction was uniform across age groups as indicated by a nonsignificant interaction effect of affect $\times$ age ($F(8,156) = .84$, $p = .573$, $\eta_p^2 = .04$, Pillai's trace = .08). Participants in the positive affect condition reported the highest positive affect ($M = 3.91$, $SD = .59$) followed by participants in the neutral affect ($M = 3.69$, $SD = .70$) and the negative affect ($M = 2.45$, $SD = .90$) condition. Similarly, participants in the positive affect condition reported the lowest negative affect ($M = 1.49$, $SD = .41$) followed by participants in the neutral affect ($M = 1.86$, $SD = .60$) and the negative affect ($M = 2.65$, $SD = .84$) condition. All simple contrasts were significant ($p < .05$) except for self-reported positive affect in the positive vs. neutral affect condition ($p = .186$).

Risk perceptions. Participants were then presented the adapted version of the Benthin Risk Perception Measure (Benthin et al., 1993). The same five risk scenarios as in Study 1 were used (i.e., drinking alcohol, smoking a cigarette, riding in a car with a drunk driver, getting into a fight, having unprotected sexual intercourse). In contrast to Study 1, a 5 $\times$ 5 Latin square was used to counterbalance the presentation order of the five scenarios. Moreover, risk perceptions were now assessed by a 5-item checklist for each risk scenario (i.e., "How risky do you find this behavior?"; "How big are the advantages of this behavior?"; "How big are the disadvantages of this behavior?"; "How scary do you find this behavior?"; "How serious are the consequences of this behavior if something 'bad' happened as a result?"). Items were presented on a 5-point scale and recoded so that higher values indicated higher risk perceptions. The resulting 25-item measure had high internal consistency ($\alpha = .86$) so that we could analyze the full scale as in other studies (Gardner & Steinberg, 2005; Magar et al., 2008).

At the end of the study, participants in the negative affect condition watched the positive video clip. All participants were thanked, invited to ask questions, and dismissed.

Results

Analyses were conducted in two steps. First, we analyzed the effect of affect on risk perceptions for early adolescents, mid-adolescents, and young adults. Second, we analyzed whether the effect of positive affect on risk perceptions was moderated by personality characteristics (i.e., impulsiveness or sensation seeking).

Effect of positive affect on risk perceptions for early adolescents, mid-adolescents, and young adults

In order to examine the effect of affect on risk perceptions in the three age groups, a 3 (affect: positive or neutral or negative) $\times$ 3 (age: early adolescents or mid-adolescents or young adults) ANOVA with risk perceptions as the dependent variable was performed. This analysis revealed a main effect of affect ($F(2,80) = 4.28$, $p < .05$, $\eta_p^2 = .10$), a main effect of age ($F(2,80) = 3.96$, $p < .05$, $\eta_p^2 = .09$) and a nonsignificant interaction effect of affect $\times$ age ($F(4,80) = 1.87$, $p = .124$, $\eta_p^2 = .09$). Simple contrasts showed that positive affect led to lower risk perceptions compared to neutral affect ($p < .01$). Moreover, early adolescents had higher risk perceptions than young adults ($p < .01$). Overall, negative affect did not have a significant effect on risk perceptions compared to neutral affect ($p = .112$). However, for mid-adolescents negative affect had an exceptional effect in that it led to lower risk perceptions compared to neutral affect ($p < .05$). Fig. 1 shows the main effect of positive, neutral, and negative affect on risk perceptions. Fig. 2 shows these effects broken down by age groups.

Effect of positive affect on risk perceptions moderated by impulsiveness and sensation seeking

In order to analyze whether the effect of positive affect on risk perceptions was moderated by personality characteristics (i.e., impulsiveness or sensation seeking), we performed two sets of multiple regression analyses following Aiken and West (1991) and using the computational tools by Preacher, Curran, and Bauer (2006). Analyses were based on participants in the positive and neutral affect condition. Affect was effect coded as (−1) neutral or (1) positive. The continuous personality variables were z-standardized.

In order to examine the moderating effect of impulsiveness, we performed a multiple regression analysis with risk perceptions as the dependent variable and affect, impulsiveness, and the interaction of affect $\times$ impulsiveness as independent

variables. The interaction effect for affect × impulsiveness did not reach significance ($\beta = -.18$, $p = .121$). A follow-up analysis indicated that the interaction effect was most pronounced for the behavioral impulsiveness subscale (11 items, $\alpha = .59$) on which we decided to focus. This analysis revealed main effects of affect ($\beta = -.40$, $p < .01$) and behavioral impulsiveness ($\beta = -.29$, $p < .05$) on risk perceptions, which were qualified by the interaction effect of affect × behavioral impulsiveness ($\beta = -.26$, $p < .05$). Following up on the interaction effect, simple slopes were analyzed following Preacher et al. (2006) and are displayed in Fig. 3. At low levels of behavioral impulsiveness (1 *SD* below the mean), positive affect had no significant effect on risk perceptions ($t = -.84$, $p = .404$). In contrast, at high levels of behavioral impulsiveness (1 *SD* above the mean), positive affect led to markedly lower risk perceptions ($t = -4.27$, $p < .001$).

In order to examine the moderating effect of sensation seeking, we performed a multiple regression analysis with risk perceptions as the dependent variable and affect, sensation seeking, and the interaction of affect × sensation seeking as independent variables. Positive affect ($\beta = -.34$, $p < .01$) and higher sensation seeking ($\beta = -.41$, $p < .01$) predicted lower risk perceptions. However, contrary to the expectations, no significant interaction effect of affect × sensation seeking was found ($\beta = -.15$, $p = .195$). Likewise, for none of the sensation seeking subscales an interaction effect with affect was found.

Discussion

Study 2 replicated the effect found in Study 1 for early adolescents (mean age 13 years), mid-adolescents (mean age 17 years), and young adults (mean age 23 years). Across age groups, positive affect led to lower risk perceptions compared to neutral affect.

Moreover, Study 2 demonstrated similarity across age groups for the effect of positive affect, but dissimilarity for the effect of negative affect. For mid-adolescents, negative affect led to lower risk perceptions, whereas it did not for early adolescents and young adults. This effect was not due to differential reactivity to the affect induction, which worked similarly across age groups. Mid-adolescence has been identified as a developmental period characterized by high stress vulnerability (Spear, 2000), low self-regulatory control (Steinberg et al., 2008), and higher risk taking (Steinberg, 2008); and these vulnerabilities may be one reason why a premature acquisition of autonomy privileges in adolescence is maladaptive in the long run (Haase, Tomasik, & Silbereisen, 2008). The present findings raise the possibility that when feeling bad, mid-adolescents may be particularly prone to engage in risky activities in order to repair their mood (cf. Tice et al., 2001) whereas individuals at other ages may use other strategies. Alternatively, it is possible that adolescents are less motivated to repair their negative affect and engage in risk behavior to make things even worse (see recent evidence on contra-hedonic motivation in adolescence; Riediger, Schmiedek, Wagner, & Lindenberger, 2009). Clearly, we studied risk perceptions and not risk behaviors, and further research is needed to follow up on these speculations. Taken together, these findings emphasize the importance of carefully investigating whether findings on affect-cognition effects generalize across age groups (Rivers et al., 2008).

As we had established an overall effect of positive affect on risk perceptions, we were interested for whom this effect would be particularly pronounced drawing from the affect infusion model (e.g., Forgas, 2002, 2008). We examined impulsiveness, a personality characteristic reflecting low self-regulatory control, which has a neurobiological basis (e.g., Galvan, Hare, Voss, Glover, & Casey, 2007). In line with our expectations, impulsiveness, specifically, behavioral impulsiveness, moderated the effect of positive affect on risk perceptions. At high levels of behavioral impulsiveness, positive affect led to markedly lower risk perceptions. In contrast, the effect was no longer significant at low levels of behavioral impulsiveness. This finding emphasizes the importance of investigating personality characteristics as moderators of affect-cognition effects (Ciarrochi & Forgas, 2000; Gasper & Clore, 2000) and suggests an underlying mechanism for the link between impulsiveness and risk taking (e.g., Stanford, Greve, Boudreaux, & Mathias, 1996). Highly impulsive individuals may be highly susceptible to positive affect in their risk perceptions. In contrast, sensation seeking did not emerge as a moderator. Thus, sensation seeking makes individuals approach positive affect (e.g., Zuckerman, 1994), but did not appear to alter reactions to positive affect.

Bringing age back into the picture, we found that early adolescents had higher risk perceptions than young adults. This finding is consistent with Boyer (2006) who concluded in his literature review that "if anything, [adolescents] may

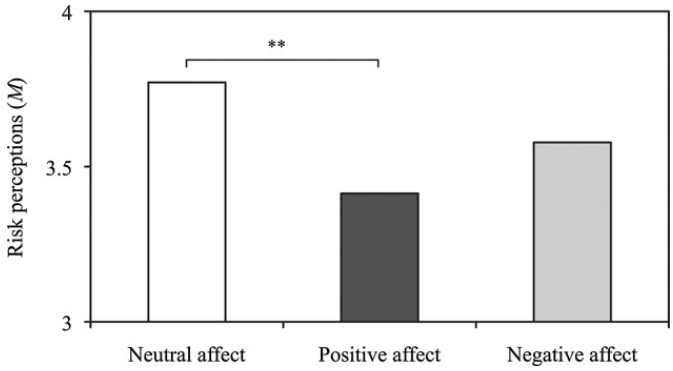

Fig. 1. Effects of neutral, positive, and negative affect on risk perceptions (Study 2). Note. $^{**}p < .01$.

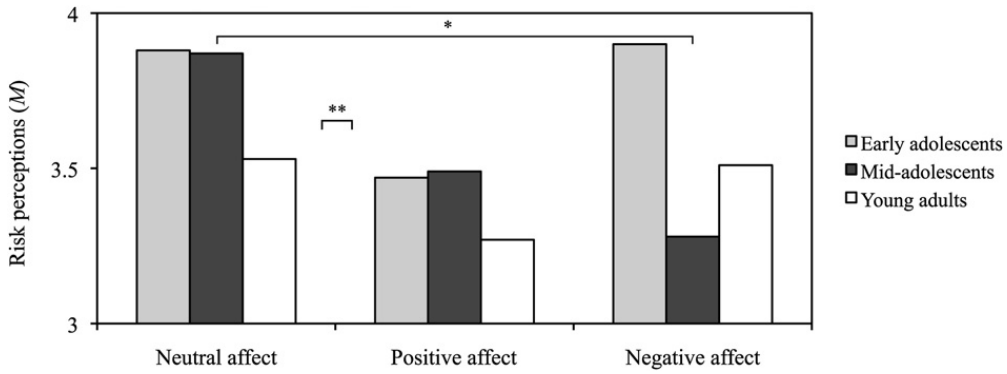

Fig. 2. Effects of neutral, positive, and negative affect on risk perceptions for early adolescents, mid-adolescents, and young adults (Study 2). Note. $^{*}p < .05$, $^{**}p < .01$.

overestimate their personal vulnerability" (p. 301). Note that Steinberg (2004) also reported a similar finding. In addition, we analyzed age-related differences in impulsiveness and sensation seeking[1]. Converging with Steinberg et al. (2008), mid-adolescents showed higher sensation seeking than early adolescents. Moreover, a negative correlation between impulsiveness and age was found, which, however, did not reach significance, presumably due to the small sample size. Other studies, spanning larger age ranges, have repeatedly demonstrated an age-related decline in impulsiveness (Stanford et al., 1996; Steinberg et al., 2008). As we found that the effect of positive affect on risk perceptions was moderated by impulsiveness, this raises the possibility that the effect of positive affect on risk perceptions may weaken with age.

In Study 2, we were able to overcome the limitations of Study 1, but Study 2 also had limitations. Although the affect induction was largely effective and worked across age groups, the effect for self-reported positive affect did not reach significance in the positive vs. neutral affect condition. Moreover, we need to acknowledge the low internal consistency of the behavioral impulsiveness subscale where we nonetheless obtained the most clear-cut interaction effect. Finally, our sample size allowed for detecting medium effects but not small ones (Cohen, 1992).

General discussion

Affective influences have been suggested to play a key role in adolescent risk taking (e.g., Steinberg, 2008), but have rarely been examined. Using an effective audiovisual method of affect induction, which combined IAPS pictures (Lang et al., 2005) with instrumental music from movie soundtracks, the present two experimental studies examined the effect of positive affect on risk perceptions. Risk perceptions were assessed referring to drinking alcohol, smoking a cigarette, riding in a car with a drunk driver, getting into a fight, and having unprotected sexual intercourse using an adapted version of the Benthin Risk Perception Measure (Benthin et al., 1993) following the example of other studies (e.g., Gardner & Steinberg, 2005). Study 1 showed that positive affect led to lower risk perceptions for young adults. Study 2 replicated this effect for early adolescents, mid-adolescents, and young adults and showed that the effect was particularly pronounced at high levels of behavioral impulsiveness.

Researchers have long been puzzled by empirical studies that have shown remarkable risk aversion among adolescents, typically using questionnaire measures (for a review see Boyer, 2006), which stands in sharp contrast to their heightened risk taking in the real world as indicated by official statistics (Steinberg, 2008). The present findings may help to better understand these conflicting findings. Adolescents and young adults may be more risk averse in contexts that do not give rise to great emotions as is presumably the case in a questionnaire study (see Boyer, 2006; Fischhoff, 2008; Millstein & Halpern-Felsher, 2002). However, in "hot" moments, when they probably experience even greater positive affect than after our positive affect induction, adolescents and young adults, particularly highly impulsive ones, may markedly lower their risk perceptions.

This effect is not necessarily maladaptive. In a basic sense, risk implies uncertainty over outcomes (Tversky & Kahneman, 1974). As almost nothing in life is certain, risk taking is not only adaptive but fundamentally necessary in order to master developmental challenges throughout the life span (see also Shedler & Block, 1990). By lowering risk perceptions positive affect may hence serve a fundamentally adaptive function (see also Fredrickson, 2001), which may, however, become hazardous when thinking about risk behaviors such as whether to get into a car with a drunk driver.

The present studies have limitations, which, at the same time, suggest directions for future research. First, we sought to maximize the internal validity of our studies by using an experimental design with a random assignment of participants to the

[1] In order to analyze age-related differences in impulsiveness and sensation seeking, we performed a MANOVA with the total impulsiveness and sensation seeking scale and their subscales as dependent variables. A significant main effect of age was found ($F(18,156) = 1.80$, $p < .05$, $\eta_p^2 = .17$, Pillai's trace $= .34$, $\eta_p^2 = .17$). Simple contrasts revealed that mid-adolescents reported higher experience seeking ($p < .01$) and higher disinhibition ($p < .05$) than early adolescents. In addition, we analyzed simple correlations and found that nonplanning impulsiveness was marginally lower with higher age ($r = -.18$, $p = .099$).

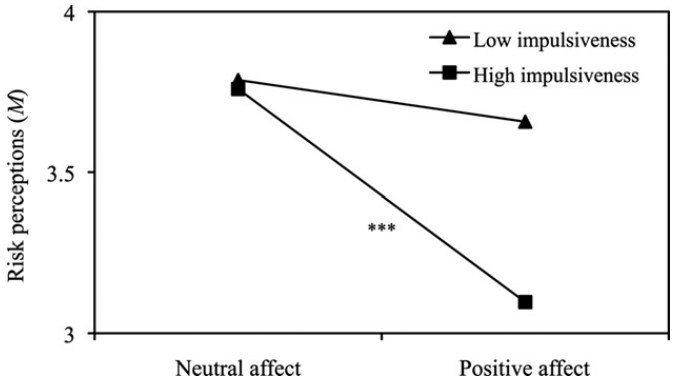

Fig. 3. Effects of neutral and positive affect on risk perceptions for individuals with low and high behavioral impulsiveness (Study 2). Note. $^{***}p < .001$.

experimental conditions. However, we used volunteer samples. Thus, future research should examine the generalizability of the present findings in representative samples. Second, we examined the effects of affect focusing on valence. Besides valence, arousal may be an important affective dimension to consider in future studies (Storbeck & Clore, 2008). Our studies presumably induced positive affect rather high in arousal, which may have a stronger effect than positive low-arousal affect (Haase, Poulin, & Heckhausen, in preparation). Another question awaiting further investigation is how negative affect influences risk perceptions in adolescents and young adults (Tice et al., 2001). Here it may be crucial to differentiate between the effects of different negative emotions such as fear and anger (see Lerner & Keltner, 2001). Third, the present studies focused on risk perception, a cognitive aspect of risk taking. Further research is needed to understand how the effects on risk perceptions generalize to other outcomes including actual risk behavior. Finally, we found that behavioral impulsiveness moderated the effect of positive affect on risk perceptions. Further research is needed to understand the mechanisms behind this effect. Moreover, future studies could examine other personality characteristics that may act as moderators such as emotion regulation (Gross & John, 2003) or mindfulness (Brown & Ryan, 2003).

Echoing Steinberg (e.g., 2008) and Rivers et al. (2008), we hope that more studies will examine affective influences on risk taking in adolescence and young adulthood. These studies are not only relevant for developmental research, they may also be of interest to research on affect and cognition (e.g., Forgas, 2008), decision-making (e.g., Hastie, 2001; Loewenstein & Lerner, 2003; Peters et al., 2006), and health (e.g., Slovic, Peters, Finucane, & MacGregor, 2005). Moreover, promoting affect regulation competencies may be an important part of programs to successfully prevent or reduce risk behavior (e.g., Steinberg, 2008).

To conclude, what makes adolescents and young adults think it is not risky to use substances, get into a car with a drunk driver, engage in a fight, or have unprotected sexual intercourse? The present experimental studies showed that feelings may profoundly alter risk perceptions. Adolescents and young adults may be more risk averse in contexts that do not give rise to great emotions, but – especially if they are highly impulsive – they have markedly lower risk perceptions under positive affect.

Acknowledgments

We would like to thank Cornelia Fröhlich for her contributions to the project and Johann Jacoby for comments on an earlier version of this article.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
Beauducel, A., Strobel, A., & Brocke, B. (2003). Psychometrische Eigenschaften und Normen einer deutschsprachigen Fassung der Sensation Seeking-Skalen, Form V. [Psychometric properties and norms of a German version of the Sensation Seeking Scales, Form V]. *Diagnostica, 49*, 61–72.
Benthin, A., Slovic, P., & Severson, H. (1993). A psychometric study of adolescent risk perception. *Journal of Adolescence, 16*, 153–168.
Beyth-Marom, R., Austin, L., Fischhoff, B., Palmgren, C., & Jacobs-Quadrel, M. (1993). Perceived consequences of risky behaviors: adults and adolescents. *Developmental Psychology, 29*, 549–563.
Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*, 129–148.
Bower, G. H., & Forgas, J. P. (2000). Affect, memory, and social cognition. In E. Eich, J. F. Kihlstrom, G. H. Bower, J. P. Forgas, & P. M. Niedenthal (Eds.), *Cognition and emotion* (pp. 87–168). New York, NY: Oxford University Press.
Boyer, T. W. (2006). The development of risk-taking: a multi-perspective review. *Developmental Review, 26*, 291–345.
Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*, 822–848.
Ciarrochi, J., & Forgas, J. P. (2000). The pleasure of possessions: affective influences and personality in the evaluation of consumer items. *European Journal of Social Psychology, 30*, 631–649.
Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*, 155–159.
Erdfelder, E., Faul, F., & Buchner, A. (1996). GPOWER: a general power analysis program. *Behavior Research Methods, Instruments, & Computers, 28*, 1–11.
Fischhoff, B. (2008). Assessing adolescent decision-making competence. *Developmental Review, 28*, 12–28.
Forgas, J. P. (2002). Feeling and doing: affective influences on interpersonal behavior. *Psychological Inquiry, 13*, 1–28.
Forgas, J. P. (2008). Affect and cognition. *Perspectives on Psychological Science, 3*, 94–101.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: the broaden-and-build theory of positive emotions. *American Psychologist, 56*, 218–226.
Galvan, A., Hare, T. A., Parra, C. E., Penn, J., Voss, K., Glover, G., et al. (2006). Earlier development of the accumbens relative to orbitofrontal cortex might underlie risk-taking behavior in adolescents. *Journal of Neuroscience, 26*, 6885–6892.
Galvan, A., Hare, T., Voss, H., Glover, G., & Casey, B. J. (2007). Risk-taking and the adolescent brain: who is at risk? *Developmental Science, 10*, F8–F14.
Ganzel, A. K. (1999). Adolescent decision making: the influence of mood, age, and gender on the consideration of information. *Journal of Adolescent Research, 14*, 289–318.
Gardner, M., & Steinberg, L. (2005). Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood: an experimental study. *Developmental Psychology, 41*, 625–635.
Gasper, K., & Clore, G. L. (2000). Do you have to pay attention to your feelings to be influenced by them? *Personality and Social Psychology Bulletin, 26*, 698–711.
Giedd, J. N. (2008). The teen brain: insights from neuroimaging. *Journal of Adolescent Health, 42*, 335–343.
Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85*, 348–362.
Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition & Emotion, 9*, 87–108.
Haase, C. M., Poulin, M. J., & Heckhausen, J. Happiness as a motivator: positive high-arousal affect enhances primary control striving. Manuscript in preparation.
Haase, C. M., Tomasik, M. J., & Silbereisen, R. K. (2008). Premature behavioral autonomy: correlates in late adolescence and young adulthood. *European Psychologist, 13*, 255–266.
Hastie, R. (2001). Problems for judgment and decision making. *Annual Review of Psychology, 52*, 653–683.
Hewig, J., Hagemann, D., Seifert, J., Gollwitzer, M., Naumann, E., & Bartussek, D. (2005). A revised film set for the induction of basic emotions. *Cognition & Emotion, 19*, 1095–1109.
Horvath, P., & Zuckerman, M. (1993). Sensation seeking, risk appraisal, and risky behavior. *Personality and Individual Differences, 14*, 41–52.
Isen, A. M., & Geva, N. (1987). The influence of positive affect on acceptable level of risk: the person with a large canoe has a large worry. *Organizational Behavior and Human Decision Processes, 39*, 145–154.
Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology, 45*, 20–31.
Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual*. (Technical Report A-6). Gainesville, FL: University of Florida.
Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology, 81*, 146–159.
Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision-making. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective science* (pp. 619–642). New York, NY: Oxford University Press.
Magar, E. C. E., Phillips, L. H., & Hosie, J. A. (2008). Self-regulation and risk taking. *Personality and Individual Differences, 45*, 153–159.
Millstein, S. G., & Halpern-Felsher, B. L. (2002). Perceptions of risk and vulnerability. *Journal of Adolescent Health, 31*, 10–27.
Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology, 51*, 768–774.
Peters, E., Västfjäll, D., Gärling, T., & Slovic, P. (2006). Affect and decision making: a 'hot' topic. *Journal of Behavioral Decision Making, 19*, 79–85.
Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics, 31*, 437–448.
Quadrel, M. J., Fischhoff, B., & Davis, W. (1993). Adolescent (in)vulnerability. *American Psychologist, 48*, 102–116.
Riediger, M., Schmiedek, F., Wagner, G. G., & Lindenberger, U. (2009). Seeking pleasure and seeking pain: Differences in prohedonic and contra-hedonic motivation from adolescence to old age. *Psychological Science, 20*, 1529–1535.
Rivers, S. E., Reyna, V. F., & Mills, B. (2008). Risk taking under the influence: a fuzzy-trace theory of emotion in adolescence. *Developmental Review, 28*, 107–144.
Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45*, 513–523.
Schwarz, N., & Clore, G. L. (2003). Mood as information: 20 years later. *Psychological Inquiry, 14*, 296–303.
Shedler, J., & Block, J. (1990). Adolescent drug use and psychological health: a longitudinal inquiry. *American Psychologist, 45*, 612–630.
Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology, 24*, S35–S40.
Spear, L. P. (2000). Neurobehavioral changes in adolescence. *Current Directions in Psychological Science, 9*, 111–114.
Stanford, M. S., Greve, K. W., Boudreaux, J. K., & Mathias, C. W. (1996). Impulsiveness and risk-taking behavior: comparison of high-school and college students using the Barratt impulsiveness scale. *Personality and Individual Differences, 21*, 1073–1075.
Stanford, M. S., Mathias, C. W., Dougherty, D. M., Lake, S. L., Anderson, N. E., & Patton, J. H. (2009). Fifty years of the Barratt impulsiveness scale: an update and review. *Personality and Individual Differences, 47*, 385–395.
Steinberg, L. (2004). Risk taking in adolescence: what changes, and why? *Annals of the New York Academy of Sciences, 1021*, 51–58.
Steinberg, L. (2007). Risk taking in adolescence: new perspectives from brain and behavioral science. *Current Directions in Psychological Science, 16*, 55–59.
Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review, 28*, 78–106.
Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: evidence for a dual systems model. *Developmental Psychology, 44*, 1764–1778.
Steyer, R., Schwenkmezger, P., Notz, P., & Eid, M. (1994). Testtheoretische Analysen des Mehrdimensionalen Befindlichkeitsfragebogen (MDBF). [Theoretical analysis of a multidimensional mood questionnaire (MDBF)]. *Diagnostica, 40*, 320–328.
Storbeck, J., & Clore, G. C. (2008). Affective arousal as information: how affective arousal influences judgments, learning, and memory. *Social and Personality Psychology Compass, 2*, 1824–1843.
Tice, D. M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: if you feel bad, do it! *Journal of Personality and Social Psychology, 80*, 53–67.
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: heuristics and biases. *Science, 185*, 1124–1131.
Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070.
Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. New York: Cambridge University Press.