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A mixed-methods approach to refining and measuring the construct of positive risk-taking in adolescence

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Abstract

Adolescence is a peak period for risk-taking, but research has largely overlooked positive manifestations of adolescent risk-taking due to ambiguity regarding operationalization and measurement of positive risk-taking. We address this limitation using a mixed-methods approach. We elicited free responses from contemporary college students ($N=74$, $M_{age}=20.1$ years) describing a time they took a risk. Qualitative analysis informed the construction of a self-report positive risk-taking scale, which was administered to a population-based sample of adolescents ($N=1,249$, $M_{age}=16$ years) for quantitative validation and examination of associations with normative and impulsive personality. Sensation seeking predicted negative and positive risk-

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Author Contributions

M.W. Patterson, E.M. Tucker-Drob and K.P. Harden developed the study concept and design. M.W. Patterson, F.D. Mann, A.D. Grotzinger contributed to data collection under the supervision of J.L. Tackett, E.M. Tucker-Drob, and K.P. Harden. M.W. Patterson, K.C. Monahan, E.M. Tucker-Drob, and K.P. Harden contributed to selection or development of study measures. M.W. Patterson and L. Pivnick developed the qualitative coding scheme and coded qualitative data. M.W. Patterson performed the data analysis and interpretation under the supervision of E.M. Tucker-Drob and K.P. Harden. M.W. Patterson drafted the manuscript, and all authors provided critical revisions. All authors approved the final version of the manuscript for submission.

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taking, whereas extraversion and openness were predominantly related to positive risk-taking. Results provide promising evidence for a valid measure of adolescents' engagement in positive risks.

Keywords

Personality; positive risk-taking; negative risk-taking

“If you want to study the entrepreneur, study the juvenile delinquent.”

– Yvon Chouinard, founder of Patagonia

Risk-taking is clearly important to human and societal well-being generally, but it may be particularly important during adolescence. As children mature into adults, they individuate from their caregivers, forge attachments with peers, compete for mating opportunities and social status, learn new skills and social roles, and develop new attitudes and identities (Weisfeld & Shattuck, 2017). Some tolerance for risk is necessary to accomplish these maturational tasks. Yet the study of adolescent risk-taking is dominated by the study of risky behaviors that are generally considered by adults to be “bad” behaviors, because they contravene laws (*e.g.*, delinquency) or have health-compromising effects (*e.g.*, smoking). Here, we aim to advance the scientific study of positive risk-taking, and in so doing, we clarify its relation to the negative risk-taking behaviors that are more commonly the focus of psychological research. Our contributions to this nascent literature are three-fold. First, we suggest how existing theoretical definitions of the construct of positive risk-taking can be refined. Our major proposition is that adolescents' *own* perspectives on what constitutes a variable or uncertain outcome should be centered in the definition of what makes a behavior “risky,” whereas the distinction between “positive” and “negative” risks centers the likely consequences of engagement in a behavior, taking into account objective detriments to health and transgressions of societal norms (*e.g.*, laws) that may result in censure. Second, reflecting our centering of adolescents' own perspectives on risk, we propose that targeted inclusion of socially-oriented risks may be key for capturing behaviors that adolescents judge to be risky. As they navigate their social worlds, adolescents are risking failure, rejection, and humiliation, and these potential negative consequences are just as salient to them as the threat of physical harms or legal censure, if not more so. Third, we evaluate the personality correlates of both positive and negative risk-taking to characterize underlying personality facets that underlie risk-taking more generally, as well as differentiate whether an individual is more likely to take positive or negative risks.

Refining the Definition of Positive Risk-Taking

Defining the construct of positive risk-taking relies on addressing two fundamental components: What is risk? And what makes a risk positive? Following behavioral economic perspectives on risk, we define a risky behavior as a behavior that has uncertain and variable consequences (Crone et al., 2016; Holton, 2004). From this definition, there is nothing about risk-taking behavior that is inherently negative. Any risk has the potential for a positive and negative outcome: What differentiates positive and negative risk-taking is not the outcome of an individual act for an individual person, but the relative severity of the expected costs and

benefits of engaging in that behavior. Positive risks have largely beneficial expected payoffs of engaging in that behavior over time, compared to negative risks that have costly expected payoffs.

This general framework provides the basis for the definition and measurement of positive risk-taking. Most notably, the construct of positive risk-taking was defined by Duell and Steinberg (2020; henceforth referred to as Duell-Steinberg) as “socially acceptable and constructive risks” with three primary features:

1. benefits to adolescent well-being despite costs,
2. potential costs with mild effects on health, safety, or well-being (in comparison to negative risks), and
3. legal and socially acceptable by adults.

The Duell-Steinberg definition of positive risk-taking represents an important advance, because it clarifies why some behaviors, like trying out for a sports team or play, taking an unfamiliar class, or standing up for your beliefs in spite of peer criticism, are appropriately considered “risky.” Such behaviors might not comport with what many researchers intuitively understand as risky, as the potential *social* costs to these behaviors—failure, humiliation, or rejection—might be underestimated or ignored by adults. Yet these behaviors do, in fact, entail potential and uncertain consequences, which might be highly salient to adolescents themselves. Thus, the Duell-Steinberg definition relies on economic perspectives on what constitutes a risk—the variability and uncertainty of potential costs and benefits, with higher risk behaviors marked by increasing variability or uncertainty (Figner & Weber, 2011)—while denoting the lower expected costs and greater expected benefits to define the behavior as positive.

While advancing the study of positive risk-taking, the Duell-Steinberg definition has limitations where adolescents are considered. In particular, the first two features of their definition involve normative judgements without specifying *whose* judgement is being centered – the adolescent who is engaging in the behavior or the (adult) society that is evaluating that behavior. That positive risks by their very definition are required to be socially acceptable may preclude many people from perceiving these actions as risky. However, the differential motivation and reward schema of adolescents may mean that perceived costs and gains carry different weight for adolescents than adults. For instance, what constitutes a “benefit” to adolescent well-being? Who is to say whether a potential cost is “mild”? From the perspective of a parent or educator, it might seem obvious that the benefits of, say, skipping class or underage drinking are minimal compared to the potential costs. From the perspective of the adolescent, however, the situation might not be so clear-cut. Indeed, engagement in some risks that are broadly considered negative might be typical and even adaptive in the process of forming new friendships and fostering youth identity and autonomy (Chassin et al., 1988), while the ostensibly “mild” potential consequences of some positive risks, such as peer rejection, might be severely detrimental to adolescent mental health (Harris, 2009; Platt et al., 2013). In fact, adolescents may planfully engage in risk-taking that presents potential costs to their health and wellbeing due to reasoned judgments that the benefits of these risks outweigh the consequences (Maslowsky et al.,

2019). We assert that when characterizing the nature of adolescent positive risk-taking it is paramount to center judgments of whether something is *risky* on the perceptions of the adolescents taking those risks, whereas the judgement of net positive or negative *payoff* relies on the average expected consequence, which is partly determined by the norms and values of a given society and objective potential harm, such as detriment to health, but is independent of the subjective perception of the adolescent.

In sum, defining a behavior as positive risk-taking in adolescence requires: 1) establishing that *adolescents* perceive this behavior to have variable expected outcomes in terms of benefits/costs; and 2) that the average expected payoff of that behavior has greater benefits relative to costs. The potential costs of a risky behavior could be experienced in multiple domains of life: physical (*e.g.*, pleasure vs. injury/disease), economic (*e.g.*, monetary gain vs. loss), social (*e.g.*, connection/status/praise vs. rejection/subjugation/blame), occupational (*e.g.*, promotion/achievement vs. demotion/failure), or psychological (*e.g.*, pride vs. humiliation). However, as the above definition makes clear, centering the adolescent perspective is key when it comes to determining whether something is a risk. As such, we hypothesize that considering the potential *social* costs of a behavior *for adolescents* will be particularly important for understanding the expression of positive risk-taking behaviors. As we review in the next section, one of the primary developmental tasks of adolescence is the re-orientation of attachment relationships from primary caregivers toward similarly-aged peers, which means that adolescents are attuned to possible threats to attachment and status in their peer groups (Ciranka & van den Bos, 2019; Crone & Dahl, 2012; Dahl et al., 2018).

Measuring Positive Risk-Taking during Adolescence: The Importance of Social Risks

Empirically, few studies have attempted to capture positive risk-taking, and measures of positive risk-taking have varied in important ways across studies (for review see Duell & Steinberg, 2019). Most measures attempting to capture positive risk-taking have emphasized participation in physically risky sports or performance activities, such as skiing or rock-climbing (Fischer & Smith, 2004; Hansen & Breivik, 2001; Wood et al., 2013), whereas engagement in activities that are novel or unfamiliar (but not physically dangerous) and engagement in interpersonal situations have received less attention (Duell & Steinberg, 2020; Fischer & Smith, 2004). This focus on perceived physical risk neglects the salience of socially-evaluative risks and rewards for adolescents. Other risk-taking scales, such as the Domain-Specific Risk Taking Scale, have sought to differentiate forms of risk-taking based on the domain of impact for benefits and costs (Figner et al., 2015; Weber et al., 2002), but do not consider whether the ratio of relative benefits to costs results in net positive or negative payoff. Though this provides considerable utility in discriminating between domains of risk-taking (*e.g.*, isolating socially-oriented risks), both risks with positive and negative net expected outcomes are included within risk-taking domain. Though we posit that the targeted inclusion of social risks is important to capture behaviors that adolescents perceive as risky, it is insufficient to distinguish between these positive or negative consequences of risk-taking.

Concerns about peer acceptance and rejection are heightened in adolescence, and peer evaluations have greater implications for how adolescents view their own self-worth and identity compared to other developmental periods (Kloep, 1999; O'Brien & Bierman, 1988; Pfeifer et al., 2009). Social sensitivity in adolescents is detected in increases in emotional reactivity to cues of inclusion and exclusion, heightened attention to real or perceived social evaluation, and more complex considerations of others' thoughts and feelings (Sommerville, 2013). Compared to adults, adolescents experience greater affective costs, such as decreased mood and increased anxiety in response to experimentally-manipulated peer rejection (Sebastian et al., 2010). Conversely, adolescents – but not young adults – respond to social rewards as strongly as they do to monetary rewards (Ethridge et al., 2017). Furthermore, studies of the neural processing of social rejection suggest that similar brain areas are activated in social pain as in physical pain (Eisenberger, 2012, 2015; Masten et al., 2009), while acceptance has been related to areas relevant for reward processing (Guyer et al., 2011). A developmental increase in social engagement during adolescence is also evident in non-human animals, suggesting that alterations in sensitivity to social rewards and punishments may facilitate the acquisition of adult levels of social competence (Douglas et al., 2004; Meng et al., 2010; Primus & Kellogg, 1989).

Due to adolescents' sensitivity to social threats and rewards, engaging in activities such as going to an unfamiliar place or joining a new social group may evoke perceptions of potential rejection or evaluation that result in perceived risk. At the same time, the potential for gains in social status, inclusion, or positive peer perceptions through engaging in these behaviors may be especially motivating and rewarding. Given this, we propose that measures of positive risk-taking will be strengthened by targeted inclusion of interpersonal behaviors that have potential consequences of rejection, failure, or feelings of humiliation and embarrassment. Consistent with this conceptualization, Fryt and Szczygiel (2021) found that positive risk-taking was associated with sensitivity to reward and tolerance of ambiguity, and was primarily linked to risks taken in the social domain. Although our emphasis here is on positive risk-taking in adolescents, another recent study suggests that social risks remain salient into adulthood. In a 21-day daily diary study, Lydon-Staley and colleagues (2020) had participants report the riskiest behavior they had engaged in each day. Of these self-identified risky behaviors, only approximately 15% were coded by study investigators as threatening to safety, health, or well-being. Semantic network analysis of self-reported risk identified several communities of risk that were broadly social in nature: risks with distant social ties (such as meeting a stranger or asking for something), risks at school or work, and risks with friends. Adolescents are not the only ones who fear negative evaluation. These findings highlight that many daily risks are indeed perceived as positive and socially-oriented in nature.

Positive and Negative Risk-Taking in Relation to Personality

An extensive body of literature has identified *sensation seeking* as a personality trait that is closely tied to engagement in negative risk-taking behaviors, such as heavy drug use or delinquent behaviors (reviewed in Harden & Mann, 2015). Similarly, in the small extant literature on positive risk-taking, much of the focus on predisposing traits has focused on sensation seeking, which is consistently correlated with various measures of positive

risk-taking, in both adolescents and adults (Duell & Steinberg, 2020; Fischer & Smith, 2004; Hansen & Breivik, 2001). Additionally, in adults, sensation seeking was found to be associated with the diversity of self-defined risk-taking behaviors across 21 days, but not specifically with whether these behaviors were identified as threatening to safety, health, or well-being, consistent with the idea that sensation seeking is associated with risk-taking behavior generally, not specifically negative risk-taking (Lydon-Staley et al., 2020). In contrast, poor impulse control has been shown to be unrelated to previous measures of positive risk-taking, unlike negative risk-taking which is associated with impulsivity (Duell & Steinberg, 2020; Fischer & Smith, 2004).

In contrast, how positive risk-taking is related to broad dimensions of personality has received less attention in this literature. No studies have assessed the association of normative personality (*i.e.*, Big Five personality dimensions of extraversion, agreeableness, conscientiousness, neuroticism, and openness) with positive risk-taking in adolescents. Given the centrality of potential social consequences in our conception of positive risk-taking, it is important to establish that any measure of positive risk-taking is not simply isomorphic with extraversion or openness to experience, although we expect to observe positive correlations. In one of the few studies that has examined personality facets, Hansen & Breivik (2001) examined sensation seeking subscales and found that though thrill seeking and activity subscales were associated across both risk-taking types, new experiences and outgoingness subscales were associated primarily positive rather than negative risk-taking in adolescents. Though not a direct measure of extraversion or openness, this evidence highlights that these personality dimensions may have key relevance for discriminating between forms of risk-taking.

However, some research has examined normative personality with respect to risk-taking domains, and though these domains are not inherently consistent with our conceptualization of positive and negative risk-taking, this literature may be informative for potential differential effects of personality on forms of risk-taking. Higher extraversion has been found to be associated with recreational and social forms of risk-taking (Gullone & Moore, 2000; Lauriola & Weller, 2018), as well as openness to experience (Weller & Tikir, 2011). In contrast, rebellious and reckless risks (*e.g.*, substance use, having unprotected sex) have been associated with lower conscientiousness (Gullone & Moore, 2000; Skeel et al., 2007). This is consistent with a larger literature suggesting a link between constructs similar to negative risk-taking, such as normative antisocial behaviors and minor delinquency, and low conscientiousness (Lauriola & Weller, 2018; Ljubin-Golub et al., 2017; Miller & Lynam, 2001). With regard to extraversion and openness to experience, associations with negative risk-taking (*e.g.*, health/safety risks) have been mixed and inconsistent (Gullone & Moore, 2000; Ljubin-Golub et al., 2017; Miller & Lynam, 2001; Skeel et al., 2007). Additionally, in a sample of adults, social risk-taking was associated with openness to experience even after accounting for associations with sensation seeking (de-Juan-Ripoll et al., 2021). Though limited, this evidence may indicate that Big Five traits are relevant for differential engagement in positive and negative risk-taking.

The Current Research

The primary aim of this research was to advance the literature on positive risk-taking in adolescence using a mixed-methods approach. First, we provide qualitative analysis to explore how a sample of contemporary college students perceive “risky” behavior in their own lives. We use results of this qualitative analysis to refine a self-report scale of positive risk-taking. Second, we conduct quantitative analyses of this self-report scale in a large, population-based cohort of adolescents to (a) examine its psychometric properties, including its dimensionality and measurement invariance across gender and age, and (b) estimate its association with personality dimensions. Based on previous research (e.g., Duell & Steinberg, 2020), it was expected that sensation seeking would be associated with greater positive and negative risk-taking to a similar magnitude, and that poor impulse control would be associated with negative (but not positive) risk-taking. It was also hypothesized that extraversion and openness would be associated with greater positive (but not negative) risk-taking. We show that the 11-item Texas Positive Risk-Taking Scale shows good psychometric properties and is associated with personality in the anticipated ways.

Study 1: Qualitative Validation of Positive Risk-Taking

Methods

Participants—A sample of 74 undergraduate students (49% female, 30% male, 21% not reporting gender; age range: 18–28 years, $M = 20.1$, $SD = 1.7$), who were enrolled in an online introductory psychology course at a large Southwestern university, answered one writing prompt with an open-ended, typed free response. In this sample of contemporary college students, of those who reported age (23% not reporting), 37% were 18–19 years, 47% were 20–21 years, and of the remaining older participants, only 4% were above the age of 22 years ($N = 2$). In qualitative studies, contemporary college students have demonstrated utility in understanding adolescent experiences when describing recollective events, given their proximity to adolescence (Crabbe et al., 2018; Pivnick et al., 2020). Participants were free to answer however they wanted, without word limits (Terry et al. 2017). Responses to the writing prompt were recorded via learning management software (Canvas), allowing for greater participant anonymity and efficient data collection (Clarke & Braun, 2013). The prompt was as follows:

“In this writing assignment, please write about a time in your life when you took a risk. This could have been a small risk or a big one. It could have turned out well, or turned out badly, or just turned out different than you expected. It could be something that you did that was obviously dangerous or that broke the rules. Or, maybe the risk you took only felt risky for you personally. In your writing, you might think about some of these issues: What is your definition of risky? Why did you take that risk? What did it feel like to take that risk? What were you hoping would happen? What were you afraid would happen? What role did other people in your life -- your parents, friends, boyfriend/girlfriend -- play in the experience you are writing about. Write continuously for the full 15 minutes. Really let go and analyze your thoughts and feelings.”

Analyses

Generating candidate risk behaviors.: Prior to the thematic analysis of participants' writing samples, we consulted previous research on positive risk-taking and generated an initial pool of 27 candidate risk behaviors. Beginning with the non-negative risk-taking scale used by Fischer and Smith (2004), we removed behaviors with low potential for risk (e.g. attending sports games), and combined very similar activities (e.g. "Played soccer" and "Played basketball" to "Played soccer, basketball, football, or some other team sport?"), resulting in a pool of 14 candidate behaviors. An additional 13 candidate risk behaviors were generated to assess interpersonal interactions and other activities or behaviors that might result in consequences of failure, rejection, or humiliation (Table 1).

Thematic analysis.: Behaviors were first defined as negative risks if they had the potential to result in harm to self/others or violated societal norms, whereas positive risks were judged to be socially acceptable. The first and second authors then generated *a priori* broad themes from the initial pool of candidate positive risk behaviors. These themes, along with sub-themes and individual candidate risk behaviors, are provided in Table 1.

We then used thematic analysis of participants' writing samples to identify, analyze, and report patterns in the responses to the free response prompt using a consensus coding approach (Braun & Clarke, 2006). First, the first and second authors performed independent close line-by-line coding by hand of ten free responses from a random subset of Study 1 participants, noting additional themes and subthemes that emerged (Palmer et al., 2010). After this first round of coding, the first and second authors reconvened to discuss suitability, mutual exclusivity, and exhaustiveness of the initial set of *a priori* themes and subthemes to the data (Weber, 1990). The authors then used notes taken during the first-round of coding to determine an additional set of emergent themes and subthemes. For a full set of positive and negative risk-taking superordinate themes and subthemes, see Table 1. Within positive risk-taking, one emergent theme was *Prosociality*, and an emergent sub-theme was *Education-related risks* under the superordinate *Joining In* theme. Within negative risk-taking, one emergent theme was *Emotional Harm*.

Given this updated list of *a priori* and emergent themes and subthemes, the authors then recoded the first ten risk-taking responses and continued to code the remaining risk-taking responses using MAXQDA (Version 12.1.3) qualitative coding software (Stemler, 2001). After each coding all risk-taking responses using the modified set of emergent and *a priori* themes and subthemes, the first two authors compared coding on each risk-taking response as a quality control check (Stemler, 2001). Where there were coding discrepancies, the authors discussed and reached an agreement on the appropriate codes. Finally, the pool of candidate risk behaviors was filtered using the coding of the free response data (process outlined in Figure 1): Candidate risk behaviors that were not spontaneously endorsed by at least respondent were dropped from further consideration.

Results

Within the 74 written responses, 95% of responses contained positive risk-taking themes (N=70), and 22% of responses contained negative risk-taking themes (N=16), with only one

response failing to identify a risk-taking behavior. Within responses describing risk-taking behavior, 18% fell into both positive and negative risk-taking themes.

Overall, *a priori* positive risk-taking themes accounted for the majority of positive risk-taking behaviors described in the qualitative responses. All positive risk-taking responses included at least one *a priori* broad theme (Table 2). Of the *a priori* broad themes, *Novelty* was included in the largest number of positive risk-taking responses (71%), followed by *Joining-In* (64%), *Autonomy* (61%), *Disclosure* (14%), and *Perceived Physical Danger* (3%). Within the *Novelty* broad theme, the “Interpersonal” sub-theme was identified in almost half (47%) of positive risk-taking responses. Of the emergent themes that were identified, only 3% of responses coded as positive risk-taking were identified within the emergent *Prosociality* theme (*e.g.*, benefiting others at the cost of oneself), and all of these responses fell within one or more of the *a priori* positive risk-taking thematic codes. For the emergent sub-theme for “Education-related risks” (under the *Joining-In* broad theme), 37% of positive risk-taking responses were identified with this code; however, only one response did not include any additional *a priori* positive risk-taking themes.

Of the 16 responses identifying negative risk-taking, 2 responses were coded as only *Physical Harm to Self* (13%), 10 responses as *Breaking Rules/Laws* (63%), and 2 responses (13%) with both of these negative risk-taking themes. An emergent broad theme for “Emotional harm to self/others” (*e.g.*, using or manipulating others) was identified and accounted for 13% of responses including negative risk-taking (2 total). No responses were coded as *Physical Harm to Others*.

To determine which of our candidate risk behaviors were spontaneously identified as risks by participants in Study 1, we assigned each response to a behavior-specific code and calculated their endorsement rates (Table 3). Of the 70 responses identified with a positive risk-taking code, 84% responses matched a behavior-specific code. Behavior-specific codes with at least one endorsement were used to develop positive risk-taking items included in subsequent quantitative analyses. Eleven candidate risk behaviors failed to be endorsed by at least one participant as risks within the Study 1 sample. Interestingly, all candidate behaviors with the *a priori* broad theme of *Perceived Physical Danger* failed to be endorsed; as such, all of the items in this category were dropped. The remaining 16 items included those from the other *a priori* broad themes: 2 out of 4 *Autonomy* behaviors were retained, 2 out of 2 *Disclosure* behaviors, 3 out of 6 *Joining-In* behaviors, and 9 out of 12 *Novelty* behaviors. Consistent with the hypothesis that socially-oriented risks may be key for measuring positive risk-taking, all interpersonal novelty behaviors were retained. These 16 candidate risk behaviors were concluded to be perceived as risk-taking by this sample of contemporary college students, and therefore selected from the pool of positive risk-taking items to be quantitatively validated in Study 2.

Study 2: Psychometric Properties of Positive Risk-Taking and Associations with Personality

Methods

Participants—The sample for the quantitative analyses was drawn from the Texas Twin Project (Harden et al., 2013), an ongoing twin study based in central Texas. The analytic sample ($N = 1,249$ from 614 unique families) ranged in age from 13.5 to 20.1 years ($M = 16.0$, $SD = 1.3$, only 8% of the sample older than 18 years), and was 49.0% female. Of these, $N = 877$ contributed data on positive risk-taking, as this measure was not administered until the second year of data collection (*i.e.*, data missing completely at random). Here, we are not estimating genetic effects thus, we analyze data from twins as individuals with appropriate correction for nesting within families. Participants were identified from public high school rosters and recruited for an in-laboratory assessment. Surveys were administered via computer and in separate rooms to protect the participants' privacy. All study procedures received approval from the University of Texas at Austin Institutional Review Board. The Texas Twin Project is a racially, ethnically, and socioeconomically diverse population-based sample. Of the individuals who self-reported race/ethnicity (1.0% did not report), 55.1% identified as White, 14.9% as Hispanic/Latino, 11.5% as African American, 5.8% as other, and 11.6% as multiracial. Twenty-four percent of the families reported receiving some means-tested public assistance (*e.g.*, food stamps) in the last six years (5% did not report). Highest attained maternal education suggests an overall representative sample socioeconomically, with 5% of mothers reporting having dropped out prior to high school diploma, 26% attaining a high school or technical school diploma, 42% holding an Associate's or Bachelor's degree, and 23% having had some level of graduate education (4% not reporting).

Measures—Descriptive statistics and internal reliabilities for all measures are provided in Table 4.

Positive Risk-Taking. Participants rated the frequency of their engagement in sixteen behaviors (Table 5) in the last year on a 6-point scale (0 – *Never*, 1 – *1–2 times*, 2 – *3–5 times*, 3 – *6–10 times*, 4 – *11–15 times*, 5 – *16 times or more*). Details on the construction of a final positive risk-taking scaled score are provided in Results section.

Negative Risk-Taking. Thirty-six items assessing engagement in delinquent behaviors (Huizinga et al., 1991), 11 items assessing substance use, and four items assessing risky sexual behavior were used to measure negative risk-taking. Delinquency items ranged in severity from “driven a car very fast?” to “carried a hidden weapon (a knife or a gun)?” and were rated on a 3-point scale (0 – *Never*, 1 – *Once*, 2 – *More Than Once*). Due to the overall low endorsement for delinquent behaviors within the community sample and for consistency with substance use and risky sexual behavior endorsement, items were dichotomized (0 – *Never*, 1 – *One or More*). Substance use was assessed by whether participants had ever tried (0 – *No*, 1 – *Yes*) alcohol, cigarettes, chew tobacco or snuff, marijuana, hallucinogens, amphetamines, heroin, cocaine, ecstasy, prescriptions that were not used as prescribed, or inhalants. Finally, four items assessed risky sexual behaviors by whether participants had

ever (0 – *No*, 1 – *Yes*) had penetrative sexual intercourse without a condom, penetrative sexual intercourse with someone they had just met or didn't know well, oral sex with someone they had just met or didn't know well, or ever sent sexually explicit pictures to someone. The 36 delinquency items, 11 substance use items, and four risky sexual behavior items were summed to create a measure of negative risk-taking.

UPPS Impulsive Personality.: UPPS subscales for Sensation Seeking, Negative Urgency, Lack of Premeditation, and Lack of Perseverance were included as dimensions of impulsive personality (Whiteside & Lynam, 2001). Participants rated agreement on a 4-point scale (1 – *Disagree Strongly* to 4 – *Agree Strongly*). Twelve items assessed sensation seeking, such as, “I generally seek new and exciting experiences and sensations.” Twelve-items measured negative urgency, such as “When I am upset I often act without thinking.” Lack of premeditation was measured by eleven reverse coded items, such as: “I usually think carefully before doing anything.” Lack of perseverance was measured by 10 items such as “I tend to give up easily,” and 8 of which were reverse coded (*e.g.*, “I finish what I start.”). Mean scores were calculated for each subscale, with higher values indicating greater endorsement.

Big Five Personality.: Normative personality was assessed using The Big Five Inventory (John et al., 2008) to measure five broad dispositional dimensions: Extraversion (8 items, *e.g.*, “is full of energy”), Agreeableness (9 items, *e.g.*, “is helpful and unselfish with others”), Conscientiousness (9 items, *e.g.*, “is a reliable worker”), Openness to Experience (10 items, *e.g.*, “is curious about many different things”), and Neuroticism (8 items, *e.g.*, “can be moody”). Participants rated agreement with each item on a 5-point scale from 1 – *Strongly Disagree*, to 5 – *Strongly Agree*. Mean scores were calculated for each subscale, with higher values indicating greater endorsement.

Risk Perception.: An adapted version of the Benthin Risk Perception Scale (Benthin et al., 1993; Pailing & Reniers, 2018) was used to measure adolescent appraisals of risk for seven behaviors (having sex without a condom, riding in a car with someone who has been drinking, trying a new drug, getting into a physical fight, smoking cigarettes, drinking alcohol, and breaking into a store at night and stealing something you really want) with one item for each behavior corresponding to the four subscales, for a total of 28 items. Participants rated their Affective Appraisal (“To what extent are the potential risks (dangers) associated with this activity frightening for you?”), Risk Likelihood Appraisal (“If you did this activity, to what extent do you believe that you would be personally at risk of getting hurt or sick?”), Seriousness of Consequences (“If an accident or something bad happened because of this activity, would you expect the harmful effects to be mild or serious?”), and Benefits vs. Consequences (“To what extents are the benefits or pleasures provided by this activity greater than the risks associated with it?”) on a 4-point scale with higher values indicating greater perception of risk. A mean score was separately calculated for each Risk Perception subscale.

Analytic Technique: The first aim of this study was to examine psychometric properties of the Texas Positive Risk-Taking Scale by testing the factor structure and measurement

invariance of across gender and age groups. To address this aim, we performed a series of exploratory and confirmatory factor analyses (EFAs and CFAs). The sample was split selecting one twin from each pair, and an exploratory factor analysis (EFA) was estimated on the first split-sample half using geomin rotation and maximum likelihood estimation. Factor enumeration was determined based on theory and model fit comparisons, with a significant improvement in model fit indicated by $RMSEA > .015$, which is comparable to Parallel Analysis in determining the optimal number of factors with sample sizes greater than 400 (Finch, 2019). A confirmatory factor analysis (CFA) was then performed in the second split-sample half based on the EFA solution after items were removed. Items were further refined to reduce collinearity as assessed through suggested residual correlations in modification indexes to achieve a unidimensional factor structure with good fit to the data. Once the factor structure was established, multi-group models were used to test for measurement invariance across gender (male, female) and age (split at the mean of 16 years such that the younger group comprised ages less than 16 years, and the older group ages 16 and older) in the full sample. Measurement invariance was indicated confirmatory fit index (CFI) $< .01$ and root-mean square error of approximation (RMSEA) $< .015$ (Chen, 2007).

The second aim of this study was to identify personality factors both commonly and uniquely associated with positive and negative risk-taking. A structural equation model was estimated to test associations between normative (Big Five) and impulsive personality (UPPS) and both positive and negative risk-taking. Positive and negative risk-taking measures were log-transformed to correct for positive skew and were entered as observed endogenous variables. The Big Five personality traits (Extraversion, Agreeableness, Conscientiousness, and Openness) and the UPPS personality traits (Negative Urgency, Premeditation, Preservation, Sensation Seeking) were entered as separate observed exogenous variables. Separate covariances were specified between positive and negative risk taking and between each personality factor. Demographic characteristics were entered as covariates by regressing positive and negative risk-taking and personality characteristics on adolescent age, gender, and race/ethnicity (binary codes for African American, Hispanic/Latino, and 'Other'). Correlations were estimated between Hispanic/Latino ethnicity and race covariates. Critical ratio of differences was used to examine whether associations between personality characteristics differed among positive versus negative risk taking, with $CR > 1.95$ indicating a significant difference (Byrne, 2011). All models were estimated in *Mplus* version 7.2 (Muthén & Muthén, 2010), using the complex sampling option to account for non-independence of twins within families. Full information maximum likelihood was used to account for missing data. The EFA and CFA analyses were restricted to the positive risk-taking subset ($N = 877$) and the full sample ($N = 1,249$) was used for the structural model. Model fit was evaluated with standard metrics, and acceptable fit was indicated with $\chi^2/df < 3.0$, CFI > 0.90 , and RMSEA < 0.08 (Kline, 2005).

Results

Factor Analyses for the Positive Risk-Taking Scale

Exploratory factor analysis.—Using the 16 items endorsed in the qualitative analysis, we estimated an exploratory factor analysis in a split-sample half ($N = 431$) to determine

the dimensionality of the data. Fit statistics from models estimating one to four factors are presented in Table S1, and factor loadings are reported in Table S2. Model fit improved with each additional factor up to the three factor solution, but a four factor model did not converge. However, the three-factor solution produced results that were not conceptually distinguishable and that had substantial item cross-loading across two of the factors, and RMSEA between the three-factor and two-factor solutions did not exceed 0.15 (Table S1). In the two factor model, the majority of the items loaded or cross-loaded on a single factor, and only three items did not load this factor: “Played soccer, basketball, football, or some other team sport” ($\lambda_2 = .04$), “Played a sport you’re not good at” ($\lambda_3 = .001$) and “Gone on a blind date” ($\lambda_8 = .08$). All other item loadings were significant and moderate in magnitude ($\lambda_s = .24 - .77$, $p_s < .05$). These results suggest that a unidimensional factor removing these items may be the most appropriate characterization of the positive risk-taking scale. Consistent with this, these items had low endorsement in the qualitative sample (1 – 3%). Thus, a unidimensional factor dropping these three items was retained for further analyses.

Confirmatory factor analysis.—Using the remaining 13 items, we tested a unidimensional confirmatory factor model in the second split-sample half ($N = 428$). Model fit was adequate ($\chi^2 = 173.26$, $df = 65$, $p < .001$, RMSEA = .062, CFI/TLI = .89/.87). Investigation of modification indices suggested residual correlations between two conceptually related item pairs: “Tried out for a team, joined a new club or activity, or auditioned for a play” ($\lambda_1 = .44$) and “Run for office in school or some other organization” ($\lambda_4 = .28$), and “Hung out with a new group of people” ($\lambda_9 = .61$) and “Gone to a social event where you didn’t know anyone” ($\lambda_{10} = .57$). Consistent with this, within each pair, the item with the lower factor loading also had lower endorsement in the qualitative sample. To reduce collinearity between items in these pairs, we tested a model dropping the item within the pair with the lower loading. The resulting model demonstrated good fit to the data ($\chi^2 = 104.00$, $df = 44$, $p < .001$, RMSEA = .056, CFI/TLI = .93/.91) without the need for residual correlations between items, and improved fit compared to the previous model as indicated by CFI = .04 (Kline, 2005). The final CFA of these 11 items produced factor loadings that were all statistically significant ($p_s < .001$) and moderate in magnitude (Table 5).

Measurement Invariance for the Positive Risk-Taking Scale

Adolescent Gender.—A series of measurement invariance models were fit in the full positive risk-taking subset ($N = 877$) to determine whether the positive risk-taking factor was invariant across gender. We first compared a *configural invariance* model, in which an equivalent factor model was fit in a two-group model, with item means and factor loading allowed to differ between genders, to a *metric invariance* model, in which factor loadings were fixed to equality for boys and girls. The metric invariance model did not result in a decrement of fit compared to the configural invariance model, indicating that items were equally good indicators of the latent positive risk-taking factor for girls and boys (Table 6). The metric invariance model was then compared to a *scalar invariance* model, in which both factor loadings and item-specific intercepts were constrained to equality across groups. The scalar invariance model fit significantly worse than the metric invariance model, indicating a difference in the item intercepts for boys and girls (Table 6). This demonstrated that items were equally good indicators of positive risk-taking for both boys and girls, but

occurred with different frequency across gender in a way that was not captured by the latent mean. Sources of invariance were investigated, and partial scalar invariance was achieved by releasing the item-specific intercepts for three items. Two item intercepts “Asked someone on a date”, and “Taken a risk and trusted someone”) were higher in boys than in girls, and one item intercept (“Ended a friendship”) was higher in girls than in boys. As investigation of gender differences was not central to our focal analyses, gender was first regressed out of each item to account for gender differences in the means when computing composite scores, and then the mean of the item-specific residuals was calculated¹. Resulting values were standardized, and these scores were used in subsequent analyses.

Adolescent Age.—A second set of measurement invariance models were tested to determine whether the positive risk-taking factor was invariant across age. Groups were split at the mean age of 16 (Younger: <16 years; Older = 16 years). Similar to measurement invariance models across gender, the models of configural and metric invariance were not significantly different indicating that the items were similar indicators of positive risk-taking for younger and older adolescents (Table 6). However, the fit of the scalar invariance model was significantly worse than that of the metric invariance model², again indicating that some item intercepts differed across age groups (Table 6). A partial scalar invariance model was achieved by releasing the item-specific means for five items. The intercept was higher for one item among the younger age group (“Tried out for a team, joined a new club or activity, or auditioned for a play”), whereas intercepts were higher in four items (“Asked someone on a date”, “Taken a class in an area you know nothing about”, “Stood up for what you believe is right, either socially or academically”, “Taken a risk and trusted someone”) among the older age group. To account for these differences in item-specific means, age was regressed out of each item prior to computing a standardized mean score, as described with gender.

Convergent and discriminant validity.—Convergent and discriminant validity was explored by examining correlations between positive risk-taking and Big Five personality, UPPS Impulsive Personality, Risk Perception, and negative risk-taking (Table 4, full correlation matrix in Table S3). Positive risk-taking was not isomorphic with personality or contextual variables. Consistent with previous evidence (Duell & Steinberg, 2020; Fischer & Smith, 2004; Hansen & Breivik, 2001), positive-risk taking was significantly correlated with sensation seeking and negative risk-taking, supporting convergent validity of our measure.

For Big Five personality traits, positive risk-taking showed significant, small to moderate correlations with extraversion and openness, consistent with our expectations based in the small extant literature on positive risk-taking (Hansen & Breivik, 2001). Positive risk-taking was not significantly related to agreeableness, conscientiousness, or neuroticism. For additional UPPS Impulsive Personality subscales, positive risk-taking showed a small negative correlation with lack of perseverance, and positive correlations with negative urgency and lack of premeditation. Consistent with previous research on impulsivity

¹As regressing gender out at the item level results in items in which mean level differences are removed, a measurement invariance model using item-specific residuals resulted in nearly identical model fit between metric and scalar invariance models.

²It should be noted that the full scalar model still had good fit, and though statistical decrement in fit was determined by $CFI > .01$, RMSEA was lower than the cutoff of .015 between the metric and full scalar model.

(Duell & Steinberg, 2020; Fischer & Smith, 2004), there associations between positive risk-taking and lack of premeditation and perseverance were small relative to more moderate associations with negative risk-taking. Positive risk-taking exhibited small negative correlations with three of the four Risk Perception subscales: affective appraisal, risk likelihood appraisal, and benefits vs consequences, and was unrelated to appraisal of seriousness of consequences. In contrast, negative risk-taking demonstrated moderate to strong negative correlations with all of the Risk Perception subscales. As our measure of positive risk-taking corrected for gender at the item level, there was necessarily no correlation with gender. Overall, these correlations conform to expectations based on the limited previous research.

Associations between Personality and Positive and Negative Risk-Taking

Structural Model.—Two preliminary SEMs examined personality associations with positive and negative risk-taking for Big Five personality and UPPS Impulsive personality separately and are reported in Tables S4–S5. A final SEM was estimated to examine associations between both personality scales concurrently and adolescent risk-taking to determine unique associations with personality facets after accounting for associations among themselves. The results from the preliminary SEMs were largely consistent with the final model. The final model provided a good fit to the data, $\chi^2(8) = 10.13$, CFI/TLI = .99/.99, RMSEA = .02. Primary model estimates are displayed in Figure 2 and Table S6, and supplemental estimates are displayed in Table S7 and personality partial correlations in Table S8. Older youth, males, and those who identified as African American engaged in higher negative risk-taking and youth who identified as Hispanic/Latino engaged in lower positive-risk taking. After accounting for covariates, greater positive risk-taking was significantly associated with higher extraversion, neuroticism, and openness, as well as higher negative urgency and sensation seeking. Greater negative risk-taking was significantly and associated with higher extraversion, negative urgency, lack of premeditation and sensation seeking, and lower agreeableness, conscientiousness and openness. Positive and negative risk-taking remained significantly correlated with one another after accounting for associations with personality dimensions ($B = .11$, $SE = .03$, $p < .001$).

Comparing Personality Correlates of Positive and Negative Risk-Taking.—

Critical ratio of differences were tested to examine whether associations between personality characteristics differed among positive versus negative risk taking, with $CR > 1.95$ indicating a significant difference ($p < .05$; Byrne, 2001). Compared to negative risk-taking, positive risk-taking was more strongly associated with greater extraversion ($CR = 3.00$), neuroticism ($CR = 2.20$), and openness ($CR = 4.99$). Compared to positive risk-taking, negative risk taking was more strongly associated with greater negative urgency ($CR = 3.40$), and lower agreeableness ($CR = 4.01$) and. Positive and negative risk taking did not significantly differ in their associations with conscientiousness ($CR = 1.71$), lack of premeditation ($CR = 1.40$), lack of perseverance ($CR = 1.24$), and sensation seeking ($CR = 0.71$).

Discussion

The positive side of risk-taking is gaining prominence in some emerging theoretical perspectives on adolescent development (Duell & Steinberg, 2019; Steinberg, 2014; Yeager et al., 2018), but research typically continues to conceptualize adolescent risk-taking as exclusively pathological. To advance the study of positive risk-taking, the current study validates a self-report measure of behaviors that place adolescents at risk for negative outcomes such as failure or rejection, but may also afford them the potential for greater success, gains in social status, interpersonal connection, and self-discovery. Engaging in these behaviors, regardless of the favorable or unfavorable consequences, may benefit adolescents as they navigate their changing social contexts, explore novel relationships, and take on new roles.

To support the validity of a self-report positive risk-taking scale, of the qualitatively coded written responses describing a time they took a risk were independently generated by a sample of contemporary college students, almost all (~95%) were associated with at least one positive risk-taking theme, and a non-negligible number of responses included both positive and negative risk-taking, consistent with previous studies demonstrating a correlation between both forms of risk-taking. As anticipated, novel and interpersonal behaviors were frequently endorsed when participants were asked to describe a time they took a risk. Further, a large proportion of the candidate risk behaviors identified *a priori* (16 out of the 27) were independently endorsed as risks by this sample indicating that these candidate behaviors are indeed considered risks. Of note, all of the behaviors related to novel interpersonal behavior were endorsed, whereas none of the behaviors related to perceived physical danger were described as risks in the qualitative responses. Overall, this suggests that the self-report items derived from the candidate risk behaviors in this study may be a better representation of self-identified risky behaviors in which youth and young adults engage in a naturalistic setting, in contrast to previous studies that often relied on engagement in physically risky sports to assess positive risk-taking.

In our quantitative examination in a second, large, population-representative sample of teens, these self-report positive risk-taking items formed a unidimensional construct, and demonstrated good internal reliability resulting in the 11-item Texas Positive Risk-Taking Scale. Consistent with previous research and the qualitative responses, positive risk-taking was correlated with negative risk-taking (Duell & Steinberg, 2020; Fischer & Smith, 2004), even after accounting for positive associations between both forms of risk-taking and sensation seeking, which were similar across positive and negative risk-taking. As an extension of the previous literature, the current results show that sensation seeking associations with risk-taking were robust to inclusion of associations with other impulsive and normative personality traits, including negative urgency and extraversion, suggesting that this relationship is unique from other personality facets. Overall, higher sensation seeking teens are more likely to engage in risk-taking that spans both positive, socially acceptable behaviors as well as negative, socially deviant behaviors. Ensuring that teens have access to and are encouraged to engage in positive risks may provide sensation seekers with a socially-acceptable outlet for risk-taking as described in the implications section below.

Consistent with hypotheses, positive risk-taking was associated with greater extraversion and openness. This aligns with our conceptualization of positive risk-taking, and highlight the importance of centering adolescent perceptions of risk: engagement in socially oriented and novel behaviors is thought to be key for capturing socially acceptable actions perceived as risky by adolescents. Though behaviors such as initiating a new friendship or taking an unfamiliar class may not be perceived as risky by adults, these behaviors open up teenagers to the potential of rejection, social evaluation, or failure that may be particularly salient during adolescence. As indicated by our qualitative analysis, these behaviors are indeed perceived as risky *by young people*. Importantly, though both extraversion and openness were correlated with negative risk-taking, these associations were less pronounced than with positive risk-taking, and in fact in the opposite direction with regard to openness. This suggests that, unlike sensation seeking, extraversion and openness demonstrate particular relevance for engagement in positive risk-taking rather than risk-taking more broadly.

Adolescents who are more outgoing and fueled by social engagement (higher in extraversion) may be potentially more rewarded by the potential gains provided by engagement in social risks. Additionally, they may be more adept at coping with potential social consequences. Identifying potential mechanisms between extraversion and engagement in positive risks is outside of the scope of the current study, however, both accentuated social reward and attenuated social consequences may explain this association. Though less pronounced than the connection between extraversion and positive risk-taking, adolescents who show higher openness to new experiences may be more likely to engage in and be rewarded by participating in new activities, despite the potential for failure, embarrassment, or negative social evaluation. A recent study demonstrated that positive risk-taking was positively associated with higher sensitivity to reward and unrelated to sensitivity to punishment (Fryt & Szczygiel, 2021), though this evidence is in contrast to other work suggesting a negative association between experimentally measured reward sensitivity and positive risk-taking (Duell & Steinberg, 2020). This may suggest that some teens, perhaps those who are higher in extraversion and openness, are more motivated by the potential rewards of engaging in socially acceptable risks, however additional research is needed to clarify these potential mediating factors.

Additionally, results indicated an unexpected significant positive association between neuroticism and positive risk-taking. However, this zero-order correlation was not significant, suggesting that this association was only detected after accounting for covariation with other personality traits and covariates. Furthermore, this association was unique to positive risk-taking, as neuroticism was unrelated to negative risk-taking after accounting for covariation with impulsive personality traits. It is unclear what may be driving teens higher in neuroticism to engage in positive rather than negative risk-taking, particularly given the significant negative correlations between neuroticism, and extraversion and sensation seeking, both strong positive correlates of positive risk-taking. Given that this association was not hypothesized and the lack of theory driven connection, replication in an independent sample and exploration of potential mechanisms may be warranted in future research.

Positive and negative risk-taking were associated with greater negative urgency. However, this association was stronger for negative compared to positive risk-taking. It is possible that adolescents are more strongly drawn to negative risk-taking experiences when they are distressed relative to positive risk-taking experiences. Additionally, we found that negative risk-taking was more strongly and negatively associated with agreeableness and conscientiousness compared to positive risk-taking. Those higher in conscientiousness and agreeableness may avoid negative risk taking behaviors, which often involve violating rules or laws and transgressing on others and can produce interpersonal conflict (Heaven, 1996). Impulsive traits (*e.g.*, lack of perseverance and lack of premeditation) have been consistently associated with negative risk-taking (Duell & Steinberg, 2020; Fischer & Smith, 2004). However, these associations were detected in zero-order correlations but appeared attenuated when accounting for correlations with normative personality traits, such as conscientiousness, which showed high correlations with these traits ($r = -.69$ and $-.47$ respectively)..

Implications for Theory and Practice

Findings from this study have implications for theory. Developmental research has attempted to predict and devise new ways to protect adolescents from the problematic outcomes associated with adolescent risk-taking. Yet, adolescents' ability to face uncertain choices involving risk of danger, failure, or rejection can also be celebrated. Strengthening theory of adolescent risk-taking and positive youth development requires careful conceptualization and measurement of positive risk-taking behaviors and experiences. This research contributes to theory on adolescent risk-taking by extending past conceptualizations of positive risk-taking (Duell & Steinberg, 2020) and by providing a novel, valid measurement tool to assess positive risk-taking among youth. Importantly, results from this study indicate that positive and negative risks co-occur with one another and to a similar degree with higher sensation seeking, which suggests that positive and negative risk-taking may have similar developmental origins and a partially shared biosocial etiology. Ignoring positive manifestations of risk-taking has thus far resulted in a literature that predominantly examines risks that have greater negative costs, leading to pathologizing risk-taking overall during adolescence rather than understanding its important role during this developmental period.

Findings also have implications for practice. Understanding adolescents' risk-taking tendency as a drive to meet certain maturation needs may encourage parents, youth program developers, and policy makers to incorporate opportunities for adolescents to take positive risks in their daily life. By increasing the opportunity to take positive risks in home, schools, and community settings, youth may experience the benefit of exploring social roles and developing novel skills while engaging their need for exciting experiences. Furthermore, the repeated act of challenging oneself in the face of potential failure to seek out greater rewards may encourage youth to pursue difficult but meaningful opportunities that entail risks in the future. Creating opportunities for—and fostering engagement in—positive risk-taking may be an underexplored means of improving adolescent well-being. As the field continues to grow, researchers should carefully consider both positive manifestations of risk-taking alongside negative manifestation to better understand what risks may be beneficial for adolescent health, well-being, relationships, and social and educational outcomes.

Limitations and Future Directions

Although the current study provides promising evidence regarding how to measure and conceptualize the advantageous risks that adolescents take, findings should be interpreted in the context of certain limitations. Foremost, the sample for the qualitative study was drawn from a convenience sample of undergraduate students, and as such includes contemporary college students rather than high school aged adolescents, as is the primary target of this measure. College students have been successfully utilized in qualitative research reflecting on high school experiences (Crabbe et al., 2018; Pivnick et al., 2020). Though this limits the perspective to youth who were college-bound, this represents a growing proportion of the adolescent population (Bound et al., 2009; Mitchell & Syed, 2015). However, future qualitative research capitalizing on the recollections of contemporary college students to understand high school experiences would benefit from specifying to reflect on a time in high school within the prompt, which is a limitation in the current study.

Additionally, all measures in the quantitative study were derived from adolescent self-report. Negative risk-taking was measured using combination of items related to delinquency, substance use, and risky sexual behaviors to capture many of the behaviors typically used to quantify youth risk-taking (Demidenko et al., 2019), however a formal negative risk-taking scale, such as the CDC's Youth Risk Behavior Surveillance Scale was not used (Kann et al., 2016). Endorsement of negative risk-taking was overall low in both studies. In the qualitative study, this could likely be a result of reporter bias to provide socially desirable responses, or it may be reflection in the experiences of college-bound youth. However, 22% of responses included risks identified as having a potential for emotional or physical harm to self or others, or violating rules/laws, which is slightly higher than the percentage of risks identified as threatening in free responses of self-described risks provided in a sample of adults (15%; Lydon-Staley et al., 2020). Low endorsement of negative risk-taking behaviors in the quantitative sample of adolescents is likely a reflection of the population-based rather than clinical sampling procedures for the larger Texas Twin Project (Harden et al., 2013). Despite low endorsement of the *number* of negative risk-taking behaviors engaged in, 86% of the quantitative sample reported engaging in *any* negative risk-taking behavior, and the patterns of covariance between negative risk-taking and other study variables was consistent with those in the broader literature on antisocial risk-taking, suggesting that this measure adequately capture community levels of delinquent risks (Duell & Steinberg, 2020; Harden et al., 2012).

Though this study tested a wide variety of both normative and impulsive personality associations with positive and negative risk-taking, the UPPS scale that was used included only the four original subscale, but did not include positive urgency (Cyders et al., 2007). Given the association of negative urgency with both positive and negative risk-taking, future research should investigate whether positive urgency yields similar associations, particularly given the strong association between these constructs for youth (Watts et al., 2020). This would be particularly informative on whether impulsive actions driven by positive or negative emotionality differentially predict manifestations of risk-taking.

Our models of measurement invariance of positive risk-taking items across gender and age indicated only partial scalar invariance, with a number of items occurring at different

frequencies for males and females, and for younger and older adolescents. Previous studies (i.e., Duell & Steinberg, 2020) have used *variety* or breadth scores as opposed to frequency or intensity scores to measure positive risk-taking, such that a greater breadth of different positive risks would indicate higher tendency towards positive risk-taking. Literature on youth activity involvement highlights that activity breadth, intensity, duration, and engagement are all distinct aspects of youth activity involvement (Bohnert et al., 2010), and future research should consider examining possible differences across these dimensions of positive risk-taking. Additionally, our measure of positive risk-taking included many items on interpersonal risks, which, although noted as a strength above, may also limit the generalizability of this scale to non-interpersonal positive risk-taking. Interpersonal risks are theoretically meaningful to our conceptualization of positive risk-taking and have the added benefit of the opportunity for repeated or frequency engagement.

Conclusion

The current study provides important validation that youth do indeed identify behaviors such as interacting with new peers, trying out for a team or engaging in a new activity, or traveling to an unfamiliar destination as risky. Moreover, the identification of dispositional profiles that drive adolescents to engage positive risks specifically, such as extraversion and openness, as well as risk-taking more broadly, such as sensation seeking, may guide our understanding of how to leverage positive risk engagement to promote youth well-being. By de-pathologizing the tendency toward risk-taking in adolescence, we may widen the opportunities to express this proclivity in socially valuable ways that foster youth social facility, autonomy, and self-discovery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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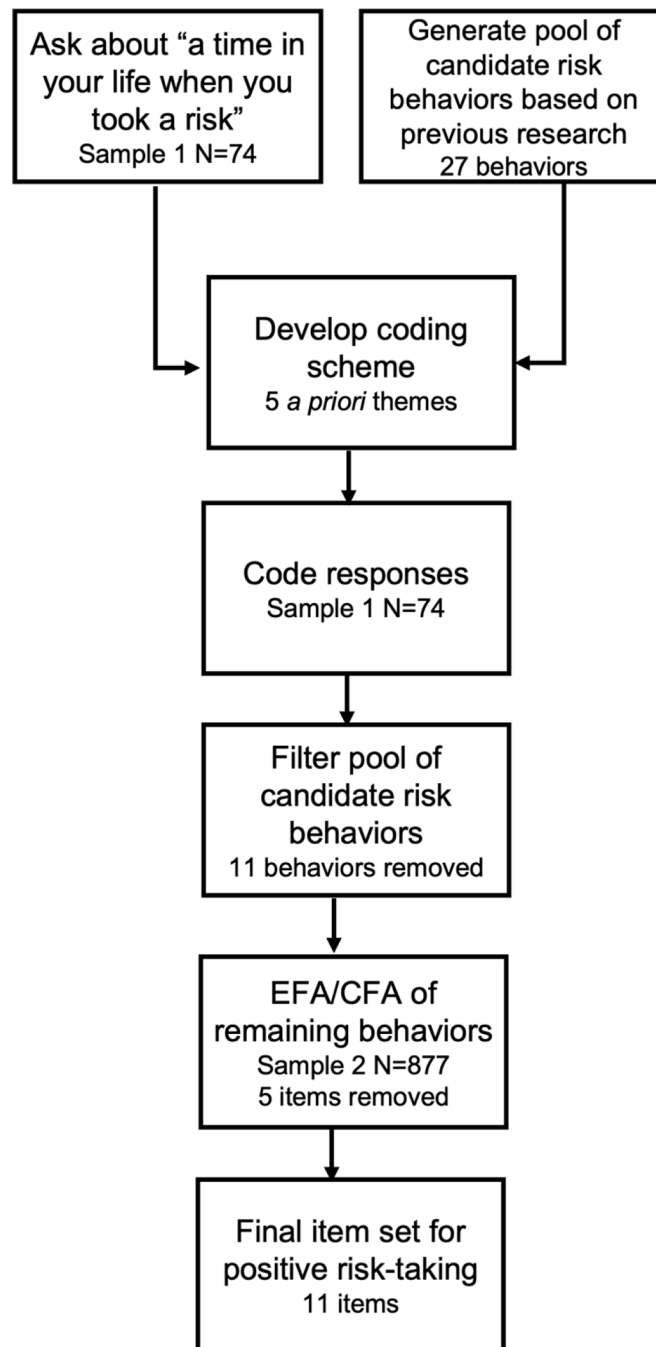


Figure 1. Pipeline of qualitative and quantitative methods applied to create and validate the positive risk-taking measure.

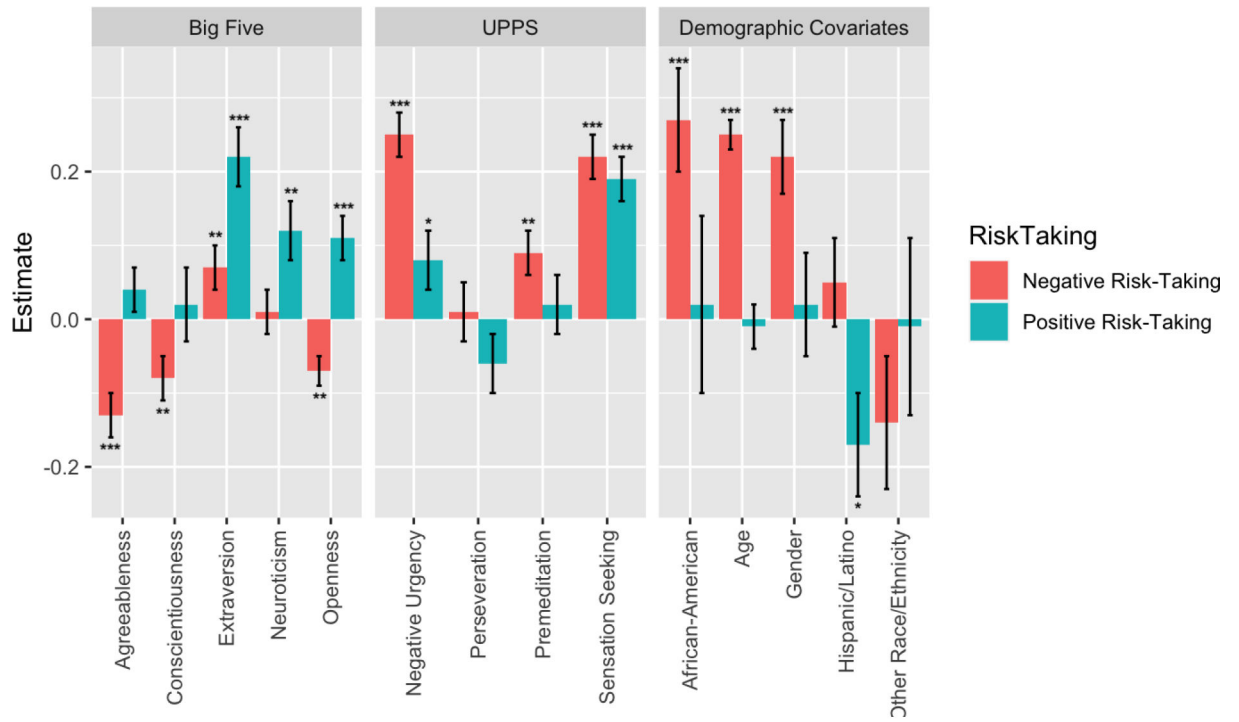


Figure 2. Model estimates and standard errors from personality and risk-taking SEM.
 * = $p < .05$, ** = $p < .01$, *** = $p < .001$

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Table 1.

Qualitative Coding Structure: *A Priori* Themes Identified from Pool of Candidate Risk Behaviors and Emergent Themes Identified from Free Response Data

Risk-Taking Domain	Broad Themes	Sub-Themes (where applicable)	Candidate Risk Behaviors (where applicable)	
Negative Risks	Physical Harm to Self Physical Harm to Others Breaking Rules/Laws <i>Emotional Harm (emergent)</i>			
Positive Risks	Disclosure		“Taken a risk and trusted someone” “Told a secret about yourself”	
	Autonomy		“Ended a friendship” “Stood up for what you believe is right, either socially or academically” “Told someone the truth even if they didn’t want to hear it” “Broken up with somebody”	
	Novelty	Interpersonal		“Initiated a new friendship” “Talked to someone who seemed very different from you” “Hung out with a new group of people” “Gone to a social event where you didn’t know anyone” “Asked someone on a date” “Gone on a blind date”
		Non-Interpersonal		“Taken a class in an area you know nothing about” “Played a sport you’re not good at” “Tried a new hairstyle or fashion trend” “Tried a new food” “Started a new diet or fitness plan” “Traveled someplace new”
	Joining In	Sports Related		“Played soccer, basketball, football, or some other team sport” “Played a sport with the opposite sex” “Tried out for a team...”
Non-Sports Related			“Run for office in school or in some other organization” “...joined a new club or activity, or auditioned for a play” “Volunteered” “Gone camping” <i>Education related activity, e.g. selecting a major (emergent)</i>	
Perceived Physical Danger		“Snow skied or snowboarded” “Ridden a rollercoaster” “Been skateboarding or biking without a helmet”		
	<i>Prosociality (emergent)</i>			

Note. Emergent themes are italicized.

Table 2.*A Priori* and Emergent Themes

	% of Total Responses (N = 74)	% of Positive Risk-Taking Responses (N=70)	% of Negative Risk-Taking Responses (N=16)
Broad Risk-Taking Themes			
Autonomy	58% (43/74)	61% (43/70)	44% (7/16)
Disclosure	14% (10/74)	14% (10/70)	25% (4/16)
Joining In	61% (45/74)	64% (45/70)	19% (3/16)
Novelty	68% (50/74)	71% (50/70)	38% (6/16)
Perceived Physical Danger	3% (2/74)	3% (2/70)	0% (0/16)
<i>Prosociality</i>	3% (2/74)	3% (2/70)	0% (0/16)
Physical Harm to Self	5% (4/74)	4% (3/70)	25% (4/16)
Physical Harm to Others	0% (0/74)	0% (0/70)	0% (0/16)
Breaking Rules/Laws	16% (12/74)	13% (9/70)	75% (12/16)
<i>Emotional Harm</i>	3% (2/74)	3% (2/70)	13% (2/16)

Note. Percentages do not total 100% as most responses were coded with more than one broad theme or type of consequence. Thirteen responses were coded as both positive and negative risk-taking. Emergent themes in italics.

Table 3.

Candidate Risk Behaviors Endorsed in Qualitative Responses

Item	Number of Responses	% of Total Responses (N = 74)
Tried out for a team, joined a new club or activity, or auditioned for a play	16	22%
Played soccer, basketball, football, or some other team sport	1	1%
Played a sport you're not good at	1	1%
Initiated a new friendship	10	14%
Talked to someone who seemed very different from you	8	11%
Run for office in school or in some other organization	3	4%
Asked someone on a date	9	12%
Gone on a blind date	2	3%
Taken a class in an area you know nothing about	3	4%
Stood up for what you believe is right, either socially or academically	21	28%
Told a secret about yourself	2	3%
Hung out with a new group of people	18	24%
Gone to a social event where you didn't know anyone	7	9%
Traveled someplace new	14	19%
Ended a friendship	2	3%
Taken a risk and trusted someone	6	8%

Note. Endorsements is the number of unique responses identified with this candidate behavior-specific code, and % of total responses is the percentage of this unique code in the total 74 written responses from Sample 1.

Table 4.

Descriptive Statistics and Correlations with Positive and Negative Risk-Taking

Measure	Range	Mean (SD)	<i>alpha</i>	Correlations	
				1.	2.
1. Positive Risk-Taking	0.00 – 4.80	1.61 (.71)	0.80		
2. Negative Risk-Taking	0.00 – 0.75	0.11 (.11)	0.93	0.20	
3. Extraversion	1.25 – 5.00	3.17 (.74)	0.84	0.27	0.10
4. Agreeableness	1.33 – 5.00	3.69 (.54)	0.76	0.05	-0.25
5. Conscientiousness	1.44 – 5.00	3.32 (.61)	0.79	0.02	-0.27
6. Neuroticism	1.00 – 5.00	2.89 (.70)	0.81	0.06	0.11
7. Openness	1.80 – 5.00	3.79 (.51)	0.74	0.16	-0.07
8. Negative Urgency	1.00 – 4.00	2.18 (.59)	0.88	0.13	0.39
9. Premeditation	1.00 – 4.00	2.04 (.47)	0.83	0.08	0.27
10. Perseverance	1.00 – 4.00	2.01 (.51)	0.84	-0.09	0.18
11. Sensation Seeking	1.00 – 4.00	2.83 (.59)	0.85	0.23	0.32
12. RP - Affective Appraisal	1.00 – 4.00	3.32 (.54)	0.76	-0.08	-0.56
13. RP - Risk Likelihood Appraisal	1.00 – 4.00	3.35 (.49)	0.71	-0.08	-0.48
14. RP - Seriousness of Consequences	1.00 – 4.00	3.45 (.45)	0.71	-0.02	-0.38
15. RP - Benefits vs. Consequences	1.00 – 4.00	3.50 (.50)	0.77	-0.12	-0.47
16. Gender	F / M	49% / 51%		0.00	0.17
17. Age	13.5 – 20.1	16.0 (1.3)		0.01	0.34

Note. Descriptive statistics are reported on raw variables prior to all transformations. A correlation matrix of all variables is located in Table S3. Correlations are reported using z-scored variables post-transformations, including log transforming negative risk-taking and Risk Perception (RP) subscales, as well as positive risk-taking item-level gender and age regression. Significant correlations at $p < .05$ in bold. Premeditation and Perseverance denote lack thereof, as described in text. Gender coded 0 = Female, 1 = Male. Age centered at the mean of 16 years.

Table 5. Positive Risk-Taking Items: CFA Factor Loadings and Metric Invariance Model Intercepts Across Groups

Item	CFA Factor Loadings (SE)	Metric Intercept - Female	Metric Intercept - Male	Metric Intercept - Younger	Metric Intercept - Older
1. Tried out for a team, joined a new club or activity, or auditioned for a play?	.42 (.05)	1.48	1.52	1.61*	1.36*
2. Initiated a new friendship?	.59 (.04)	2.28	2.48	2.42	2.33
3. Talked to someone who seemed very different from you?	.65 (.04)	2.47	2.68	2.52	2.66
4. Asked someone on a date?	.33(.05)	0.35*	0.90*	0.51*	0.81*
5. Taken a class in an area you know nothing about?	.30 (.05)	0.77	0.81	0.69*	0.92*
6. Stood up for what you believe is right, either socially or academically?	.58 (.04)	2.46	2.69	2.47*	2.72*
7. Told a secret about yourself?	.62 (.04)	1.75	1.76	1.73	1.79
8. Hung out with a new group of people?	.58 (.04)	1.62	1.76	1.71	1.66
9. Traveled someplace new?	.48 (.04)	1.29	1.50	1.44	1.35
10. Ended a friendship?	.38 (.05)	0.74*	0.62*	0.65	0.71
11. Taken a risk and trusted someone?	.58 (.04)	1.54*	1.89*	1.64*	1.83*

Note. CFA factor loadings are reported from the unidimensional factor model in split-sample half of Sample 2 (N = 428), dropping five items, standard error in parentheses. All factor loadings were significant at $p < .001$. Item-specific means as estimated by the item intercepts within the metric measurement invariance models (full positive risk-taking subsample of Sample 2, N = 877) for each group are reported, with

* s denoting means allowed to vary across groups in the partial scalar invariance models.

Table 6.

Measurement Invariance Model Comparisons

Model	χ^2 (df)	RMSEA	CFI/TLI	Model comparison	RMSEA	CFI
Gender						
Configural	202.556 (88)	.054	.922/.902			
Metric	212.519 (98)	.052	.922/.912	Metric vs. Configural	.002	.000
Scalar	292.801 (109)	.062	.874/.873	Scalar vs. Metric	.010	.048
Partial Scalar	226.757 (106)	.051	.918/.914	Partial Scalar vs. Metric	.001	.004
Age						
Configural	162.897 (88)	.044	.947/.934			
Metric	170.627 (98)	.041	.949/.942	Metric vs. Configural	.003	.002
Scalar	228.308 (109)	.050	.916/.915	Scalar vs. Metric	.009	.033
Partial Scalar	179.052 (104)	.041	.947/.944	Partial Scalar vs. Metric	.000	.002

Note. Chi-square (χ^2) was statistically significant for all models ($p < .001$). Statistically significant ($p < .001$) changes in model chi-square (χ^2) are denoted by an asterisk.